CHAPTER - 9

HEREDITY AND EVOLUTION

Class	X
Subject	Science
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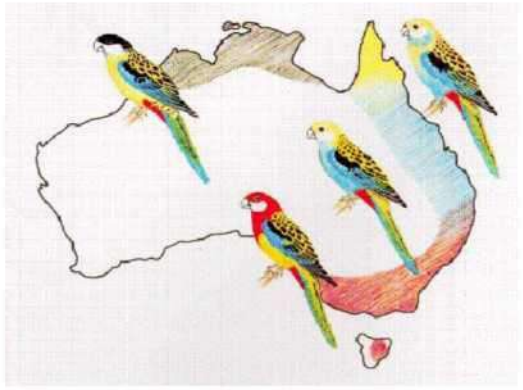
School	KANKARBAGH (FS)

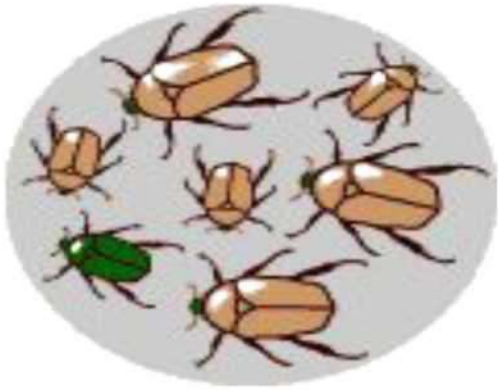
1a) Heredity

The transfer of characters or traits from the parents to their offsprings 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 offsprings show minor variations due to inaccuracies in DNA copying. These variations are less in asexual reproduction and more in sexual reproduction.

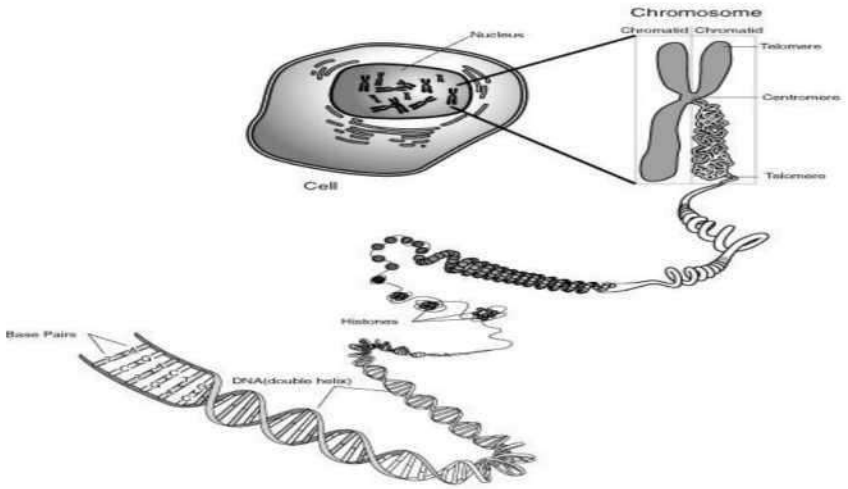
Some variations are useful variations and they help the organism to adjust to the changes in the environment. Some variations do not help the organism to adjust to the changes in the environment and they may die and become extinct.

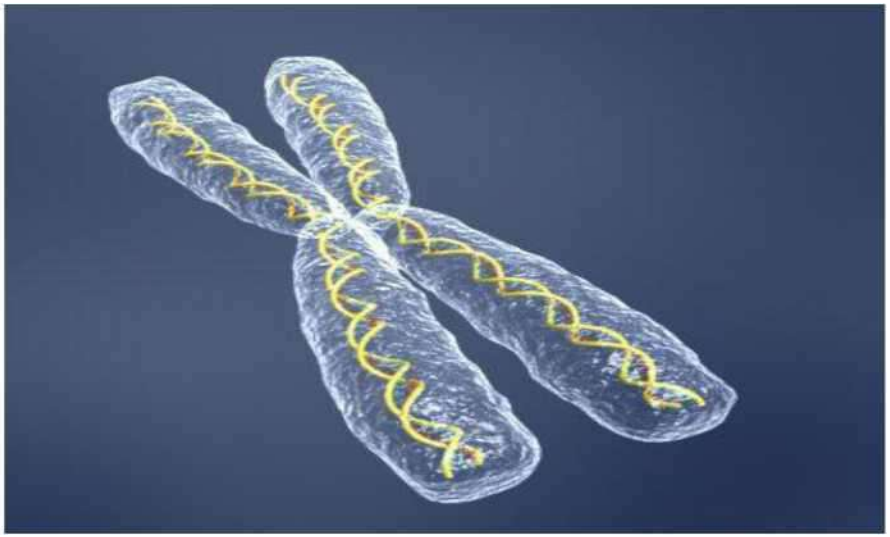
3) Rules for inheritance of characters (traits)

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.





