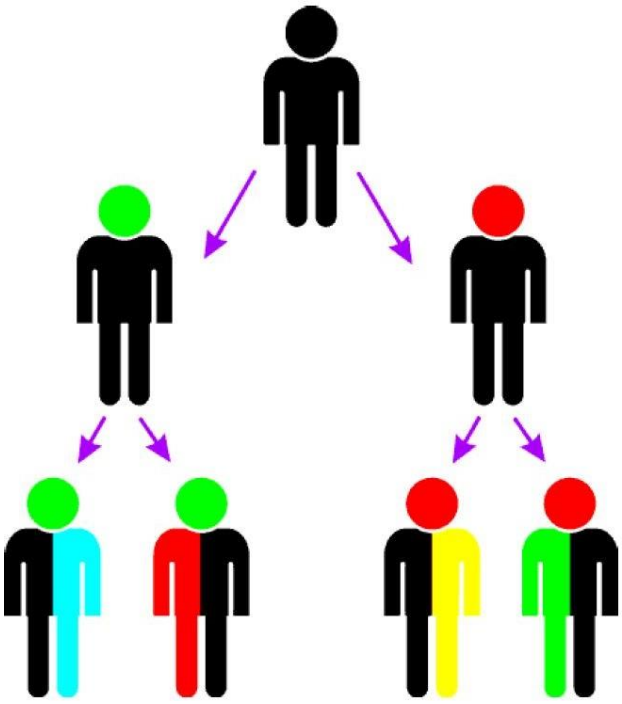
CHAPTER – 9

HEREDITY AND EVOLUTION

ACCUMULATION OF VARIATION DURING REPRODUCTION

By virtue of being the progeny of the parent, the progeny individual, need not just be the replica of what its parents are. (Inheritance of characters from the parents to the progeny (i.e., Heredity) ensures the passing of the parental characters to the progeny). The difference or change in the characteristics between the individuals is called Variation. Human population shows a great deal of variation.
Inheritance from the previous generation provides both a common basic body design, and subtle changes in it, for the next generation. The second generation will have differences that they inherit from the first generation, as well as newly created differences.

The below figures shows Creation of diversity over succeeding generations. The original organism at the top will give rise to, say, two individuals, similar in body design, but with subtle differences. Each of them, in turn, will give rise to two individuals in the next generation. Each of the four individuals in the bottom row will be different from each other. While some of these differences will be unique, others will be inherited from their respective parents, who were different from each other.



INTEXT QUESTIONS PAGE NO. 143

Q1. If a trait A exists in 10% of a population of an asexually reproducing species and a trait B exists in 60% of the same population, which trait is likely to have arisen earlier?

Ans: Trait 'B'.

Percentage of any gene in a population increases from generation to generation.

Q2. How does the creation of variations in a species promote survival?

Ans:

During reproduction (also inaccuracies in DNA replications), many variations occur in the offspring. Some individuals have more favourable variations than the other. Such individuals

survive and pass these variations on their progeny. For example, let us consider the population of beetles. Due to certain conditions, a colour arised during reproduction so that one beetle is green in colour (instead of red). This beetle can pass this colour to its progeny. Crows now cannot see these green-coloured beetles on green leaves and hence, their population become more than that of red-coloured beetles.

HEREDITY

The progeny produced through the reproductive process is similar to its parents, in body design, function etc., The rules of heredity determine the process by which the traits and the characteristics are relatively inherited.

"The inheritance of characteristics through generation is called heredity"

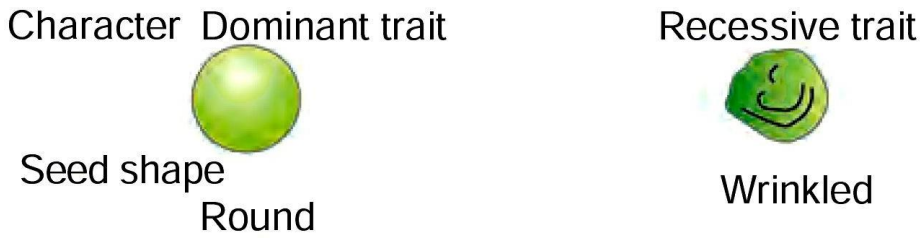
The inheritable characteristics may be morphological/anatomical/physiological/ reproductive and are also known as traits.

If we take a very close look at the rules of inheritance, both father and mother contribute equal amount of genetic material to the child. This means that each trait can be influenced by both paternal and maternal genetic material – i.e, DNA.

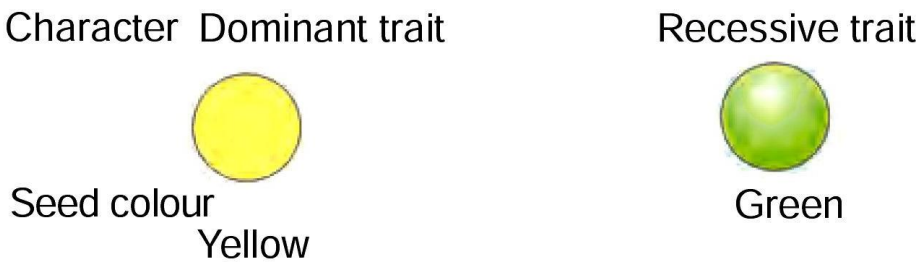
RULES FOR THE INHERITANCE OF TRAITS – MENDEL'S CONTRIBUTIONS

Gregor Johann Mendel (1822-1884) worked out the first ever scientific experimental study on heredity.
Mendel, an Austrian Augustinian monk observed variations in the characteristics of garden pea plant (Pisum sativum) which he had cultivated in his monastery garden. Mendel was curious to find out the results of crossing of pea plants with the variation in traits. The visible contrasting characters that Mendel observed in the garden pea plants were given below:

