

# CHAPTER - 9

## HEREDITY AND EVOLUTION

Class

**:- X**

Subject

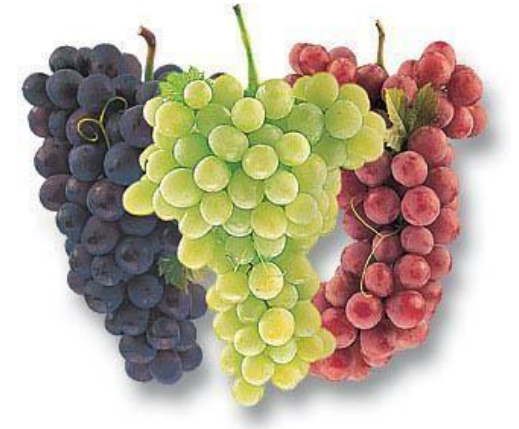
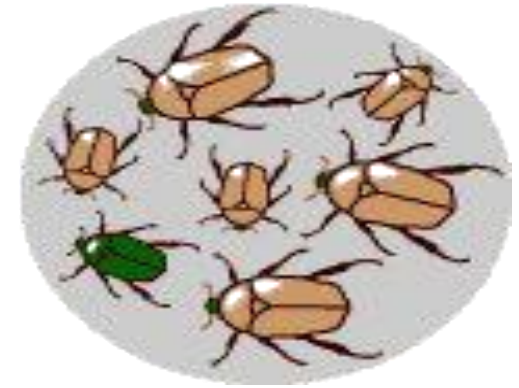
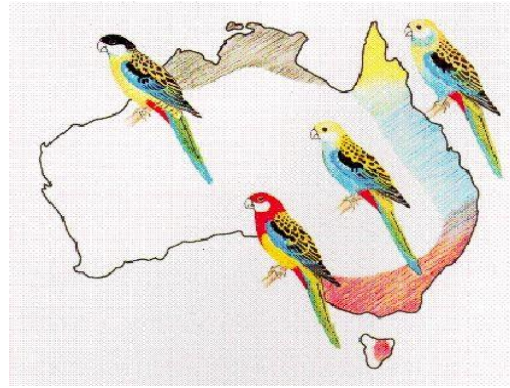
**:- Science**

# 1a) Heredity :-

The transfer of characters or traits from the parents to their off springs is called **heredity**.

# b) Variations :-

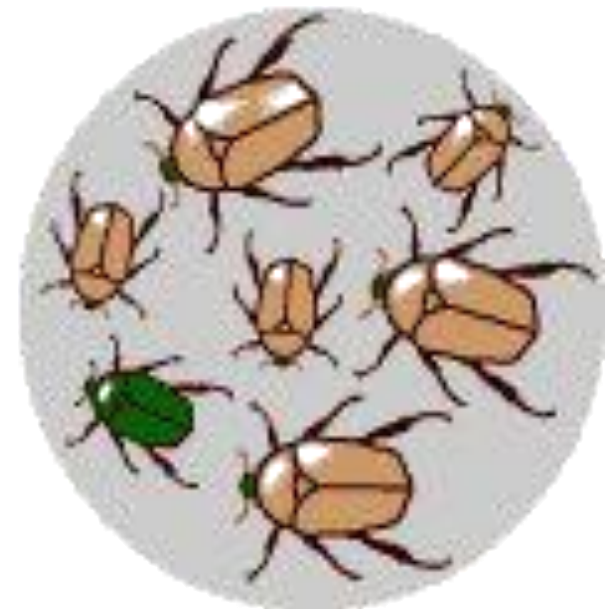
The differences between the characters or traits among the individuals of the same species are called **variations**.



## **2) Accumulation of variations during reproduction**

**When organisms reproduce, the off springs show minor variations due to inaccuracies in DNA copying. These variations are less in asexual reproduction and more in sexual reproduction.**

**Some variations are useful variations and they help the organism to adjust to the changes in the environment. Some variations do not help the organism to adjust to the changes in the environment and they may die and become extinct.**



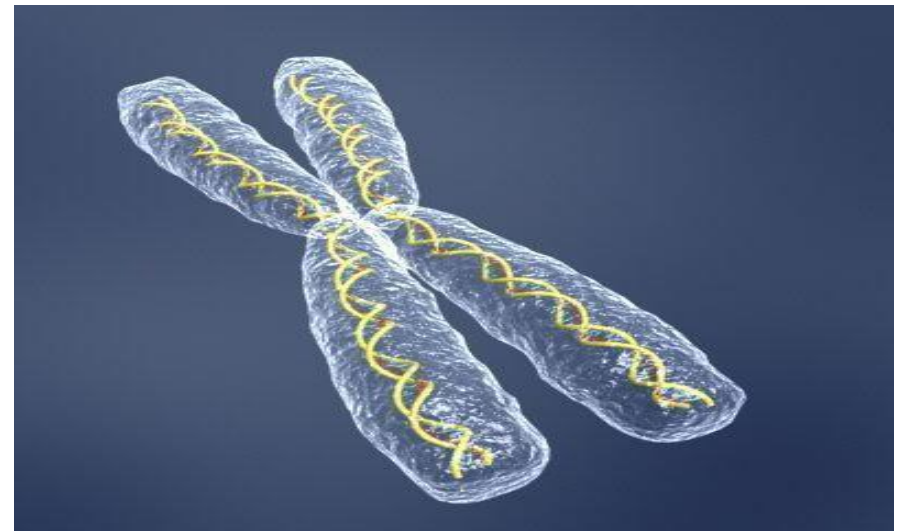
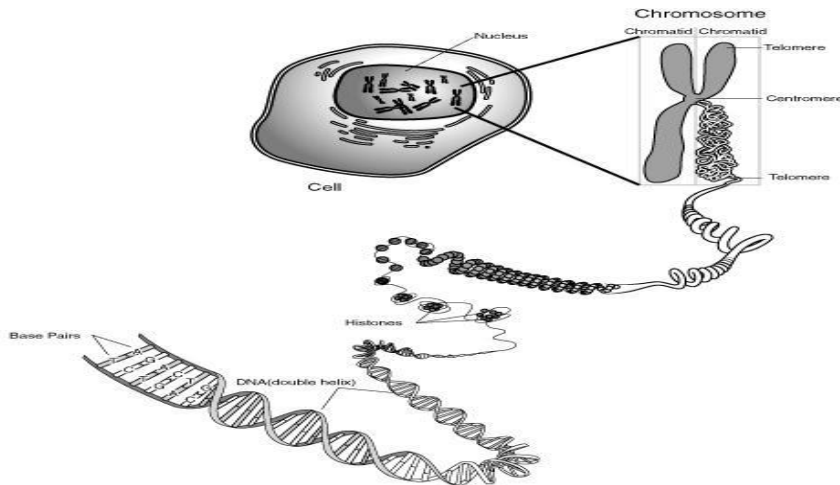