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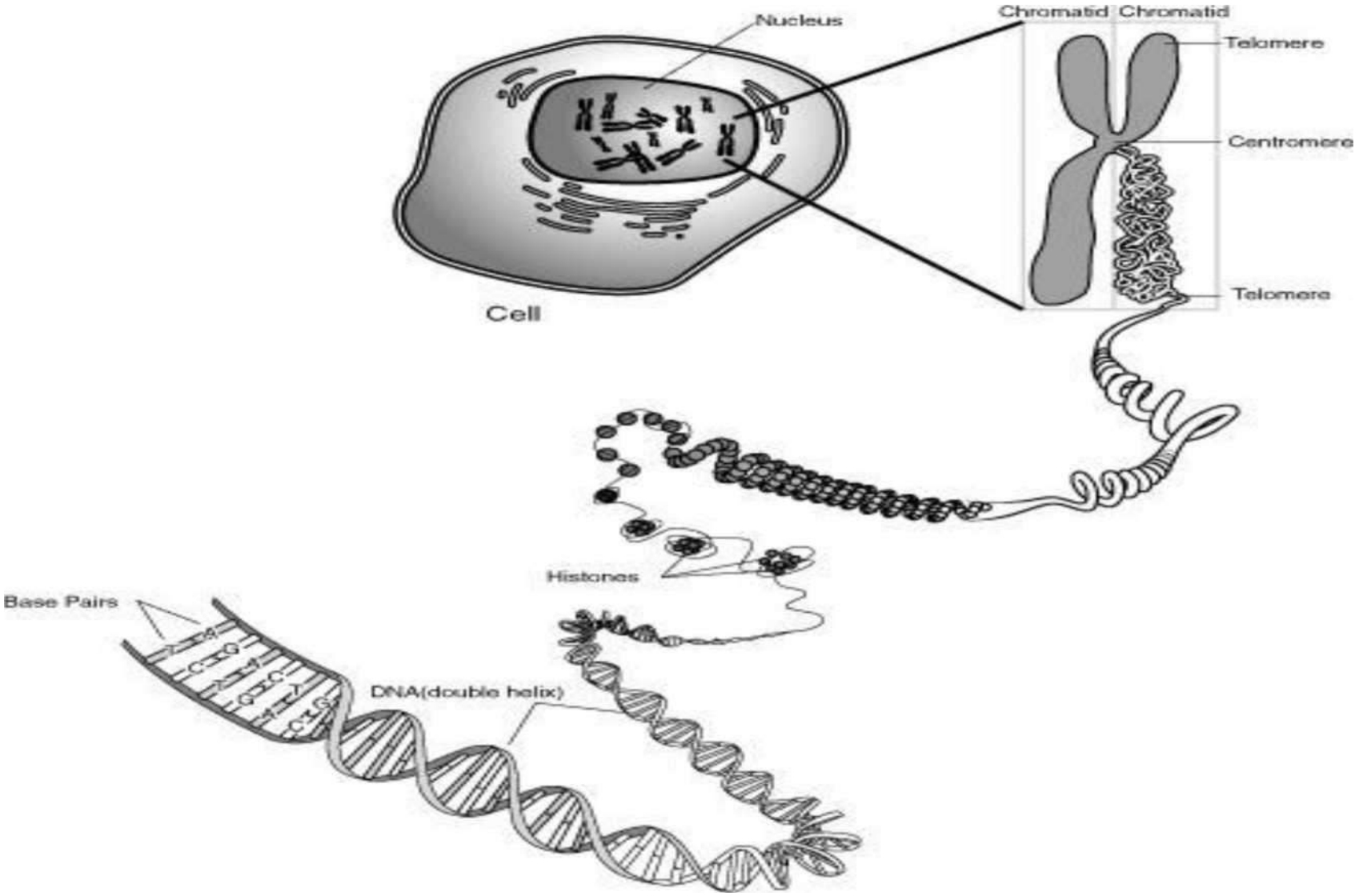

Nucleus
Cell
Chromatid
Chromatid
Telomere
Centromere
Telomere
Histones
Base Pairs
DNA(double helix)

DNA- Deoxyribonucleic Acid

It is the chemical name for the molecule that carries genetic instructions in all living organisms.

Gene-is the basic physical and functional unit of heredity. Genes are made up of DNA. It is a segment of DNA that codes for a particular phenotype/function.

Alleles: are different forms of the same gene. For example a gene which controls height in pea plant has two alternative form, one of the allele controls tallnes (T) while the other controls dwarfness (t).

Phenotype: observable physical characteristics of an organism. It is determined by both genetic makeup and environmental influences.

Genotype: Set of genes that an organism carries.

Homozygous- means that the organism has two copies of the same allele for a gene i.e. TT or tt.

Heterozygous- means that an organism has two different alleles of a gene eg. Tt.

Dominant trait- is the one that will express phenotypically in the heterozygotes. A dominant allele is expressed by capital letter (T).