Seed shape - Round/Wrinkled



Seed colour - Yellow/Green



Flower colour - Violet / White

Character Dominant trait Recessive trait

Flower colour

Violet

White

Pod shape - Full / Constricted

Character Dominant trait Recessive trait

Pod shape

Full

Constricted

Pod colour - Green / Yellow

Character Dominant trait Recessive trait

Pod colour

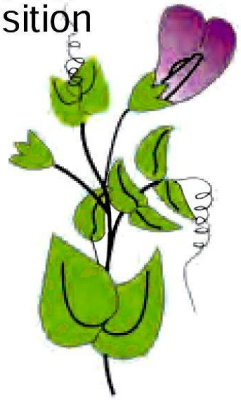
Green

Yellow

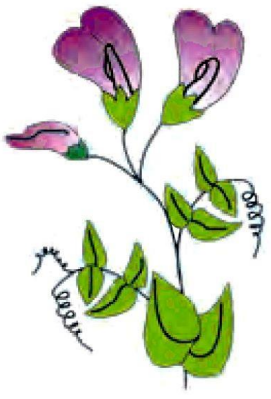
Flower position - Axillary / Terminal

Character Dominant trait Recessive trait

Flower Position

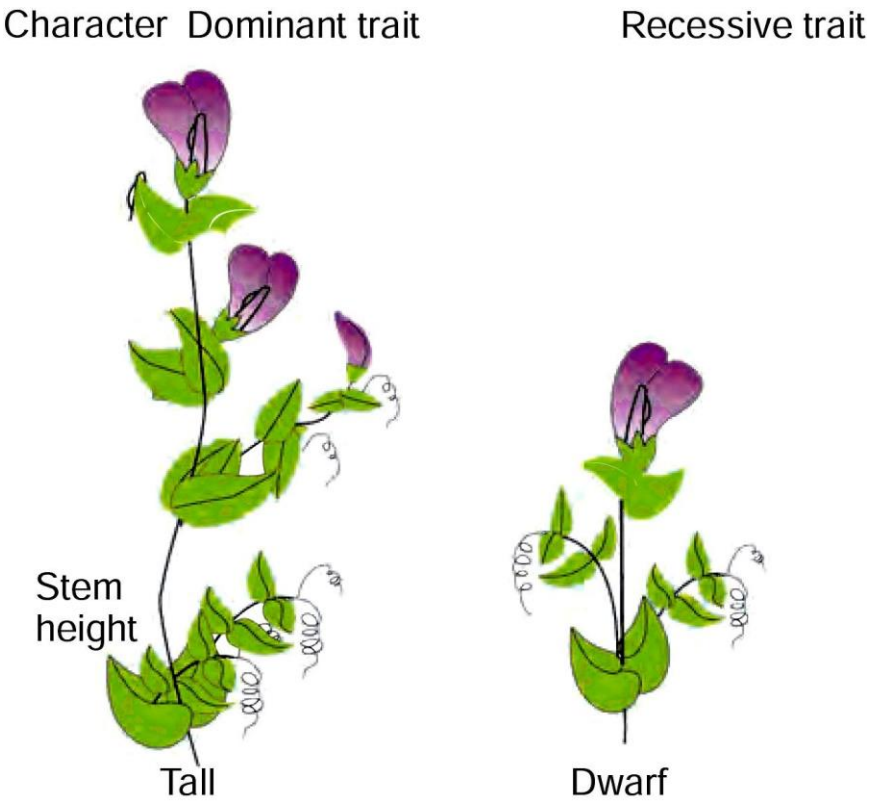


Axial



Terminal

Stem height - Tall / Dwarf



MENDEL'S MONOHYBRID CROSS

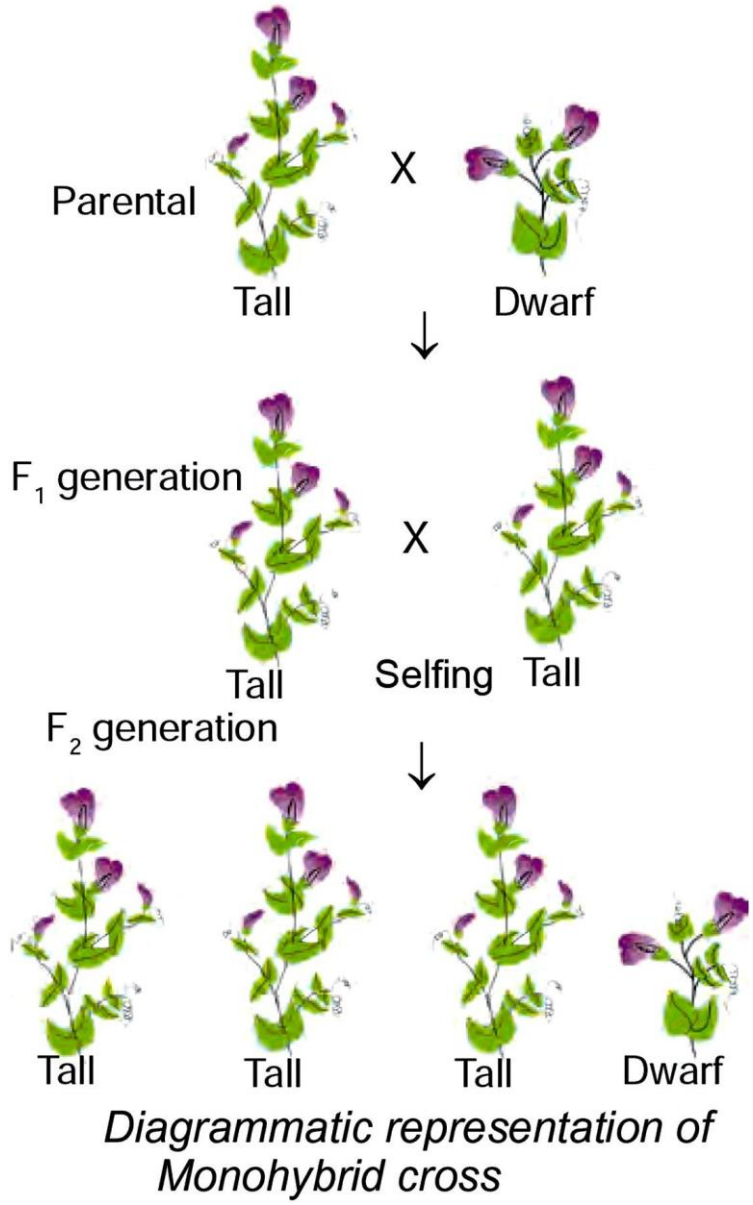
Mendel selected the garden pea plant, Pisum sativum for his experiments. He selected tall and dwarf plants and allowed them to grow naturally. As pea plants produce seeds only by self pollination, he observed that tall plants produced always tall plants generation after generation under natural condition. Similarly, dwarf plants produced always dwarf plants generation after generation. Hence, he termed the tall and dwarf plants as wild types or pure breeding varieties.

Then he crossed a tall plant with a dwarf plant, produced progeny and calculated the percentage of tallness and dwarfness in subsequent generations. When a pure breeding tall plant was crossed with a pure breeding dwarf plant, all plants were tall in the first filial generation (F1) i.e., there was not any medium height plants or dwarf plants.
This means that only one of the parental traits were seen and not the mixture of the two. When such a F1 tall plant was allowed to have self pollination, both the tall and dwarf plants appeared in second filial generation (F2). in the ratio of 3:1.
This indicates that both tallness and dwarfness were inherited in the F1 plants but only tallness trait was expressed.

The first experiment of Mendel considering the inheritance of a single trait (Height of the plant Tall/Dwarf) is called Monohybrid Cross.

Expression of morphological characters as tall or dwarf plant, violet or white flower is called Phenotype.

The expression of gene (or Chromosomal make up) of an individual for a particular trait is called Genotype.



Diagrammatic representation of Monohybrid cross

POINTS TO REMEMBER:

- **Heredity:** The passing of traits from the parents to offspring is called heredity. **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 result of genotype's interaction with the environment. Due to this reason, many phenotypes are not inheritable.
- **Acquired Traits:** Traits; which are acquired due to interaction with the environment; are called acquired traits. Acquired traits are not inheritable.
- **Inheritable Traits:** Traits; which can be expressed in subsequent generations; are called inheritable traits. Such traits bring a change in the genotype of the organism and hence become inheritable.