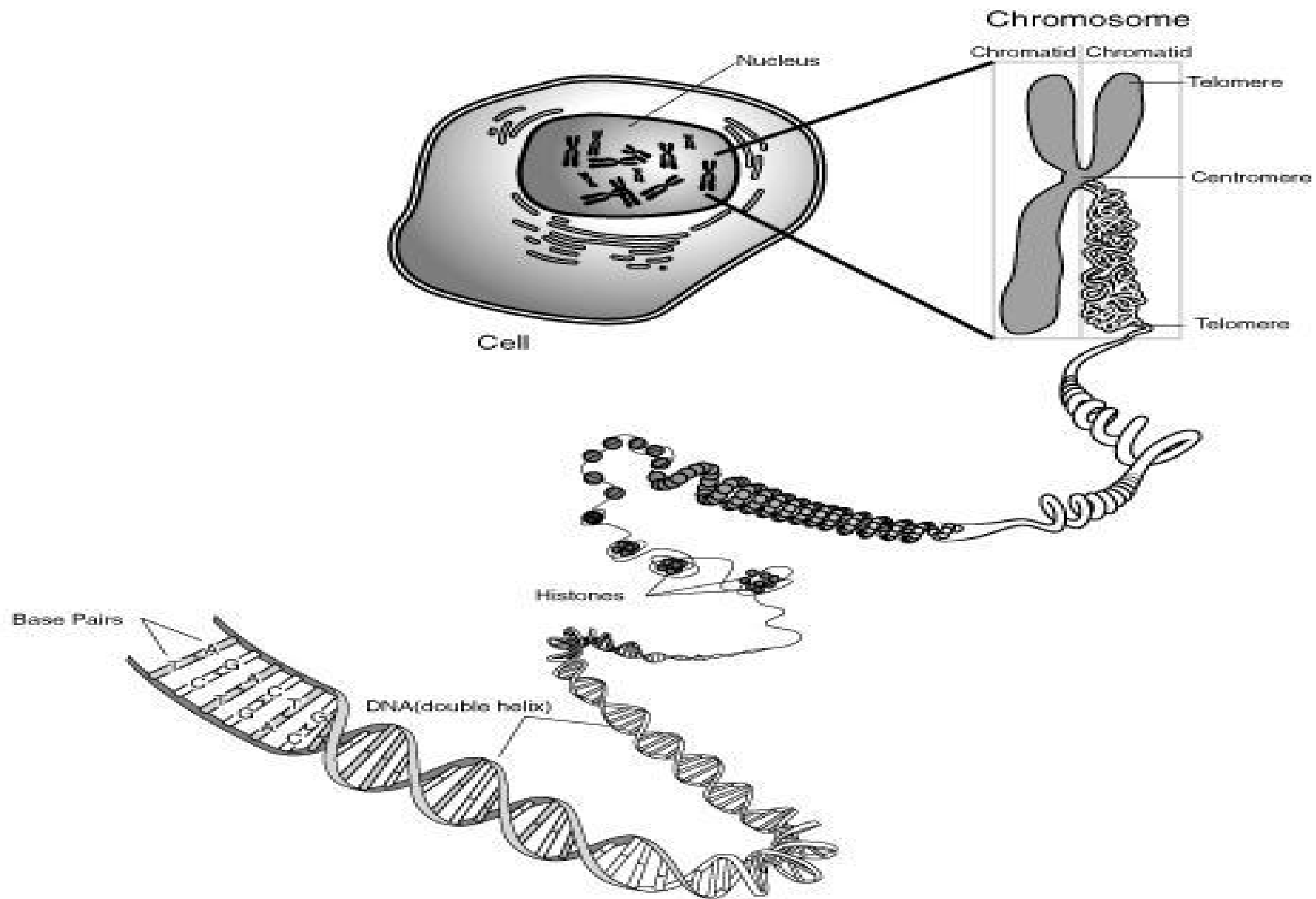
### **3) Rules for inheritance of characters (traits) :-**

Characters are transferred through genes present in the DNA molecules in the chromosomes present in the nucleus of the cell.

The inheritance of characters is due to the fact that both the father and mother contributes equal amount of genetic material to the child. So for each trait there are two factors one from the father and one from the mother.

Gregor Johann Mendel conducted experiments with garden pea plants and determined the rules for the inheritance of traits.



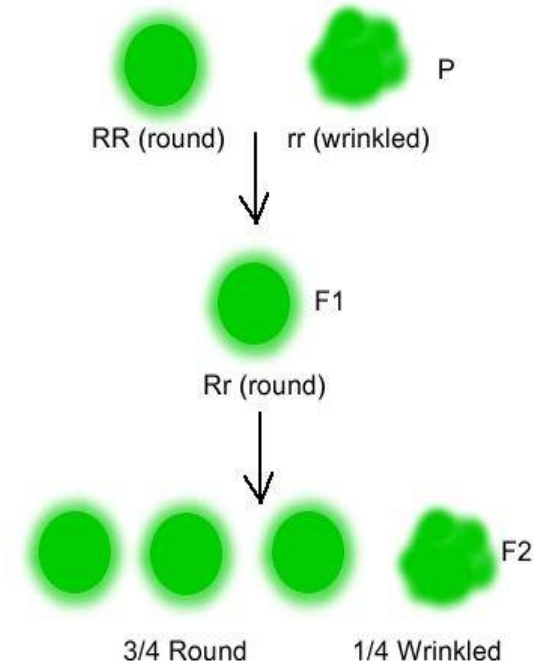
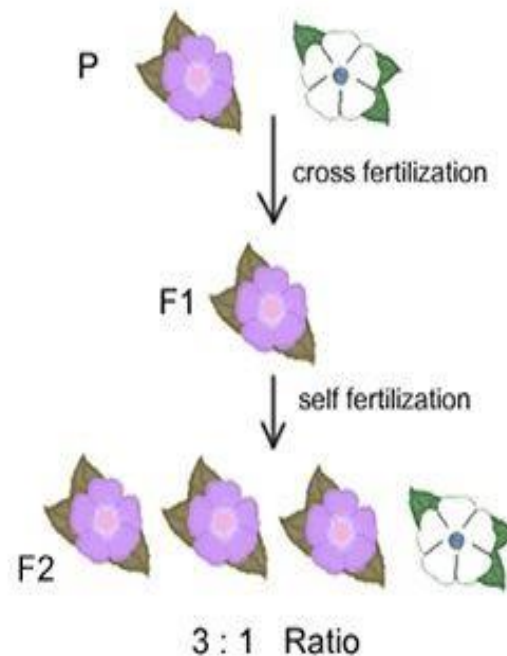
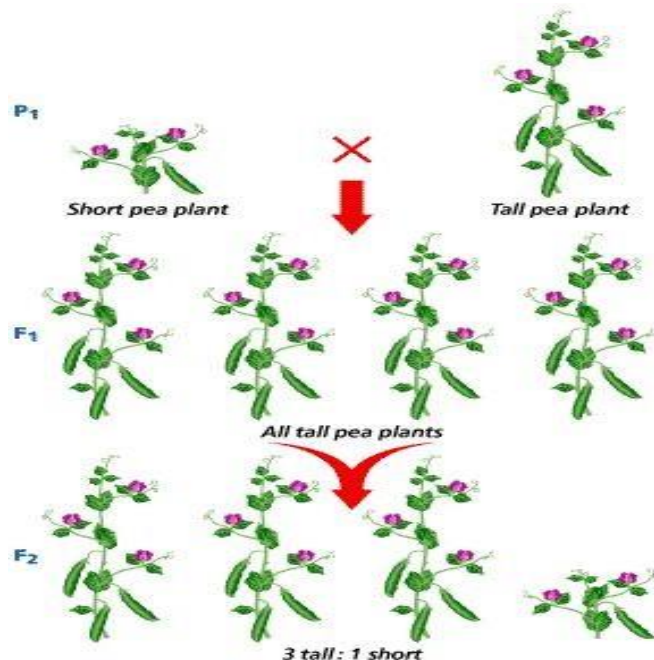