Recessive trait- is the one that will only express in homozyogotes. A recessive allele is expressed by small letter (t)

Mendel's Laws of Heredity

- Gregor Mendel, an Austrian monk, carried important studies on Heredity.
- He is regarded as Father of Genetics.
- He was the first person who succeded in predicting how traits are transferred from one generation to the next generation.
- Mendel worked on Pea Plants- *Pisum sativum*

Because- they can grow easily in large numbers

- they can be either self-pollinated themselves or cross-pollinated with another plant

- they contain many contrasting characters

Seven characters studied by Mendel

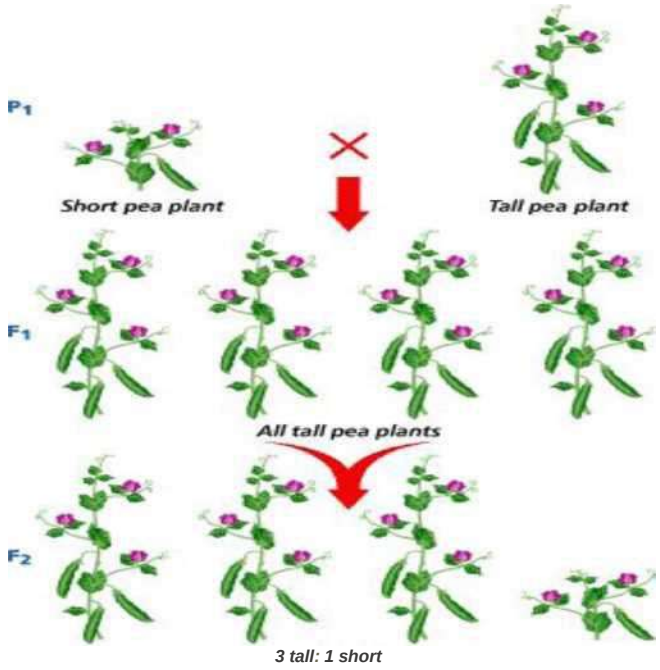
	Flower Colour	Plant Height	Seed Color	Seed Shape	Pod Colour	Pod Shape	Flower Position
Dominant Trait	 Purple	 Tall	 Yellow	 Round	 Green	 Inflated (full)	 Axial
Recessive Trait	 White	 Short	 Green	 Wrinkled	 Yellow	 Constricted (flat)	 Terminal

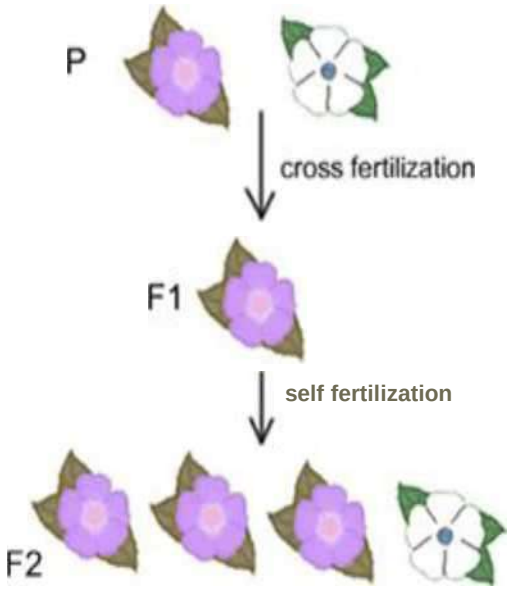
a) When plants having one pair of character (Eg:- tall and short plants) was crossed (Monohvbrid cross)

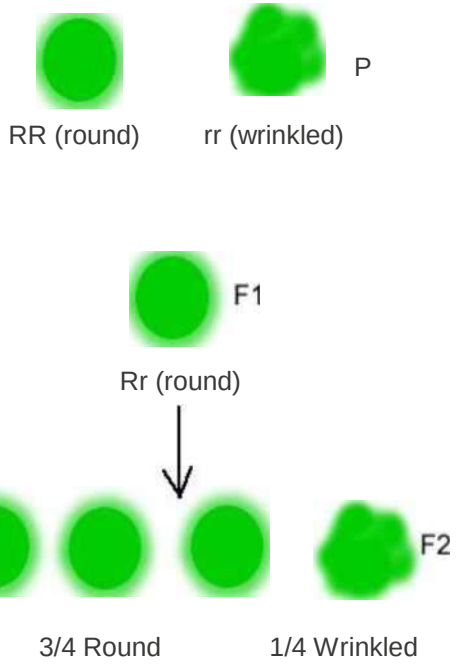
Mendel selected pea plants having one pair of character - a tall pea plant and a short pea plant. He selected pure tall (TT) and pure short (tt) pea plants and cross pollinated them. He obtained all tall plants (Tt) in the first generation (F_1). When the first generation plants were self pollinated,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