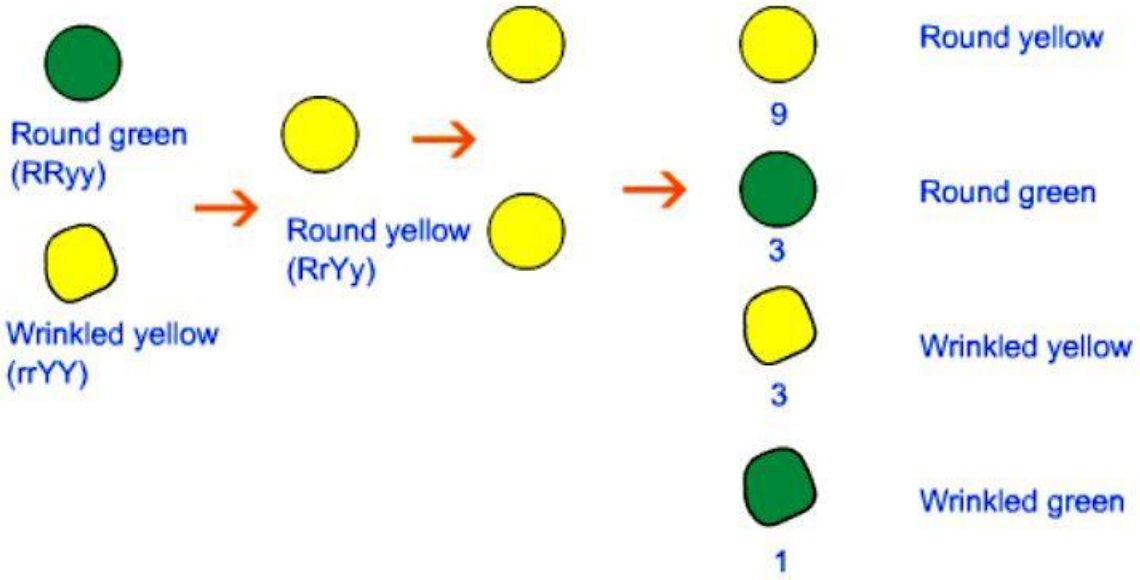
MENDEL'S FIRST LAW

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

The cross in which two pairs of characters are studied is called dihybrid cross. In his second experiment, Mendel used dihybrid cross.

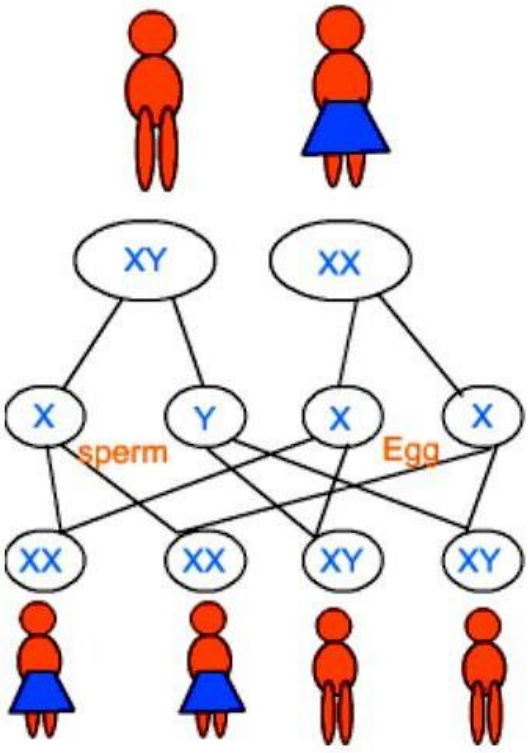
Let us take example between plants with round and green seeds and those with wrinkled and yellow seeds. The genotype of round and green seeds is shown by RRyy and that of wrinkled and yellow seeds is shown by rrYY. In the F1 generation, all plants produced round and yellow seeds; which means that wrinkled texture was the recessive character and so was the green colour of seeds. When plants of F1 generation were allowed to self pollinate; it was observed that most of the plants in F2 generation produced round and yellow seeds. Some plants produces round green seeds, some produced wrinkled yellow seeds and some produced wrinkled green seeds. The ratio was 9 : 3 : 3 : 1; as shown in the below figure.



MENDEL'S SECOND LAW:

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.

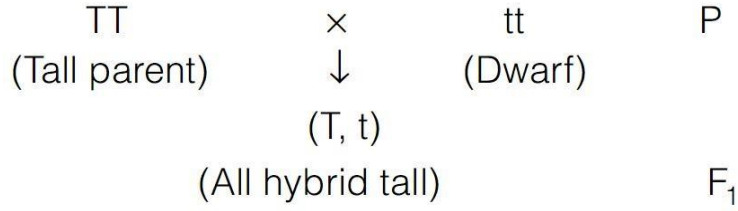


<u>SEX DETERMINATION IN HUMANS:</u>

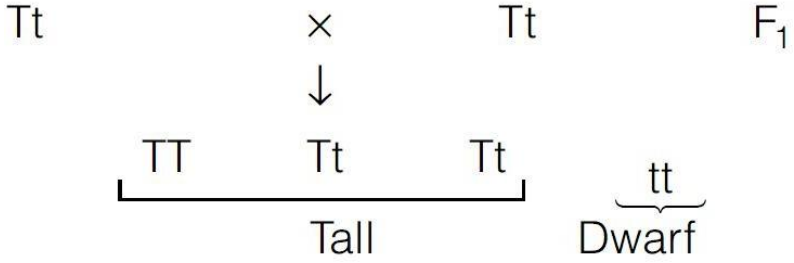
Somatic cells in human beings contain 23 pairs of chromosomes. Out of them the 23rd pair is composed of different types of chromosomes which are named as X and Y chromosomes. The 23rd pair contains one X and one Y chromosome in a male.On the other hand, the 23rd pair in a female contains X chromosomes. This means that all the eggs would have X chromosome as the 23rd chromosome, while a sperm may have either X or Y chromosome as the 23rd chromosome. When a sperm with X chromosome fertilizes the egg, the resulting zygote would develop into a female child. When a sperm with Y chromosome fertilizes the egg, the resulting zygote would develop into a male child.

INTEXT QUESTIONS PAGE NO. 147

Q1. How do Mendel's experiments show that traits may be dominant or recessive?
Ans:
Mendel crossed a pure tall pea plant (TT) with pure dwarf pea plant (tt) and observed that all the progeny were hybrid tall (Tt), *i.e.,* only one of the trait was able to express itself in the F_1 generation, which is the **dominant trait.** The other trait called the **recessive** trait remain suppressed.

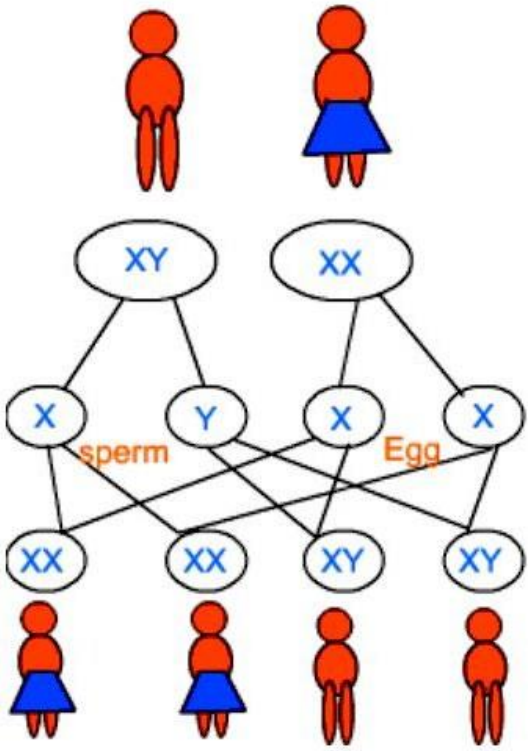


However, when he self crossed plants of F_1 generation, he observed that **one fourth** of the plants were dwarf and three fourth were tall.