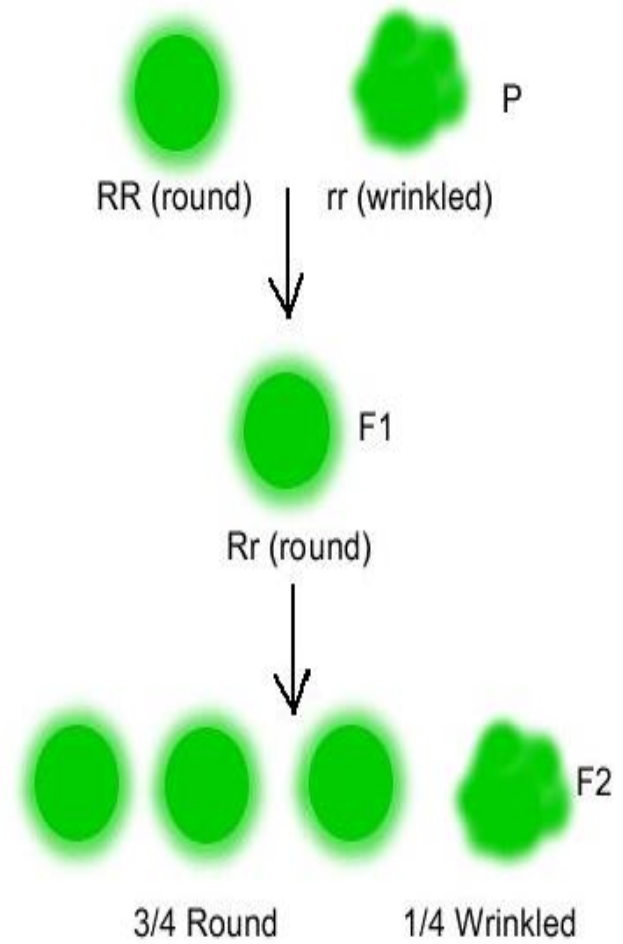
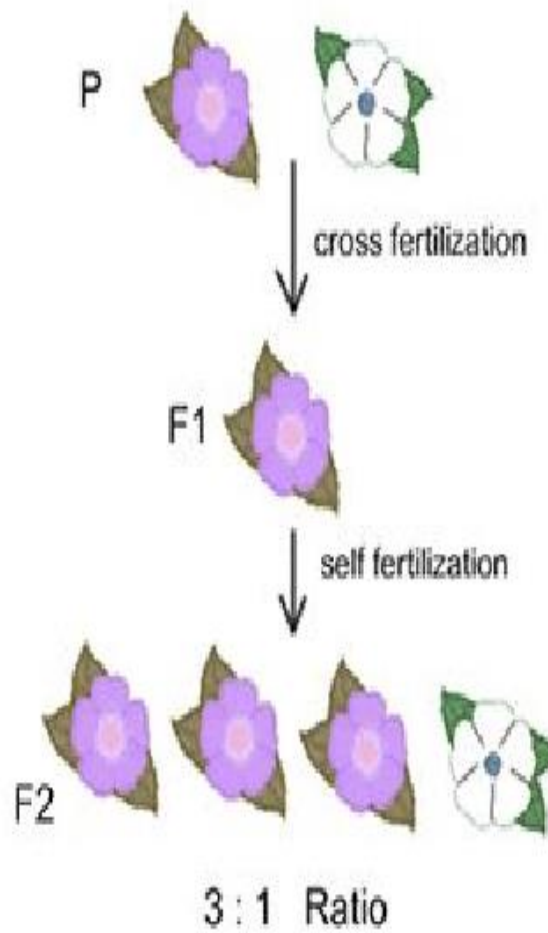
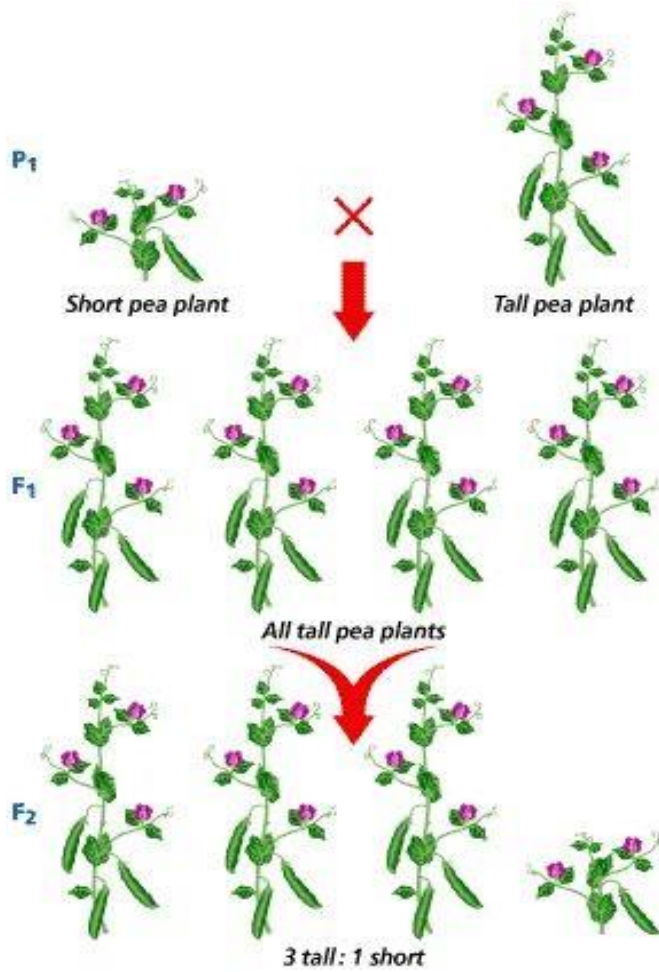
# a) When plants having one pair of character (Eg:- tall and short plant) was crossed (Monohybrid cross) :-

Mendel selected pea plants having one pair of character – a tall pea plant and a short pea plant. He selected pure tall (TT) and pure short (tt) pea plants and cross pollinated them. He obtained all tall plants (Tt) in the first generation ( $F_1$ ). When the first generation plants were self pollinated, he obtained tall and dwarf plants in the ratio 3:1 in the second generation. ( $F_2$ )

The ratio of pure tall (TT), hybrid tall (Tt) and pure dwarf (tt) was in the ratio 1:2:1

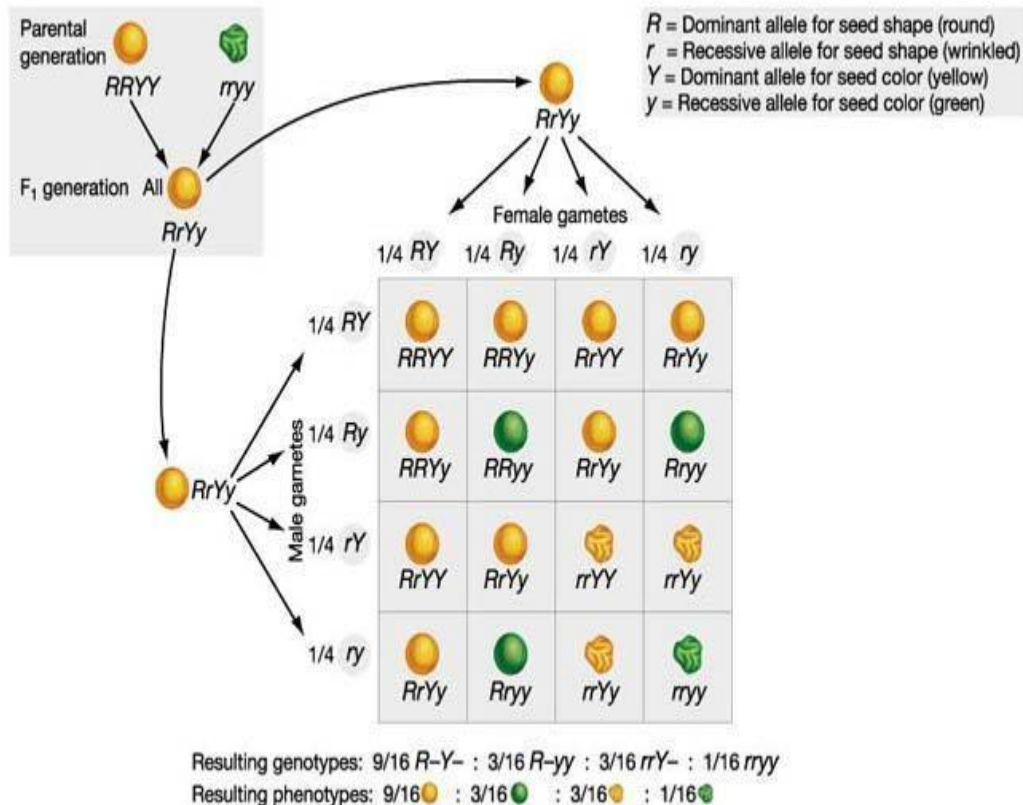
The trait that is expressed in the  $F_1$  generation is called the dominant trait and the trait that is suppressed in the  $F_1$  is called the recessive trait.





