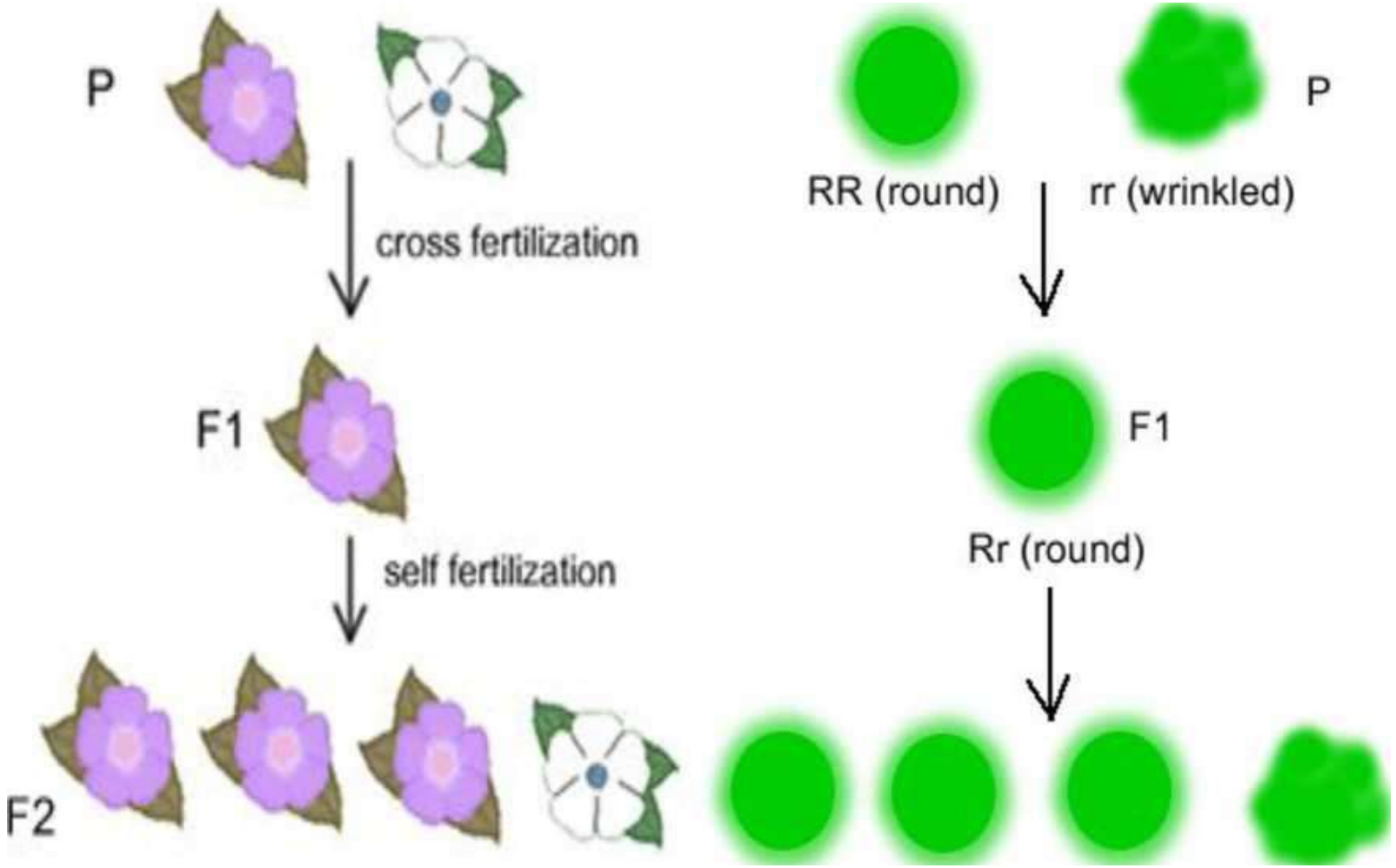
The ratio of pure tall (TT), hybrid tall (Tt) and pure dwarf (tt) was in the ratio 1:2:1

The trait that is expressed in the F_1 generation is called the dominant trait and the trait that is supressed in the F1, is called the recessive trait.