Q2. How do Mendel's experiments show that traits are inherited independently?
Ans: Please refer the above section **DIHYBRID CROSS**

Q3. A man with blood group A marries a woman with blood group O and their daughter has blood group O. Is this information enough to tell you which of the traits – blood group A or O – is dominant? Why or why not?
Ans:
This shows that blood group 'O' is dominant and 'A' is recessive because blood group 'O' was able to express itself in heterozygous condition, due to which the progeny had blood group 'O'.



Q4. How is the sex of the child determined in human beings?
Ans:
Somatic cells in human beings contain 23 pairs of chromosomes. Out of them the 23rd pair is composed of different types of chromosomes which are named as X and Y chromosomes. The 23rd pair contains one X and one Y chromosome in a male. On the other hand, the 23rd pair in a female contains X chromosomes. This means that all the eggs would have X chromosome as the 23rd chromosome, while a sperm may have either X or Y chromosome as the 23rd chromosome. When a sperm with X chromosome fertilizes the egg, the resulting zygote would develop into a female child. When a sperm with Y chromosome fertilizes the egg, the resulting zygote would develop into a male child.

EVOLUTION

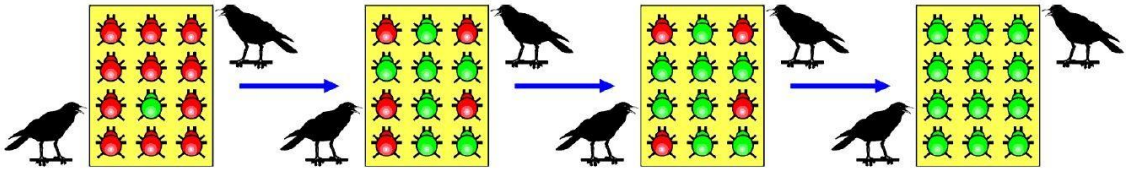
The change in inherited traits in biological population over subsequent generations is called evolution. Scientists have proven that life evolved in the form of simple unicellular organisms on this earth; and all the organisms which are present today have evolved from a common ancestor. The idea of evolution is based on the premise of a common ancestry.

Let us consider a group of twelve beetles. They live in bushes on green leaves. Their population will grow by sexual reproduction. So they were able to generate variations in population. Let us assume crows eat these red beetles. If the crows eat more Red beetles their population slowly reduced.

Let us think of different situations.

Situation-1:

In this situation a colour variation arises during reproduction. So that there appears one beetle that is green in colour instead of red.



Red and green beetles

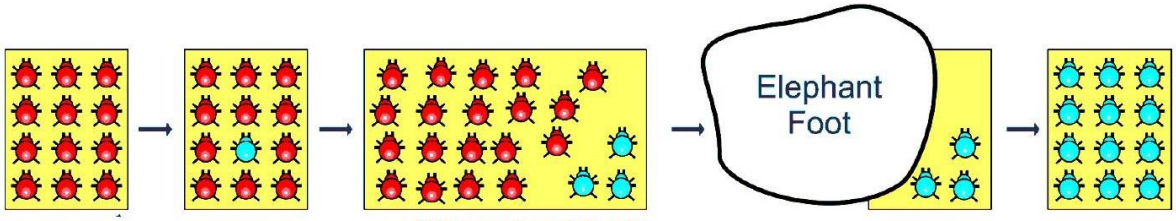
More over this green coloured beetle passes it's colour to it's off spring (Progeny). So that all its progeny are green. Crows cannot see the green coloured beetles on green leaves of the bushes and therefore crows cannot eat them. But crows can see the red beetles and eat them. Asa result there are more and more green beetles than red ones which decrease in their number.

The variation of colour in beetle 'green' gave a survival advantage to 'green beetles' than red beetles. In other words it was naturally selected.

We can see that the 'natural selection' was exerted by the crows. The more crows there are, the more red beetles would be eaten and the more number of green beetles in the population would be. Thus the natural selection is directing evolution in the beetle population. It results in adaptation in the beetle population to fit in their environment better.

Situation-2:

In this situation a colour variation occurs again in its progeny during reproduction, but now it results in 'Blue' colour beetles instead of 'red' colour beetle. This blue colour beetle can pass its colour to its progeny. So that all its progeny are blue.



Blue and red beetle

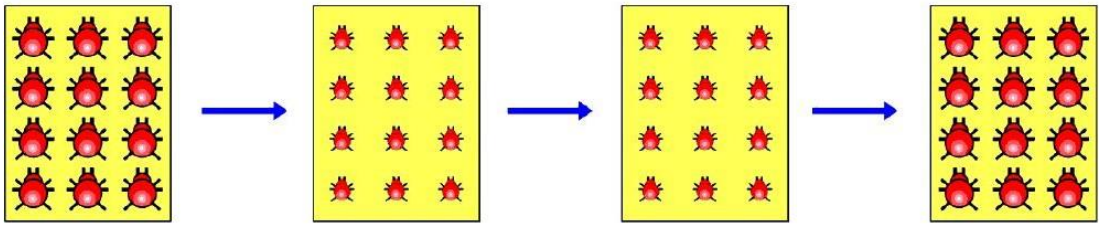
Crows can see blue coloured beetles on the green leaves of the bushes and the red ones as well. And therefore crows can eat both red and blue coloured beetles. In this case there is no survival advantage for blue coloured beetles as we have seen in case of green coloured beetles.

What happens initially in the population, there are a few blue beetles, but most are red. Imagine at this point an elephant comes by and stamps on the bushes where the beetles live. This kills most of the beetles. By chance the few beetles survived are mostly blue. Again the beetle population slowly increases. But in the beetle population most of them are in blue colour.

Thus sometimes accidents may also result in changes in certain characters of the a population. Characters as we know are governed by genes. Thus there is change in the frequency of genes

in small populations. This is known as "Genetic drift', which provides diversity in the population.

Situation-3:
In this case beetles population is increasing, but suddenly bushes were affected by a plant disease in which leaf material were destroyed or in which leaves are affected by this beetles gotless food material. So beetles are poorly nourished. So the weight of beetles decrease but no changes take place in their genetic material (DNA)**.** After a few years the plant disease are eliminated. Bushes are healthy with plenty of leaves.



Poorly nourished beetles

ACQUIRED AND INHERITED CHARACTERS AND EVOLUTION
The germ cells of sexually reproducing population are formed in specialised reproductive tissue. If the weight of the beetles is reduced because of starvation, that will not change the DNA of the germ cells. Therefore, low weight is not a trait that can be inherited by progeny ofa starving beetle. Therefore, even if some generations of beetles lose their weight because of starvation, that is not an example of evolution, since the change is not inherited over generations. Change in non-reproductive tissues cannot be passed on to the DNA of the germ cells. Therefore, the experiences of an individual during its lifetime cannot be passed on to its progeny, and cannot direct evolution.