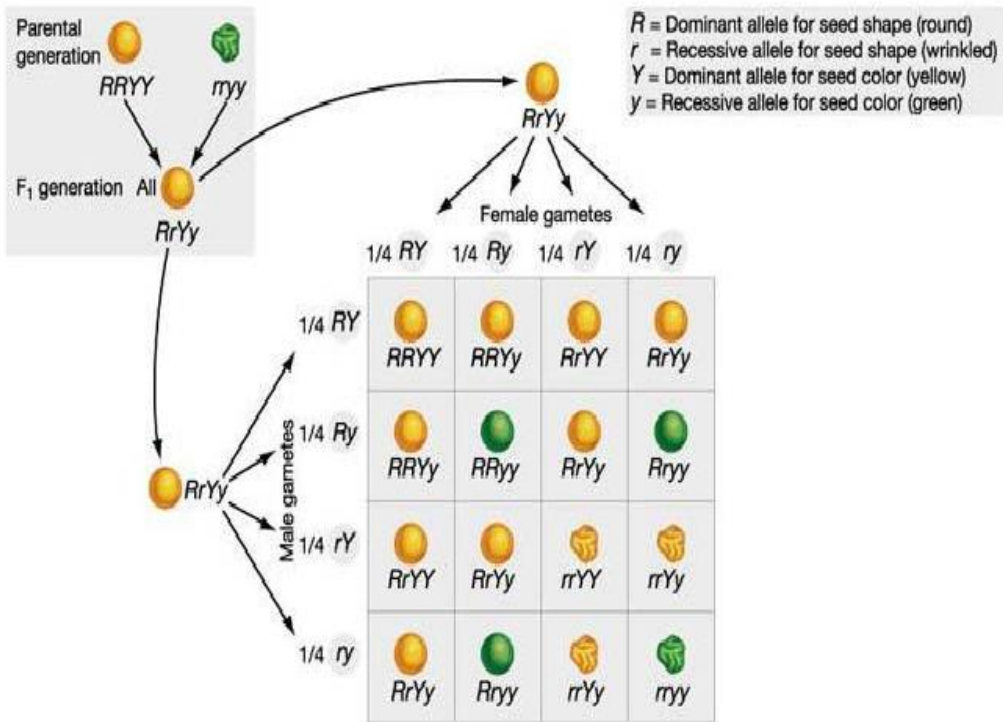
## b) When plants having two pairs of characters (Eg:- shape and colour of seeds) were crossed (Dihybrid cross) :-

Mendel selected pea plants having two pairs of characters – shape and colour of seed. He selected plants having round yellow seeds (RRYY) and wrinkled green seeds (rryy) and cross pollinated them. He obtained all plants with round yellow seeds (RrYy) in the F<sub>1</sub> generation. When these plants were self pollinated in the F<sub>2</sub> generation out of 16 plants, 9 had round yellow (RrYy), 3 had round green (RrYY), 3 had wrinkled yellow (rrYy) and 1 had wrinkled green (rryy) seed. In the ratio 9:3:3:1.



















		♂ gametes			
		RY 1/4	Ry 1/4	ry 1/4	rY 1/4
♀ gametes	RY 1/4	RRYY 1/16 	RRYy 1/16 	RrYy 1/16 	RrYY 1/16 
	Ry 1/4	RRYy 1/16 	RRyy 1/16 	Rryy 1/16 	RrYy 1/16 
	ry 1/4	RrYy 1/16 	Rryy 1/16 	rryy 1/16 	rrYy 1/16 
	rY 1/4	RrYY 1/16 	RrYy 1/16 	rrYy 1/16 	rrYY 1/16 
		9  : 3  : 3  : 1 			
		 Round, yellow			
		 Round, green			
				 Wrinkled, yellow	
				 Wrinkled, green	







$R$  = Dominant allele for seed shape (round)  
 $r$  = Recessive allele for seed shape (wrinkled)  
 $Y$  = Dominant allele for seed color (yellow)  
 $y$  = Recessive allele for seed color (green)

		♂ gametes			
		$RY$ $\frac{1}{4}$	$Ry$ $\frac{1}{4}$	$rY$ $\frac{1}{4}$	$ry$ $\frac{1}{4}$
♀ gametes	$RY$ $\frac{1}{4}$	$RRYY$ $\frac{1}{16}$ 	$RRYy$ $\frac{1}{16}$ 	$RrYy$ $\frac{1}{16}$ 	$RrYy$ $\frac{1}{16}$ 
	$Ry$ $\frac{1}{4}$	$RRYy$ $\frac{1}{16}$ 	$RRyy$ $\frac{1}{16}$ 	$Rryy$ $\frac{1}{16}$ 	$Rryy$ $\frac{1}{16}$ 
	$rY$ $\frac{1}{4}$	$RrYy$ $\frac{1}{16}$ 	$Rryy$ $\frac{1}{16}$ 	$rryy$ $\frac{1}{16}$ 	$rrYy$ $\frac{1}{16}$ 
	$ry$ $\frac{1}{4}$	$RrYy$ $\frac{1}{16}$ 	$RrYy$ $\frac{1}{16}$ 	$rrYy$ $\frac{1}{16}$ 	$rrYy$ $\frac{1}{16}$ 

9 Round, yellow : 3 Round, green : 3 Wrinkled, yellow : 1 Wrinkled, green

 Round, yellow

 Wrinkled, yellow

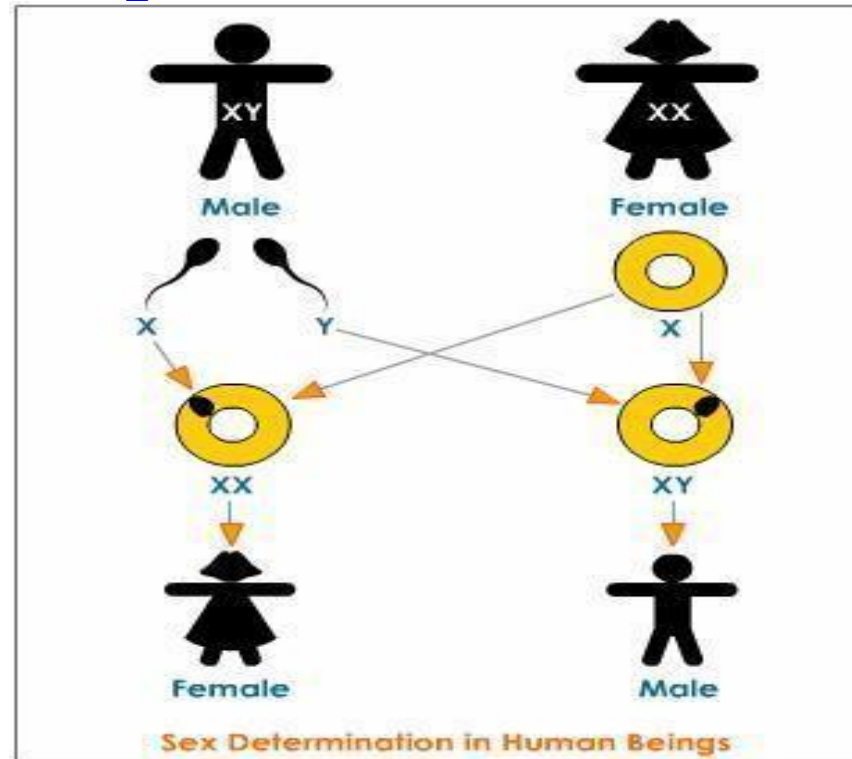
 Round, green

 Wrinkled, green

## 4) Sex determination in human beings :-

Human beings have 23 pairs of chromosomes in the nucleus of the cell. Out of this two chromosomes are sex chromosomes X and Y. The female has two X chromosomes (XX) and male has one X and one Y chromosome (XY). The sperms and eggs have one set of sex chromosomes. Some sperms have X chromosome and some have Y chromosome. All eggs have X chromosome.