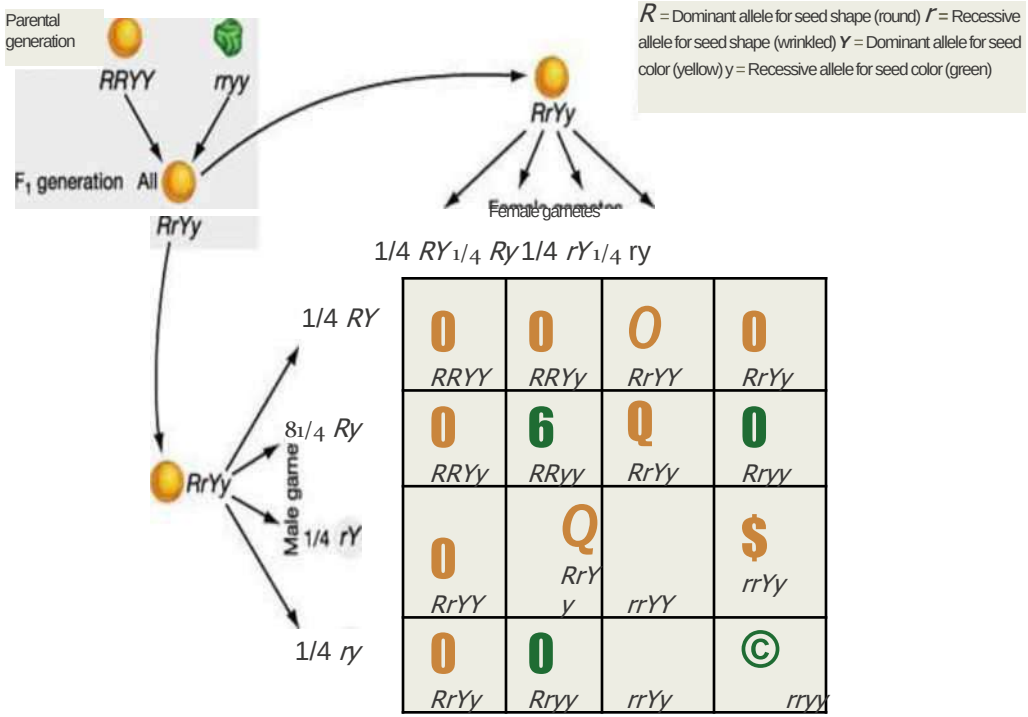
3 : 1 **Ratio**

3/4 Round

1/4 Wrinkled

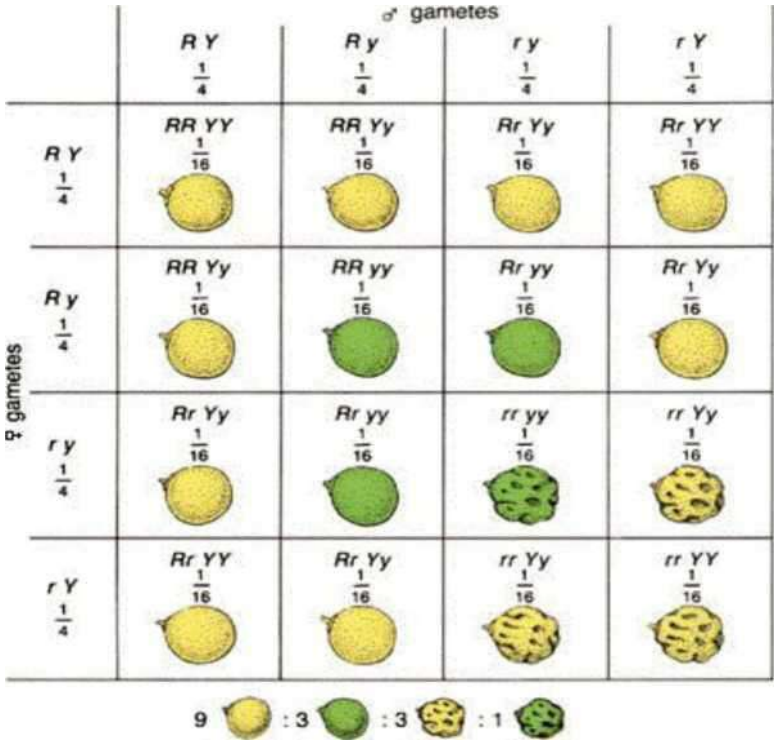
b) When plants having two pairs of characters (Eg:- shape and colour of seeds) were crossed (Dihybrid cross)

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_1 generation. When these plants were self pollinated in the F_2 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



Resulting genotypes: 9/16 *R-Y-* : 3/16 *R-yy* : 3/16 *rrY-* : 1/16 rryy

Resulting phenotypes: 9/160 : 3/160 : 3/16-0 : 1/16<



O Round, yellow

Wrinkled, yellow

Round, green

Wrinkled, green

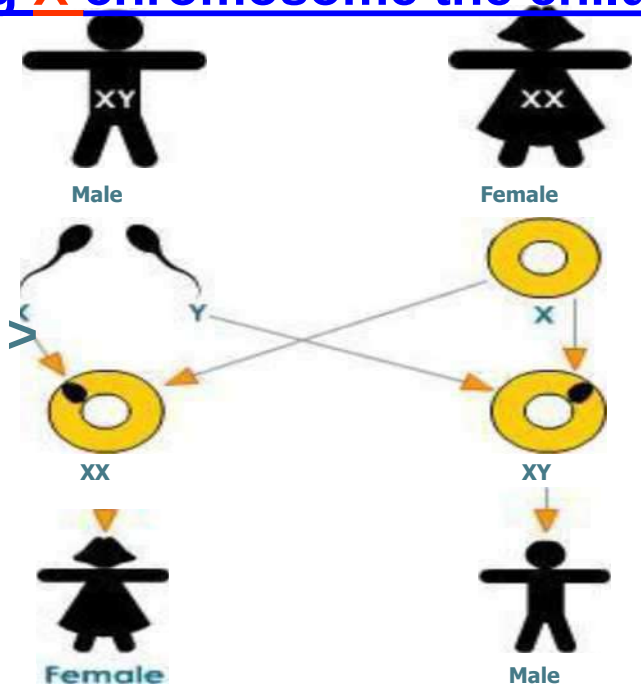
MENDEL'S FIRST LAW
VERSUS
MENDEL'S SECOND LAW

MENDEL'S FIRST LAW	MENDEL'S SECOND LAW
A principle that describes the separation of the two copies of each hereditary factor during the production of gametes	A principle that describes the independent assortment of alleles of different genes during the formation of gametes
Also called the law of segregation	Also called the law of independent assortment
Uses a monohybrid cross	Uses a dihybrid cross
Ratio of offspring is 3:1	Ratio of offspring is 9:3:3:1

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.



Sex Determination in Human Beings

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) Aquired 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 driftNatural 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.

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.