DARWIN'S THEORY OF EVOLUTION:
Charles Darwin wrote his famous book 'Origin of Species'. He threw new insights on evolution of species. Some salient points of Darwin's theory are as follows:

Organisms have unlimited capacity to reproduce:
Organisms can reproduce offspring at a fast pace. This is necessary for survival, because a higher number of offspring ensures that at least some of them could survive. Each organism has to struggle for its day-to-day survival. For example; a frog lays thousands of eggs at one go.The spawn is released in water and it is left to fend for itself. Most of the eggs are either washed away or are eaten by predators. However, some portion of eggs from the spawn develops into tadpoles. Once again, many tadpoles are eaten up by predators; leaving a few which develop into adults. It is evident, that a large number of eggs is needed to ensure that at least some of them develop into adults.

Natural Selection:
Different individuals of a particular species have different traits. Those with more suitable traits are selected by the nature. Each organism needs a particular trait for finding food and finding a mate. Those with better traits are finally able to pass on their traits to the next generation.

Survival of the Fittest:
Those organisms which are the fittest are able to survive, while others perish. That is how many species become extinct and some species continue to evolve over a period of time.

MOLECULAR ORIGIN OF LIFE:

Stanley L. Miller and Harold C. Urey, conducted the Miller-Urey experiment in 1953 to demonstrate how the life would have originated on the earth. They created an environment in laboratory which mimicked the environment of earth as it was during the time of origin of life. Water, methane, ammonia and hydrogen were used in that experiment. The liquid was heated to initiate evaporation and electrodes were used to create electric discharge. At the end of two weeks, some organic molecules were formed in the setup. Some amino acids and sugar were also formed. This proved the hypothesis of J. B. S. Haldane that life originated from inorganic raw materials.

INTEXT QUESTIONS PAGE NO. 150

Q1. What are the different ways in which individuals with a particular trait may increase in a population?

Ans:

There are different ways in which an individual with a particular trait may increase in a population

- ☞ When a colour variation arise during reproduction, it can pass the colour on to its progeny which may protect them from prey.
- ☞ Accidents in small population can change the frequency of some genes in a population even if they give no survival advantage.
- ☞ Poor nourishment may reduce the population of individuals but when nourishment conditions improve the population starts increasing again.

Thus, the maturation, adaptation to environment and natural selection may increase a particular trait in a population.

Q2. Why are traits acquired during the life-time of an individual not inherited?

Ans:

Traits acquired during the life-time of an individual just enable an individual to adapt itself to the surrounding and do not change the genetic make up of the organism. Only those variations are inherited, which come into the germ cell of the organism.

Q3. Why are the small numbers of surviving tigers a cause of worry from the point of view of genetics?

Ans:

Small numbers of surviving tigers are a cause of worry from the point of genetics because their loss would cause a loss of gene pool, *i.e.,* many genes will be eliminated from a gene pool.

SPECIATION

The process of origin of a new species is called speciation. A species is a group of organisms in which most of the characters are similar and members of a species are able to breed among themselves. Speciation can happen if two groups of the same species are somehow prevented from interbreeding for several generations. This can happen because of geographical segregation or because of some genetic changes. Evolution of new species, because of geographical segregation is called genetic drift.

INTEXT QUESTIONS PAGE NO. 151

Q1. What factors could lead to the rise of a new species?

Ans:

Genetic drift and natural selection could lead to rise of a new species.

Q2. Will geographical isolation be a major factor in the speciation of a selfpollinating plant species? Why or why not?

Ans:

No, geographical isolation is not a major factor in the formation of new species of self- pollinated plants. This is because self-pollinated plants receive pollen grains from the same flower or another flower on the same plant and its distance from other plants hardly affects its reproduction. Moreover, self-pollinated plants rarely, show variations in characters.

Q3. Will geographical isolation be a major factor in the speciation of an organism that reproduces asexually? Why or why not?

Ans:

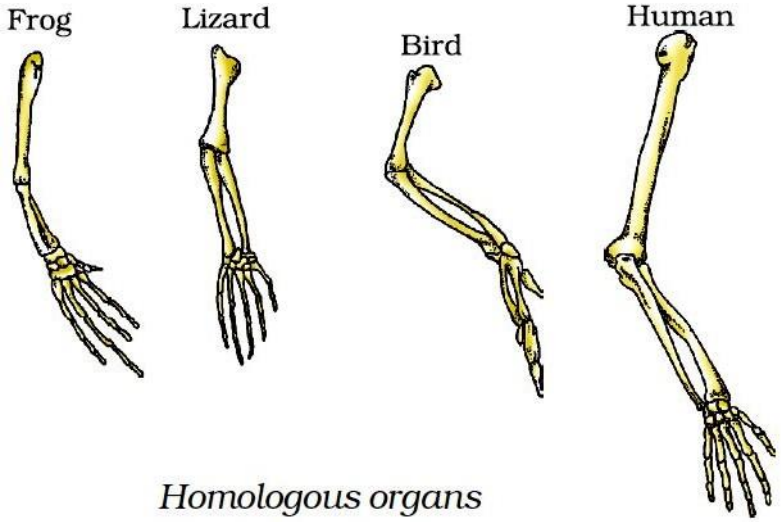
No, because asexual reproduction involves only a single parent. So, the geographical isolation do not affect its reproduction cycle. Moreover, asexually reproducing organisms rarely show any variations in characters.

EVOLUTION AND CLASSIFICATION

The modern system of classification is based on evolutionary relationship. Due to this, this is also known as phylogenetic classification. The kingdom is the highest taxa, while the species is the lowest taxa. Members of a species have a higher number of common characters, than members of a kingdom. For example; all human beings belong to the species Homo sapiens. Human beings can interbreed; irrespective of their race or skin colour. All human beings come under the class mammalia; as do the monkeys, elephants and cows. Apparently, each species of the class mammalian is quite different yet they have certain common characters; like hairs on the body and mammary glands in females. Similarly, all animals are eukaryotes and cell wall is absent in their cells. The degree of similarity or dissimilarity shows that all animals have evolved from a common ancestor.

HOMOLOGOUS ORGANS

Organs which have common design but serve different functions in different animals are called homologous organs. For example; the forelimbs of all tetrapods are composed of humerus, radio-ulna, tarsals and metatarsals. Yet, the forelimbs of frogs are adapted to a jumping movement, those of birds are used for flying and those of humans are used for handling tools. This shows that frogs, birds and humans have evolved from a common ancestor.