If a sperm having X chromosome fuses with an egg having X chromosome the child will be a **girl**. If a sperm having Y chromosome fuses with an egg having X chromosome the child will be a **boy**.



## **5. Variations may or may not help organisms to survive :-**

### **a) Some variations help organisms to survive :-**

**Eg :-** There are some beetles living in green bushes. They increase their numbers by reproduction. Crows can easily see the red beetles and they are eaten by the crows. During reproduction due to some variation some green beetles are produced instead of red beetles. The green beetles are not visible to crows and are not eaten by them. Then gradually the population of the red beetles decreases and the population of the green beetles increases. This variation has helped the organisms to survive.

### **b) Some variations do not help organisms to survive :-**

**Eg :-** During sexual reproduction a colour variation occurs in red beetles and some blue beetles are produced instead of red beetles. Both the red and blue beetles are visible to crows and are eaten by them. Then the population of both red and blue beetles decreases. This variation has not helped the organisms to survive

### **c) Acquired traits cannot be passed from one generation to the next :-**

**Eg :-** If the population of beetles increases and plants are affected by diseases, then the food available for the beetles decreases and their body weight also decreases. If after a few years the availability of food increases then the body weight of the beetles also increases. This acquired trait cannot be passed from one generation to the next because there is no change in their genetic composition.

## **6. Speciation :- ( Formation of new species from existing species )**

The formation of new species from existing species is mainly due to one or more of the following factors. They are :- Accumulation of variations, Physical barriers, Genetic drift, Natural selection and migration.

**i) Accumulation of variations :-** The differences between the individuals of the same species is called variations. The accumulation of variations over several generations produce new species.

**ii) Physical barriers :-** Populations may get separated by physical barriers like mountains, rivers, lakes etc. These isolated groups produce variations which can produce new species.

**iii) Genetic drift :-** Natural calamities or introduction of new members of the same species in an area can produce changes in the gene pool of the population and new variations are produced which can produce new species.

**iv) Natural selection :-** Only those individuals of a species which have useful variations and can adapt to the changes in the environment survive and the others die. These organisms can produce variations and new species.

**v) Migration :-** Some individuals of a species may migrate to a new geographical area and adjust to the changes in the environment there and develop new variations and produce new species.



## **7. Evolution :-**

The gradual changes taking place in living organisms giving rise to new organisms due to changes in their genetic composition is called evolution.

### **8a. Inherited traits :-**

Inherited traits are traits in an organism due to changes in the genetic composition and it can be passed from one generation to the next and it results in evolution..

### **b. Acquired traits :-**

Acquired traits are traits which are acquired by an organism during its lifetime and it cannot be passed from one generation to the next and it does not result in evolution.

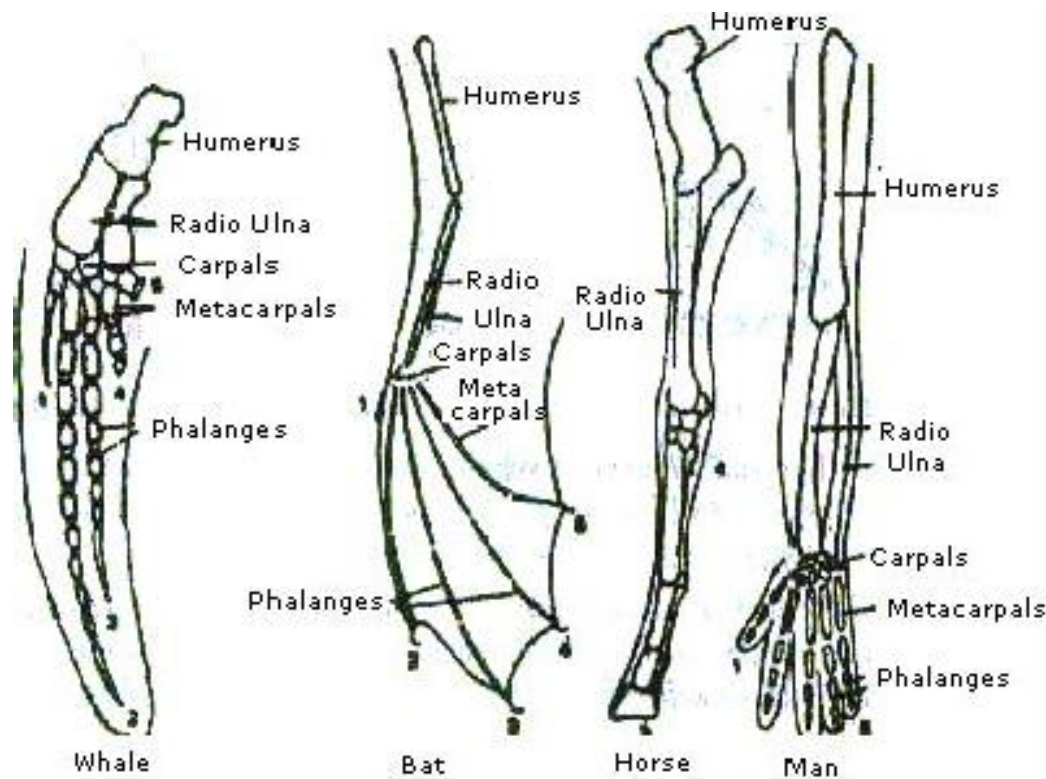
## **9. Evidences of evolution :-**

There are a number of common features in different organisms which provide evidence to show evolutionary relationship. The main evidences of evolution are from the study of :-

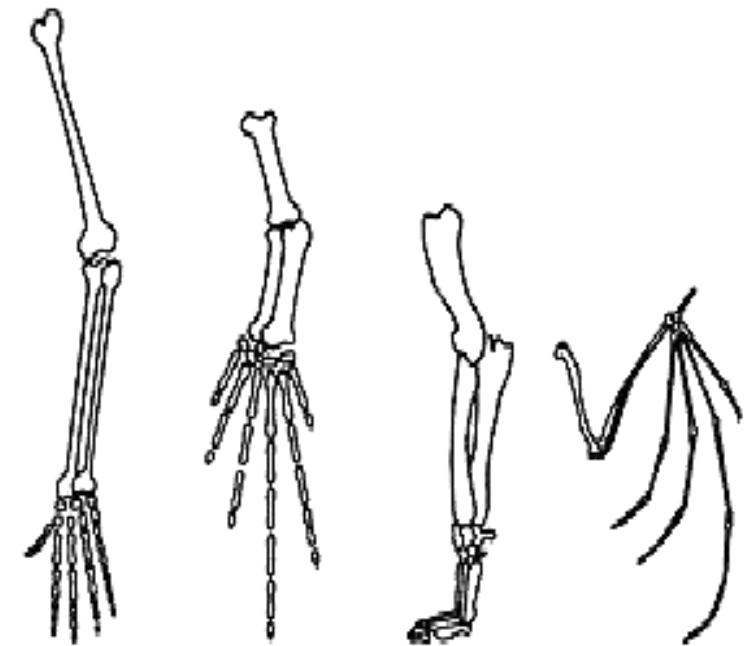
Homologous organs, Analogous organs and Fossils.

**a) Homologous organs :-** are organs which are similar in structure but different in functions.

**Eg :-** The fore limbs of amphibians, reptiles, birds, and mammals have similar structures but different functions. Frog (amphibian) uses its fore limb to raise the front of the body. Lizard (reptile) uses its fore limb for walking and running. Birds fore limbs are modified as wings for flying. Mammals use the fore limbs for grasping, walking, running, swimming, flying etc. This shows evolutionary relationship.