Evolution

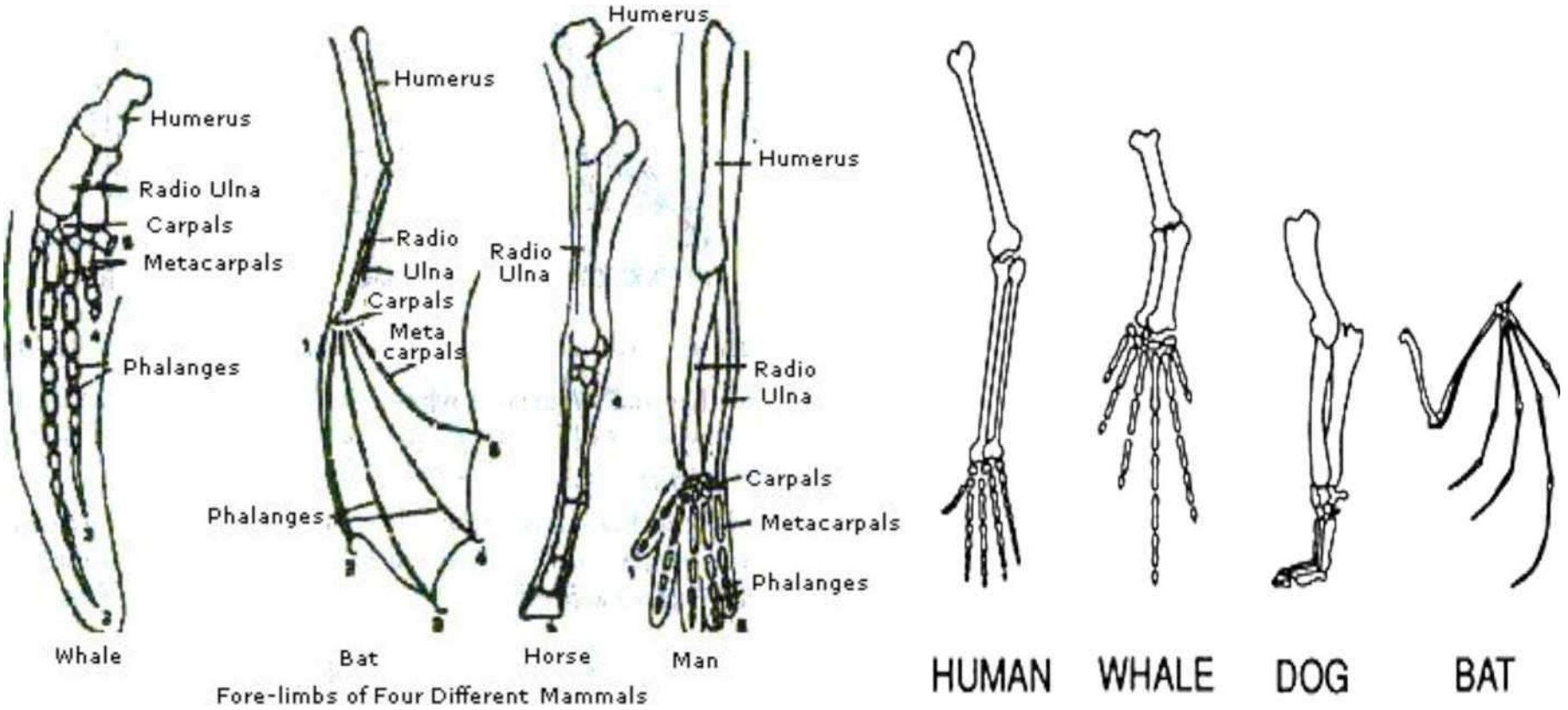
The gradual changes taking place in living organisms giving rise to new organisms due to changes in their genetic composition is called evolution.