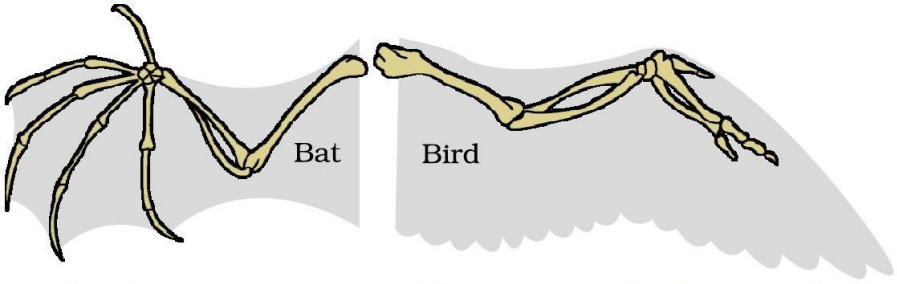


Homologous organs

ANALOGOUS ORGANS

Organs which have different design but serve a common function in different animals are called analogous organs. Wings of birds and wings of bat are good examples of a pair of analogous organs. Wings of birds are composed of all the bones of forelimb and are covered

with feathers. Wings of bats are mainly composed of the digital bones and a thin membrane covering the structure. Yet wings in both the organisms are used for flying.



Analogous organs – The wing of a bat and the wing of a bird

FOSSILS

The preserved remains of animals or plants or other organisms from the distant past are called fossils. Fossils provide the evidence that the present animal have originated from previously existing ones through the process of continuous evolution. Fossils can be used to reconstruct evolutionary history of an organism. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are more highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks. It gives us an idea of time in history when different species were formed or became extinct. Fossil also helps to trace the evolutionary history of some animals. Fossils also indicate connecting link between the two groups of organisms. For example, *Archaeopteryx* is a connecting link between reptiles and birds.

INTEXT QUESTIONS PAGE NO. 156

Q1. Give an example of characteristics being used to determine how close two species are in evolutionary terms.

Ans:

Homologous organs, analogous organs, vestigial organs, etc.

Q2. Can the wing of a butterfly and the wing of a bat be considered homologous organs? Why or why not?

Ans:

Butterfly belongs to phylum–Arthropoda which have chitinous exoskeleton. The bat belongs to class–Mammalia which have wings of skin. Thus, both butterfly and bat are not homologous but analogous in wing structure, *i.e.*, have similar functions not similar structure.

Q3. What are fossils? What do they tell us about the process of evolution?

Ans:

The preserved remains of animals or plants or other organisms from the distant past are called fossils.

- ☞ Fossils provide the evidence that the present animal have originated from previously existing ones through the process of continuous evolution.
- ☞ Fossils can be used to reconstruct evolutionary history of an organism. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are more highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks.

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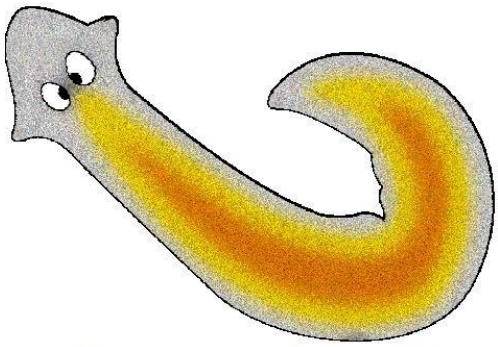
- ☞ Fossil also help to trace the evolutionary history of some animals.
- ☞ Fossils also indicate connecting link between the two groups of organisms.
- ☞ For example, *Archaeopteryx* is a connecting link between reptiles and birds.

EVOLUTION BY STAGES

Evolution of complex organs and thus of complex organisms has happened in stages. Let us take the example of evolution of eyes. Planaria is the first animal which shows 'eye' like structure. The dark spots on planaria are light sensitive spots but a planaria cannot distinguish between two different objects. Eyes of insects are compound eyes which are made up of thousands of optical surfaces. Eyes of higher animals are simple eyes which are composed of a single lens. Most of the animals cannot differentiate among colours. Depth perception is also weak in many animals. Human eyes are the most advanced; because humans can recognize colours and have very good depth perception.

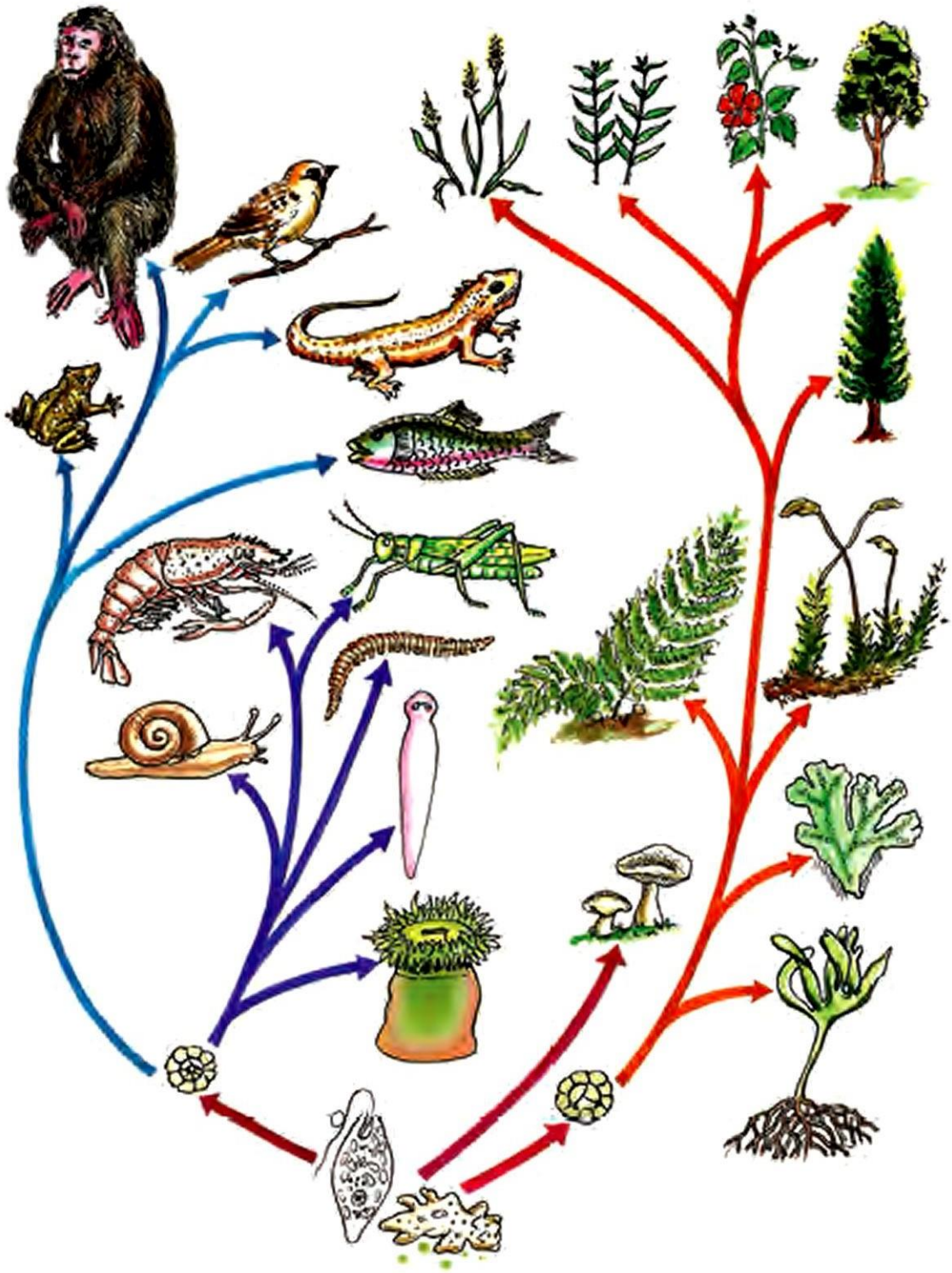
Most of the tetrapods have to use all the four limbs for locomotion. Some apes can walk up to smaller distances by using just the hind limbs. Humans have finally evolved the bipedal walking.