Fore-limbs of Four Different Mammals

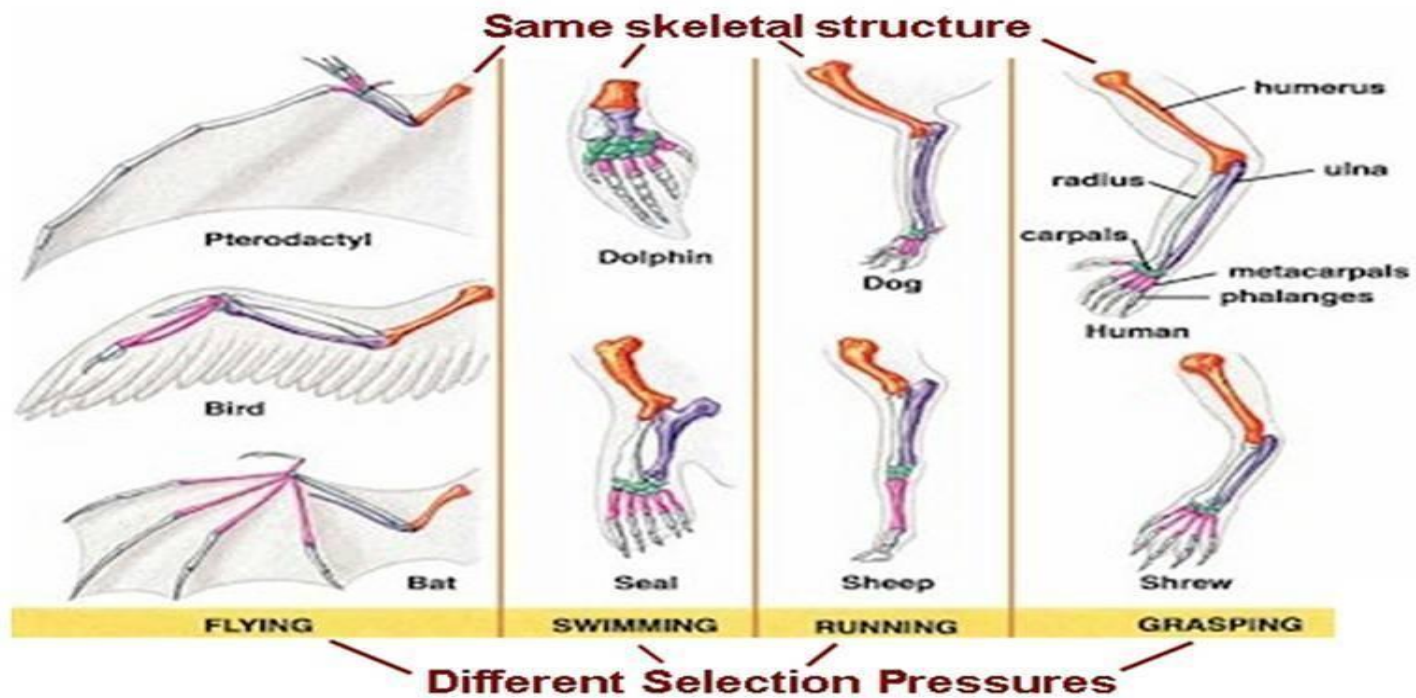
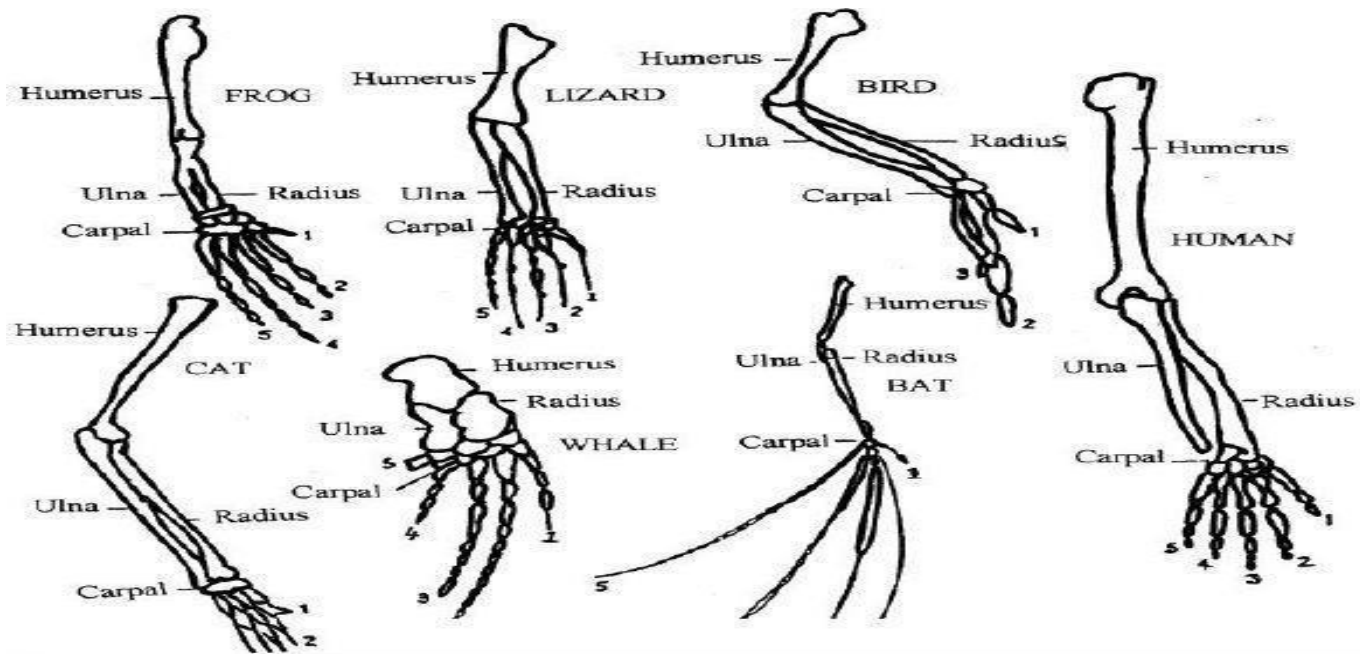