Evidences of evolution

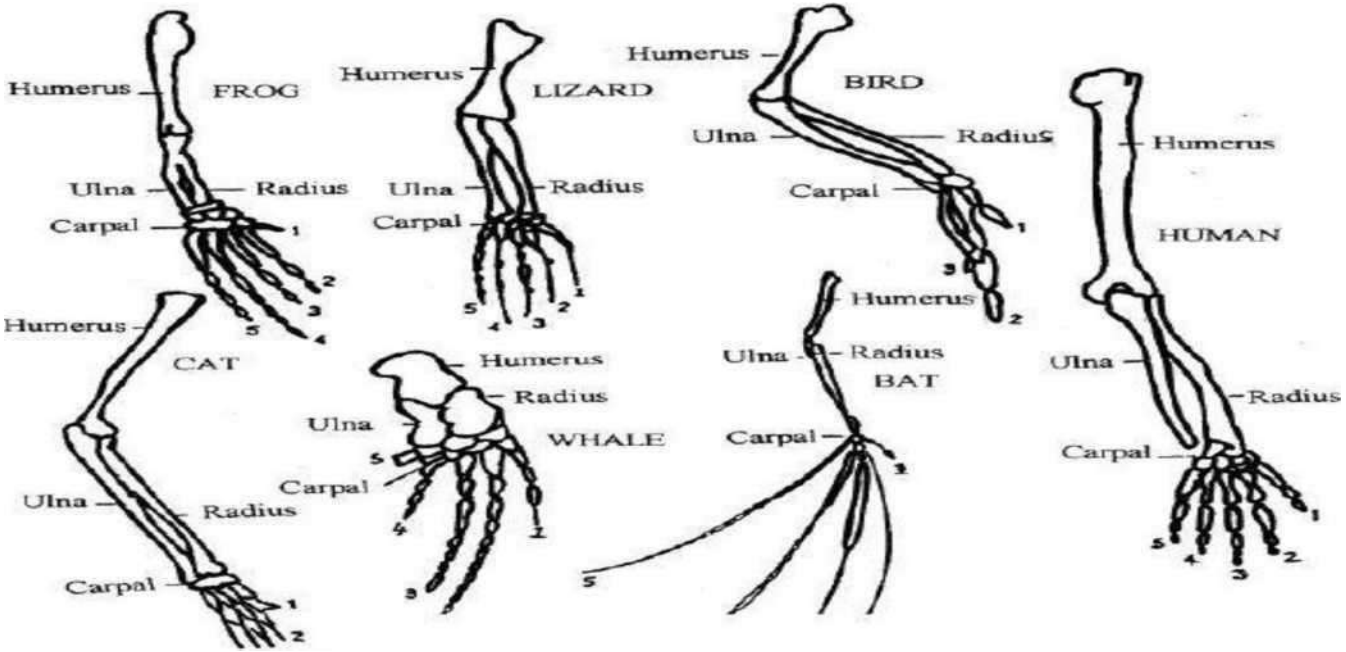
There are a number of common features in different organisms which provide evidence to show evolutionary relationship. The main evidences of evolution are from the study of Homologous organs, Analogous organs and Fossils.

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

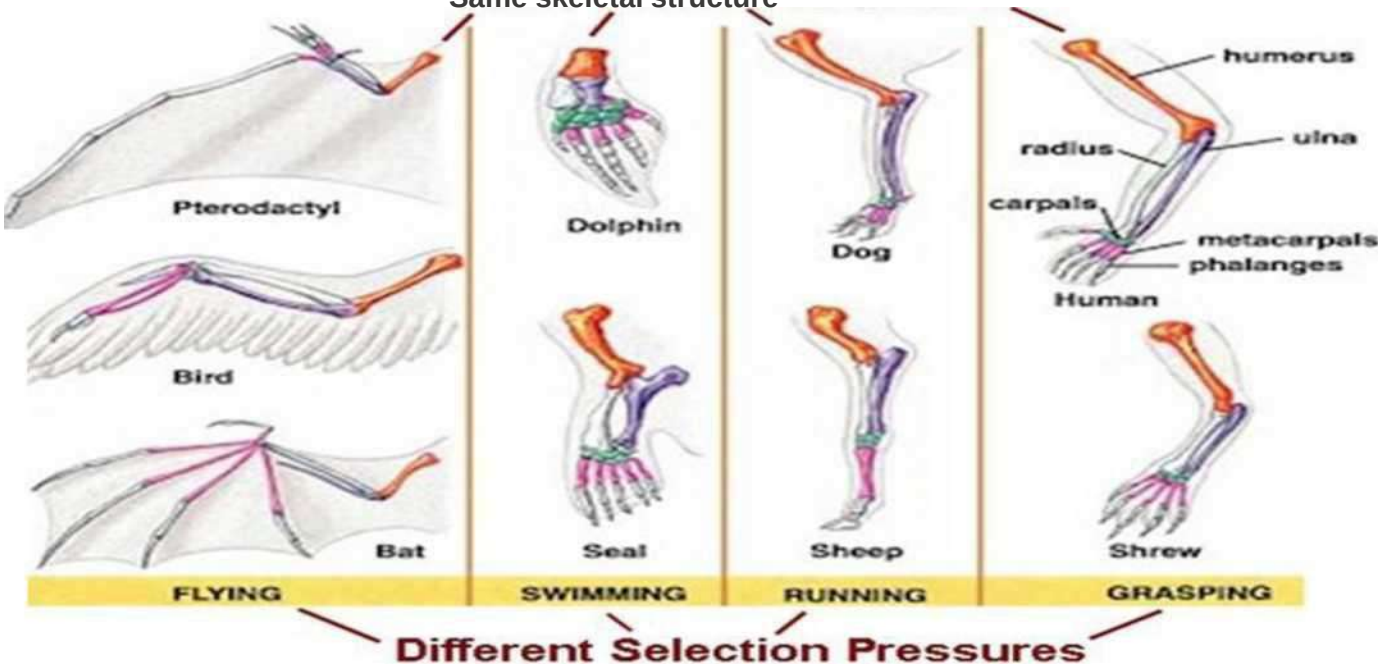
Eg The fore limbs of amphibians, reptiles, birds, and mammals have similar structures but different functions. Frog (amphibian) uses its fore limb to raise the front of the body. Lizard (reptile) uses its fore limb for walking and running. Birds fore limbs are modified as wings for flying. Mammals use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



Fore-limbs of Four Different Mammals



Same skeletal structure



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.