A flatworm named Planaria has very simple 'eyes' that are really just eye-spots which detect light.

EVOLUTION TREE

To understand evolution, a branching diagram or "Tree" is used to show the inferred evolution, relationships, among various biological species or other entities based upon similarities and differences in their physical and genetical characters. (see the below figure).



EVOLUTION vs PROGRESS

Evolution does not mean progress in every case. This can be proved by example of bacteria. Bacteria are the simplest and one of the oldest organisms on the earth. Their simple body design does not make them weak from any angle. Bacteria are known to survive some of the harshest climates; like craters of volcanoes and sulfur springs. Many animals have certain features which hamper even their routine activities. For example; the branch-like horns of antelope are a handicap for them. When an antelope runs for its life; there are times when its horns get entangled in branches or bushes. This results in the death of the antelope. Colourful feathers of a male peacock are very good when it comes to attract a female. But because of its

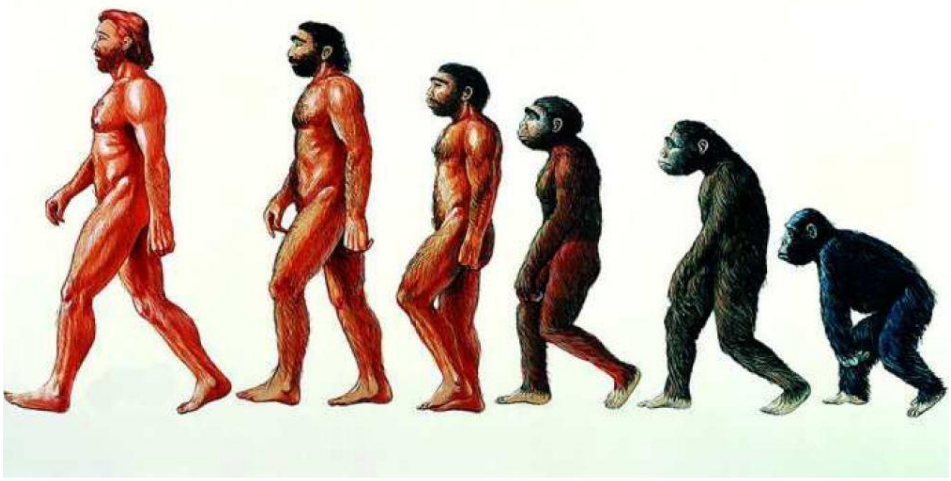
conspicuous feathers, it can be easily spotted by a predator. Because of its bulky feather it cannot fly away to safety.

HUMAN EVOLUTION

The modern humans are called Homo sapiens. Many scientific investigations have shown that the modern humans evolved in Africa. They migrated towards north; in due course of time and settled near what is known as the Mediterranean Sea. When the ice age ended, melting of ice resulted in the in water level. The humans migrated in different directions from that area. One branch went to the western Asia, then to the Indian Peninsula and finally to Australia. From the Indian Peninsula, branch migrated towards China and subsequently to the North America. From North America, the humans migrated to the South America. From the Mediterranean Sea, the second branch migrated towards Europe; where they are believed to replace the Neanderthals.

Human evolution is the evolutionary process leading up to the appearance of a modern human being. We the present human beings are also have an evolutionary history like plant and other animals. Early man like forms appeared about 7 lakhs 50 thousand years ago. The first sure fossil of our own species of man the Homosapiens, indicate that true man appeared on the earth 2 lakhs 50 thousand years ago.

Evolution of man through ages:
Homo habilus lived between 1.6 - 2.5 million years ago.
Homo erectus lived between 1 - 1.8 million years ago.
Homo sapiens neanderthalensis lived between 2,30,000 - 3,00,000 thousands years ago.
Homo sapiens (present man) appeared about 40 thousand years ago.



Human evolution

There is a great diversity in human forms and features across the planet. So that for a long time, people used to talk about human ‘races’. Skin colour used to be the commonest way of identifying the so called races. Some were called black, some white or brown. Over recent years, the evidence has become very clear. There is no biologicalbasis to the notion of human races. All humans are a single species with a common ancestor.

INTEXT QUESTIONS PAGE NO. 158

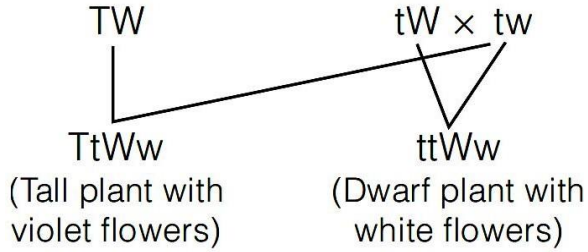
Q1. Why are human beings who look so different from each other in terms of size, colour and looks said to belong to the same species?
Ans:

All human beings, even though they have different size, colour and looks, belong to the same species because they have similar DNA sequences and have descended from same ancestors. Also, they are capable of reproducing among themselves. These variations may have arisen due to environmental factors, mutation and mixing of characters during reproduction.

Q2. In evolutionary terms, can we say which among bacteria, spiders, fish and chimpanzees have a 'better' body design? Why or why not?
Ans:
Evolution is the generation of diversity due to environmental selection. More and more body designs have emerged over time. Among bacteria, spiders, fish and chimpanzees, we can say that the chimpanzees have a better body design because of a more complex body design. Various organisms evolve in their own separate ways to give rise to the current forms and have a basic difference in their body design because of specialization of all types and tissues. The chimpanzees are best adapted to survive the present day conditions and have proper division of labour in their body, *i.e.*, they have different organs for performing different vital functions inside the body.
For example, respiratory, excretory, circulatory and nervous system, etc.

EXERCISE QUESTIONS PAGE NO. 159

Q1. A Mendelian experiment consisted of breeding tall pea plants bearing violet flowers with short pea plants bearing white flowers. The progeny all bore violet flowers, but almost half of them were short. This suggests that the genetic make-up of the tall parent can be depicted as
(a) TTWW
(b) TTww
(c) TtWW
(d) TtWw
Ans: (c) TtWW.
Parent with genotype TtWW produce two types of gametes TW and tW, while the other with genotype ttww produce only one type of gamete 'tw'



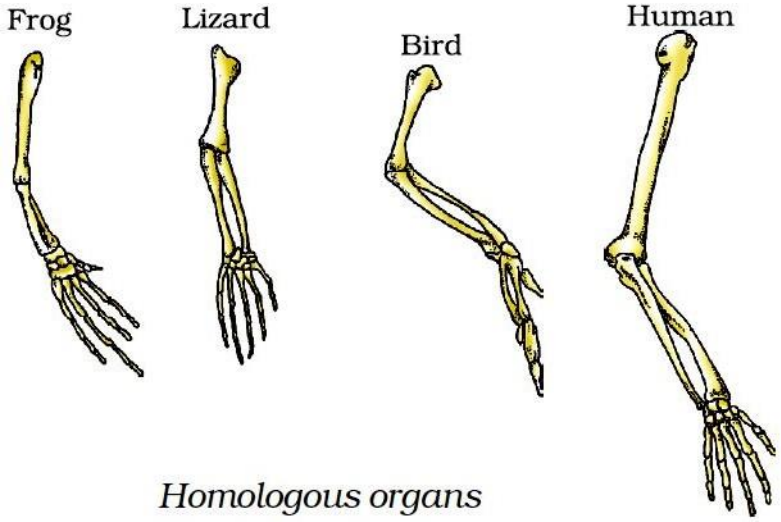
Q2. An example of homologous organs is
(a) our arm and a dog's fore-leg.
(b) our teeth and an elephant's tusks.
(c) potato and runners of grass.
(d) all of the above.
Ans: (a)
Our arms and a dog's fore-leg is the example of homologous organs.