HUMAN

WHALE

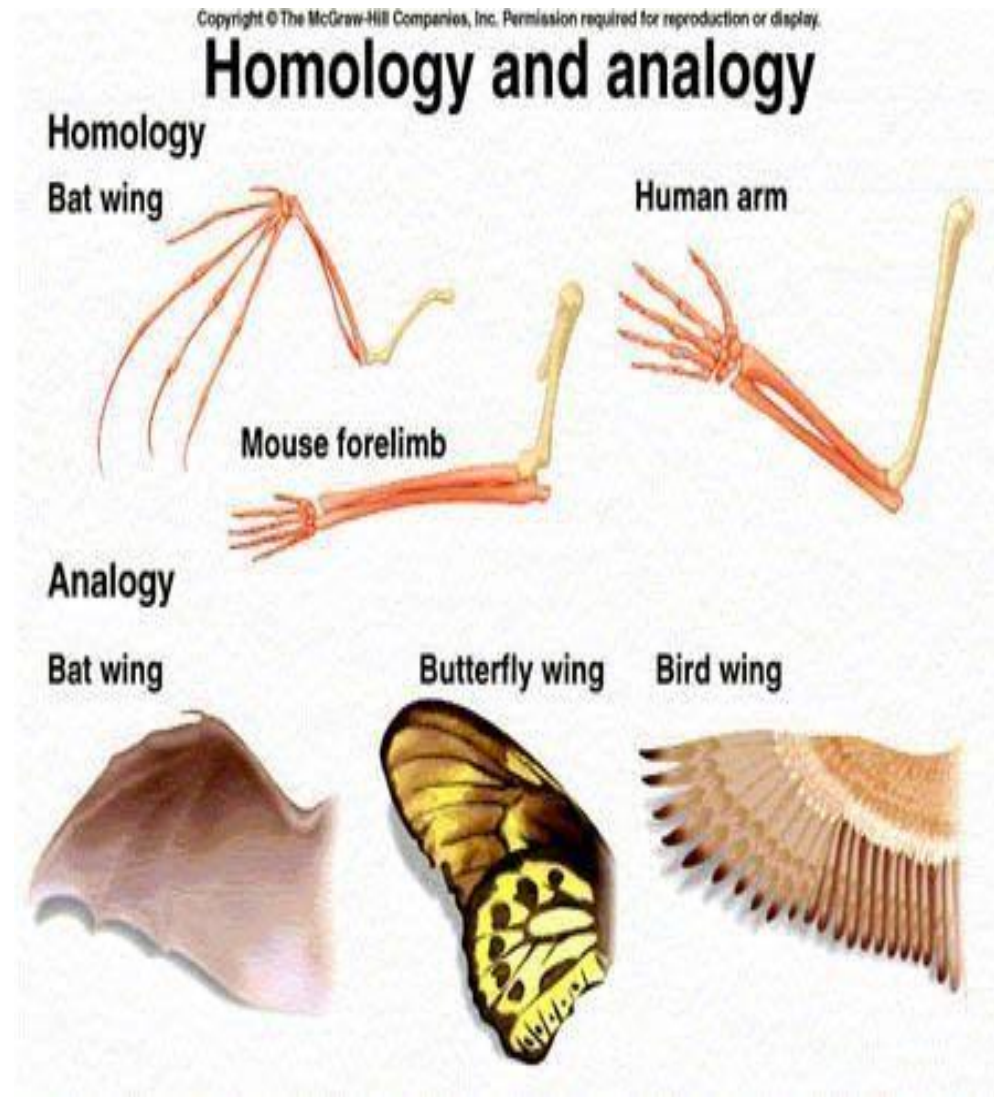
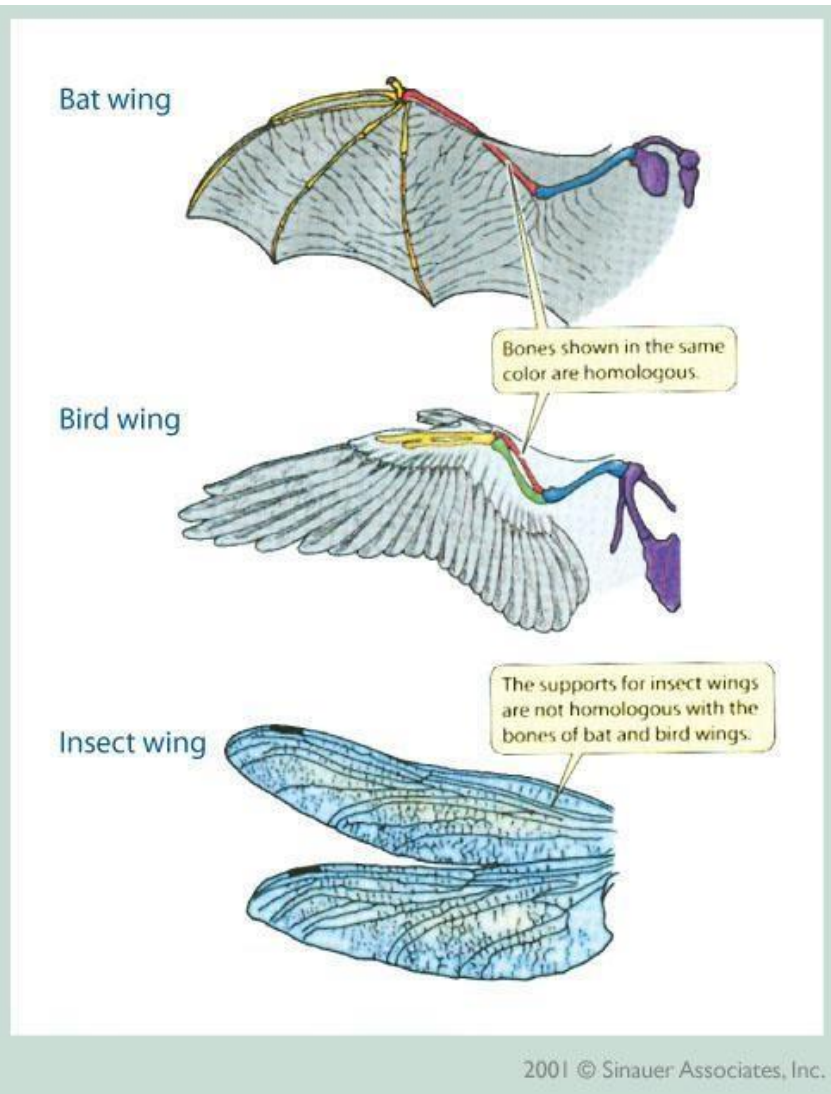
DOG

BAT



**b) Analogous organs :-** are organs which are different in structures but similar in functions.

**Eg :-** The wings of butterfly, bird and bat have different structures but similar functions. This shows evolutionary relationship.

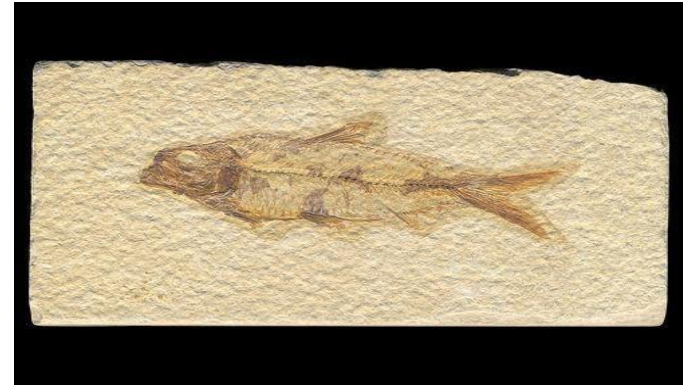




**c) Fossils :-** are the remains of organisms which lived long ago. From the study of fossils we can know their structures and the time period in which they lived. The fossils of complex and recent organisms are found closer to the surface of the earth and the fossils of simpler organisms are found deeper inside the earth. The age of fossils can be determined by Radio Carbon Dating. The study of fossils show evolution of simpler forms into complex forms and their evolutionary relationship.



**Tree trunk fossil**



**Fish fossil (Knightia)**

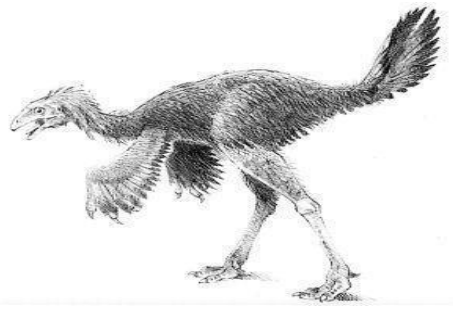
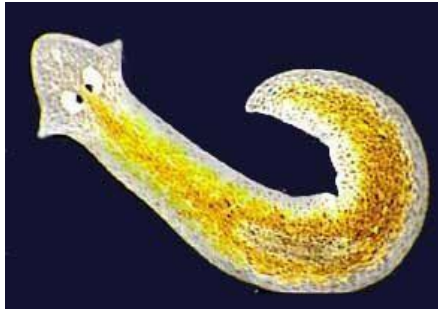


# **10. Evolution by stages :-**

Complex organisms and its organs developed from simpler organisms gradually over generations.

i) **Evolution of eyes** :- The eyes of planaria are just eye spots to detect light. It developed gradually into a complex organ in higher animals.

ii) **Evolution of feathers** :- Feathers were first developed in dinosaurs and used for protection from cold. Later birds used them for flying.



iii) **Evolution by artificial selection** :- Humans cultivated wild cabbage for over 2000 years and produced different vegetables from it by artificial selection.

Eg :- Cabbage – by selecting short distance between the leaves.

Cauliflower – by selecting sterile flowers.