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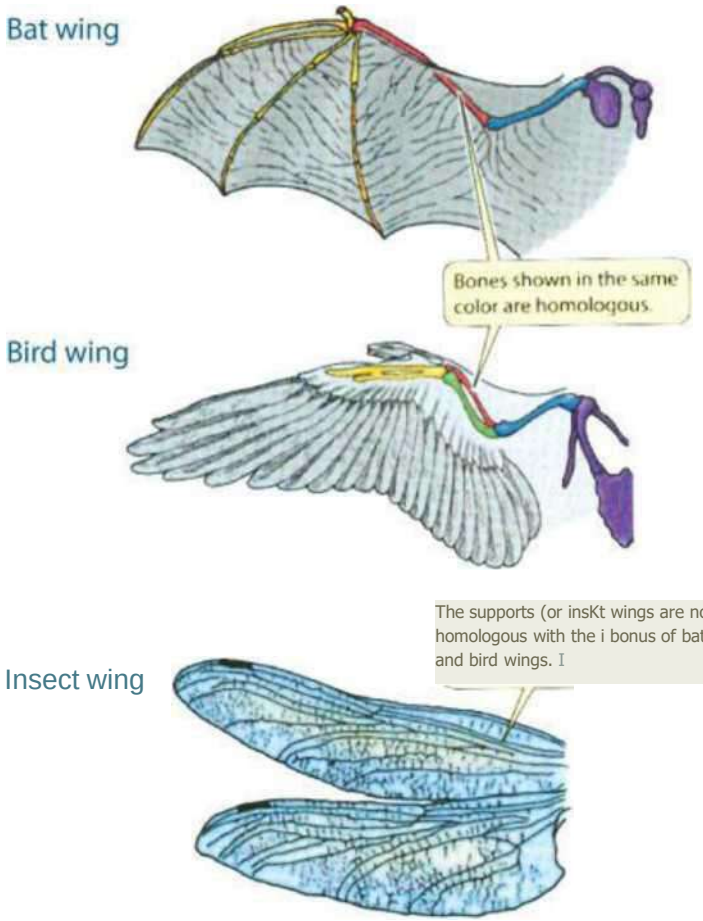
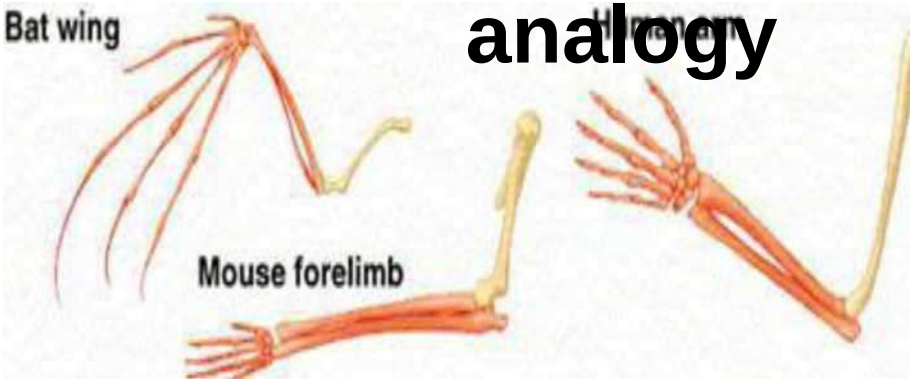


The supports (or insKt wings are not homologous with the i bonus of bat and bird wings. I

Homology and analogy

Homology

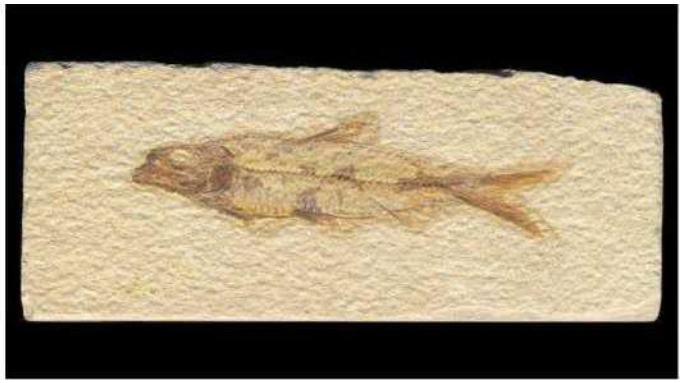


Analogy

Bat wing Butterfly wing Bird wing

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 study of fossils show evolution of simpler forms into complex forms and their evolutionary relationship.



Tree trunk fossil

Fish fossil (Knightia)

Age of fossils can be determined by:

1. Relative method: By estimating the age of the layer of earth's crust where the fossil is found. Fossils near the surface are recent and those in the deeper layers are older.
2. Radio –carbon dating: By detecting the ratios of different isotopes of carbon in the fossils.

Importance of fossils:

1. By determining the age of fossils we come to know the type of earth's strata present at that time.
2. We can also know the type of animals and plants present on the earth at that time.
3. They help in establishing evolutionary relationship by providing connecting links, for eg . Archeoptaryx- a connecting link between reptiles and birds.

10. Evolution by stages

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

i) Evolution of eves 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





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.

Trofessing themselves to be wise they became fools. “ (Romans 1:22)