Q3. In evolutionary terms, we have more in common with
(a) a Chinese school-boy.
(b) a chimpanzee.
(c) a spider.
(d) a bacterium.
Ans: (a)
A chinese school-boy because both have almost similar DNA.

Q4. A study found that children with light-coloured eyes are likely to have parents with light-coloured eyes. On this basis, can we say anything about whether the light eye colour trait is dominant or recessive? Why or why not?
Ans:
From this study, we cannot make any inference whether light eye colour trait is recessive or dominant, because as both the parents have light colour eye, all the children will definitely have light colour eye (though certain variations may occur.)

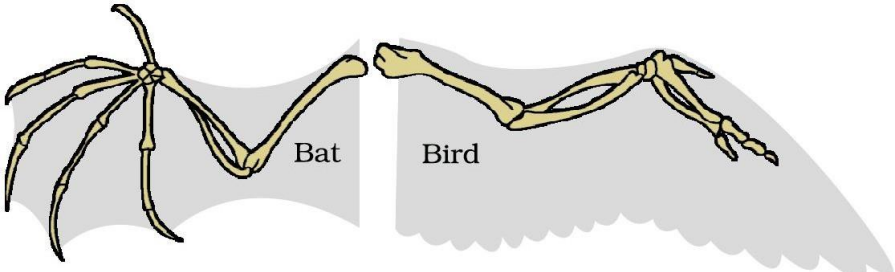
Q5. How are the areas of study – evolution and classification – interlinked?
Ans:
The study of classification of various organisms give us idea about the evolutionary history of an organisms. Organism which have certain similar characteristics are placed in one group. It can be thus concluded that the organisms placed in one group may have evolved from common ancestors and may have common evolutionary history.

Q6. Explain the terms analogous and homologous organs with examples.
Ans:
Homologous organs have the same basic structure and origin but perform different functions. For example, the forelimb of a frog, a bird and a man have the same basic design of bones, but they perform different functions (frog use them to jump, birds use them to fly and man use them to grasp).



Homologous organs

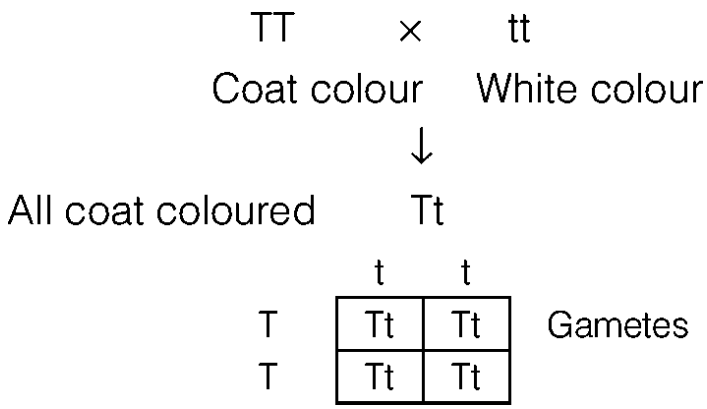
Analogous organs have different basic structure and origin but have similar appearance and perform similar functions, *e.g.*, wings of insects and wings of birds have different basic structure as the wings of insect is a fold of membrane and wings of a bird are modified forelimbs.



Analogous organs – The wing of a bat and the wing of a bird

Q7. Outline a project which aims to find the dominant coat colour in dogs.

Ans:
Coat colour 'T' is a dominant factor and white colour 't' is recessive.



Q8. Explain the importance of fossils in deciding evolutionary relationships.
Ans:
The preserved remains of animals or plants or other organisms from the distant past are called fossils.

- ☞ Fossils provide the evidence that the present animal have originated from previously existing ones through the process of continuous evolution.
- ☞ Fossils can be used to reconstruct evolutionary history of an organism. The distribution pattern of fossils shows that the ancient fossils present in the bottom rocks are simple, while the most recent fossils found in the upper strata are more highly evolved. It means fossils form and become more and more complex as we proceed from earliest to recent rocks.
- ☞ It gives us an idea of time in history when different species were formed or became extinct.
- ☞ Fossil also help to trace the evolutionary history of some animals.
- ☞ Fossils also indicate connecting link between the two groups of organisms.
- ☞ For example, *Archaeopteryx* is a connecting link between reptiles and birds.

Q9. What evidence do we have for the origin of life from inanimate matter?
Ans:
Life must have developed from the simple inorganic molecules which were present on Earth soon after it was formed. Conditions on Earth could have given rise to more complex organic molecules that were necessary for life. The first primitive organism would have arisen from further chemical synthesis. The organic molecules were assembled in an atmosphere similar to that thought to exist on early Earth over water. This was maintained at a temperature just below 100°C and sparks were passed through the mixture of gases to stimulate lightning. At the end, carbon was converted to simple compounds of carbon including amino acids which make up protien molecules. This experiment set up demonstrates that life originated from inorganic molecules.

Q10. Explain how sexual reproduction gives rise to more viable variations than asexual reproduction. How does this affect the evolution of those organisms that reproduce sexually?
Ans:
Sexual reproduction involves fusion of gametes. The offsprings show variations from their parents due to crossing over and exchange of gene segments. They are not carbon copies of their parents, due to recombination of parental genes and produce better offsprings. Also, dueto environmental factors certain favourable variations are also produced. Due to production of variations, sexually reproducing animals show very quick evolution.
Whereas in asexual reproduction, organisms raised are the exact copies of parents. They rarely show any variation.

Q11. How is the equal genetic contribution of male and female parents ensured in theprogeny?

Ans:

The male and female reproductive cells divide by meiosis to form haploid gametes. These gametes have equal genetic material. The zygote is formed by the fusion of male and female gamete, *i.e.*, it has equal genetic contribution from male and female parents. The individual is developed from the zygote these after.

Q12. Only variations that confer an advantage to an individual organism will survive in apopulation. Do you agree with this statement? Why or why not?

Ans:

All the variations in a species do not have equal chances of surviving in the environment. Depending on the nature of variations different individuals would have different kinds of advantages. Selection of variants by environmental factors forms the basis of evolutionary process. The variations which confer disadvantages to an individual organism will not survive because the environmental factor cannot support this.