Kale – by selecting large leaves

Kholrabi – by selecting the swollen stem

Broccoli – by arresting flower growth





# Embryology

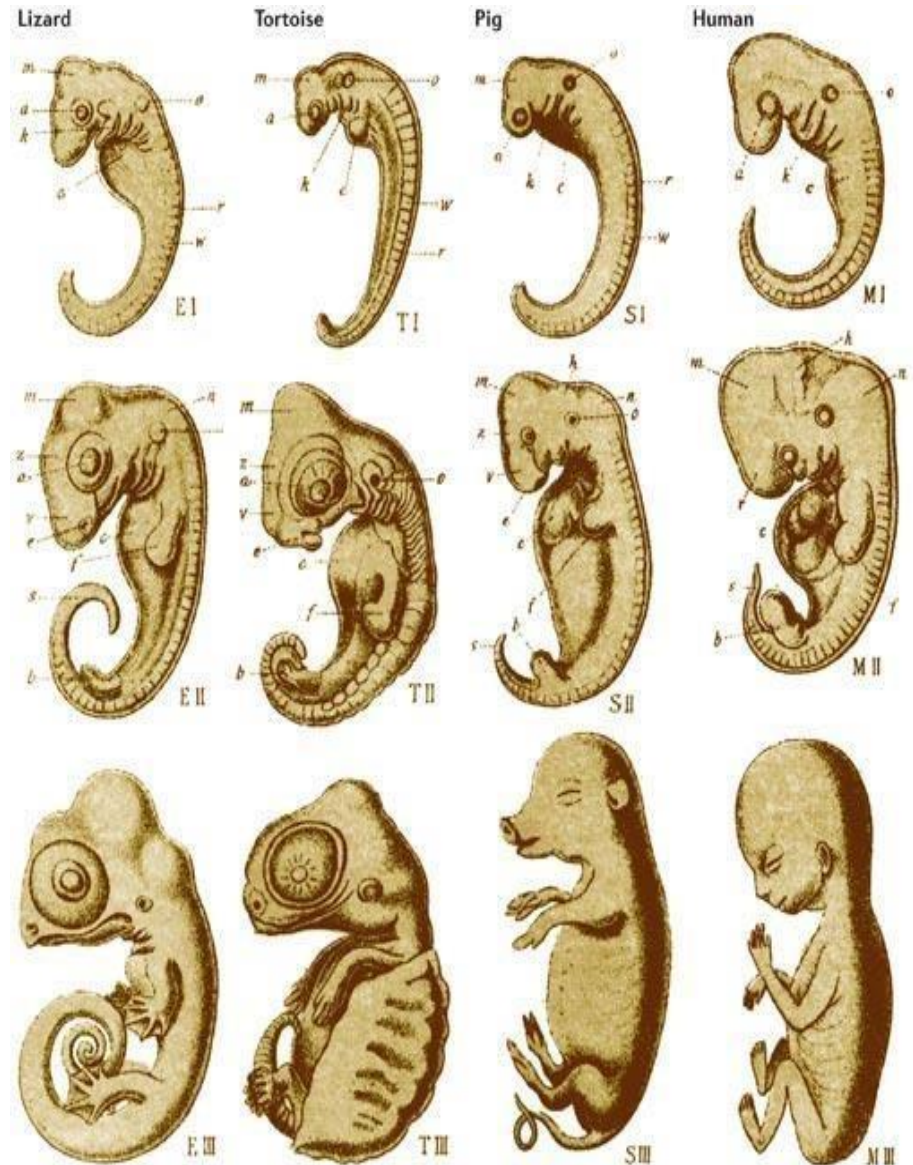
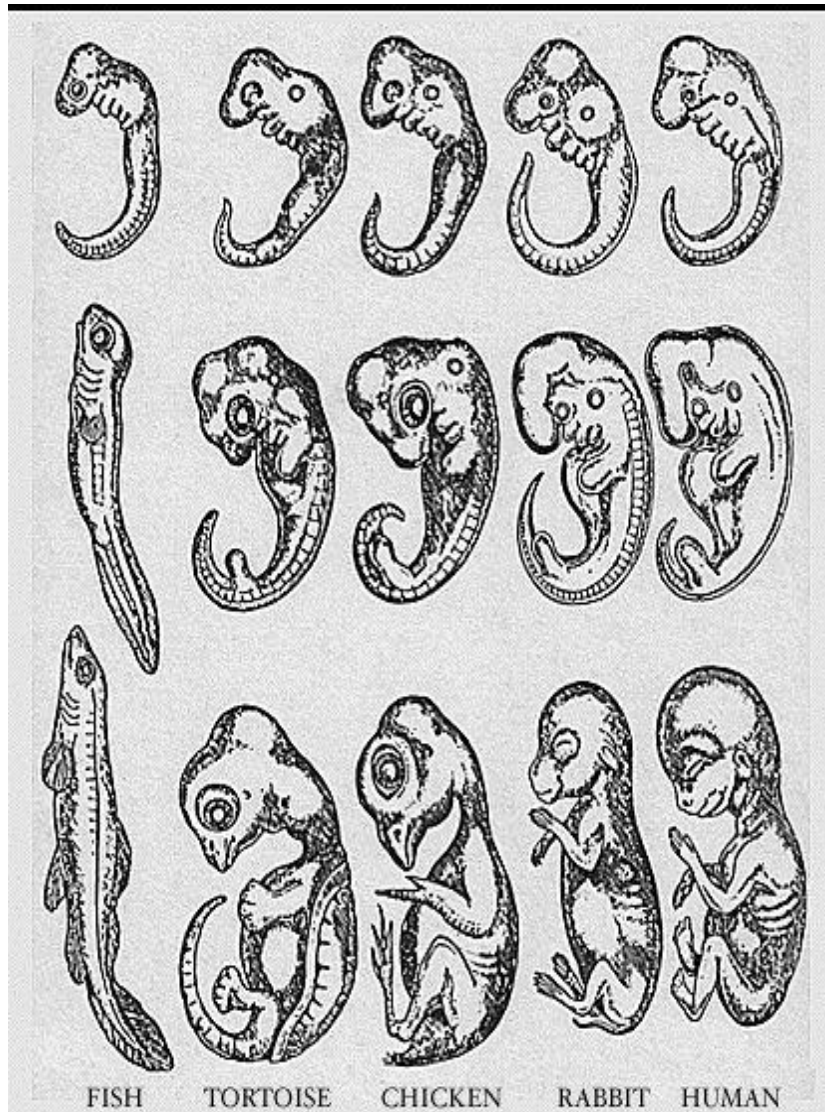


Fig. 10 The startling similarity in the embryonic development of different species evokes the primal origin of "theme and variations" technique. Art thus imitates nature. (Based on E. Hackel, *The History of Creation*, London: Kegan Paul, 1892).

## **11. Evolution should not be equated with progress :-**

Evolution has not resulted in progress. Evolution has resulted in the formation of several complex species from simpler species due to variations, genetic drift and natural selection. This does not mean that one species gets eliminated when new species are formed or that the new species are better than the older species. Species get eliminated only if they are not able to adapt to the changes in the environment. Several species which could adapt to the changes in the environment still continue to survive for example bacteria.

Human beings have not evolved from chimpanzees. They had a common ancestor from which they evolved separately. Human beings are not the pinnacle of evolution but they are only one species among the several evolving species.

## **12. Human evolution :- (Homo sapiens)**

There is a great diversity among human beings in their form and features around the world. Human beings evolved in Africa. Some of them stayed there and others migrated to different parts of the world. Then due to genetic variations and the environmental changes in different geographical regions they developed changes in their forms and features.





### **LUCY**

Nearly all experts agree Lucy was just a 3 foot tall chimpanzee.



### **HEIDELBERG MAN**

Built from a jawbone that was conceded by many to be quite human.



### **NEBRASKA MAN**

Scientifically built up from one tooth, later found to be the tooth of an extinct pig.



### **PILTDOWN MAN**

The jawbone turned out to belong to a modern ape.



### **PEKING MAN**

Supposedly 500,000 years old, but all evidence has disappeared.



### **NEANDERTHAL MAN**

At the Int'l Congress of Zoology (1958) Dr. A.J.E. Cave said his examination showed that this famous skeleton found in France over 50 years ago is that of an old man who suffered from arthritis.



### **NEWGUINEA MAN**

Dates way back to 1970. This species has been found in the region just north of Australia.



### **CROMAGNON MAN**

One of the earliest and best established fossils is at least equal in physique and brain capacity to modern man... so what's the difference?



### **MODERN MAN**

This genius thinks we came from a monkey.

*"Professing themselves to be wise they became fools."  
(Romans 1:22)*