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ORIGIN AND EVOLUTION OF LIFE

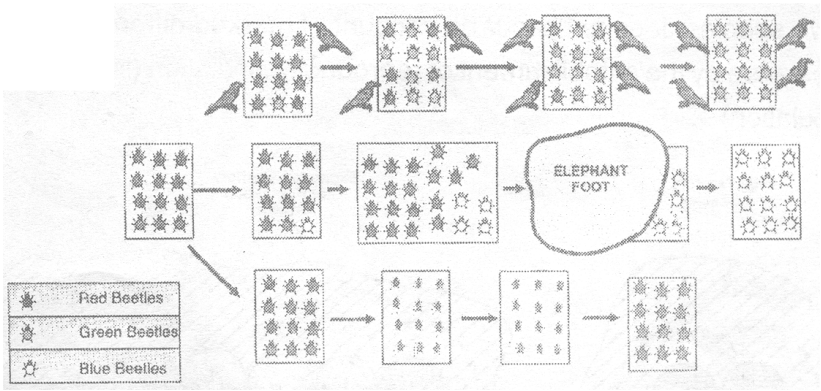
16.1 INTRODUCTION :

All living organisms have arisen through the evolutionary process and show diversity, yet some similarities exist among them. e.g. Amphibians, reptiles and mammals have limbs for locomotion in water, fishes have fins for swimming in water and birds have wings for flying.

- A close examination reveals that the limb, fins and wings are formed on the same basic structural plan.
- All such examples can be explained if we consider that the diverse groups of organisms share a common ancestor from who they have diverged and formed two different species. Such process of change in biological system is called as **evolution.**
- The Doctrine of the **Organic Evolution** state that the organisms existing at present are the descendants of much simpler ancestors.

16.2 EVOLUTION :

The term **'Evolution'** means **"unrolling or unfolding"** change from one condition to another. It means members of a species change generation after generation with environmental requirements to turn into better organized and more complex new species. The changes in the properties of population of organisms or groups of such populations over the course of generations are considered as organic evolution. It is a process of cumulative change of living populations and in the descendant populations of organisms. In other words, it is **"descent with modifications."** Evolution is a change in the genetic composition of a population. There is an inbuilt tendency of variation during reproduction, both because of errors in DNA copying and as a result of sexual reproduction.



Variations in a population –inherited and otherwise

- **Illustration.** Let us consider a group of twelve red beetles, which reproduce by sexual reproduction and lives in the bushes with green leaves. They are preyed upon by crows. As we know that more the crows eat, the fewer beetles are available to reproduce. Now let us consider various causes of variation in the population of red beetles.

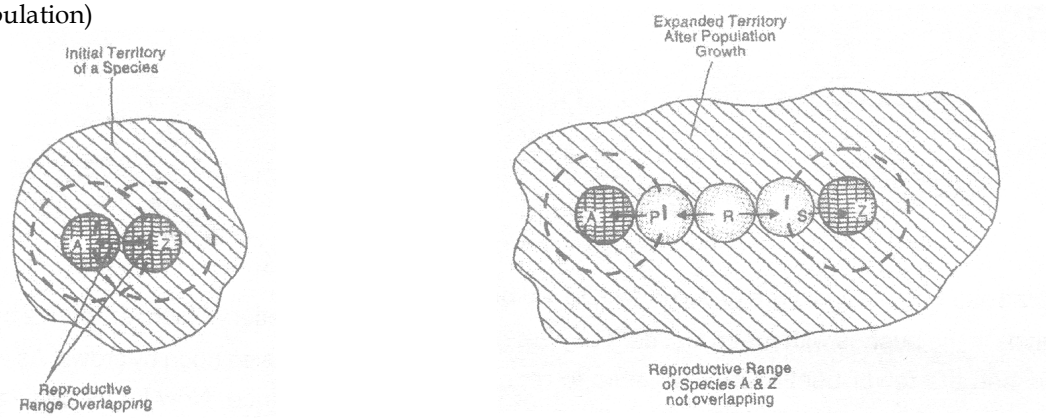
- **Case I.** The process of sexual reproduction results in the formation of few green beetles instead of red beetles. These green beetles were able to pass the colour on to its progeny, so that all it progeny beetles are green. These green beetles cannot be seen by crows so, they are not eaten. As a result, with passage of time there will be more number of green beetles than red beetles. In this case, natural selection is directing evolution in the beetle population. The natural section is exerted by the crows. The more crows there are, the more red beetles would be eaten and more the proportion of green beetles in the population would be. So, natural selection brings about improved adaptive relative between organisms and environment by favouring the reproduction and survival of those individuals which are found more suited to the given environment.

- **Case II** The process of reproduction again results in the formation of another colour variant i.e., blue colour beetles. These beetles were also able to pass the colour on to its progeny, so that all its progeny beetles are blue. These beetles can be seen by crows, so they are eaten. in initial stages there are more number of red beetles in comparison to blue beetles in a population. But at this point, an elephant comes by and stamps on the bushes where the beetles live This kills most of the beetles. But by change free beetles that have survived are mostly blue. These beetles (blue) will now slowly increase their number. In this case, the colour change gave no survival advantage. It is simply a matter of accident survival of beetles of one colour that changed the common characteristics of the resultant population. The elephant would not have caused such major havoc in the beetle population if the beetle population had been very large. This random change in the gene frequency occurring by change irrespective of its being beneficial or harmful is called genetic drift. For this reason, is small population, some unfavourable characters may also be fixed or beneficial characters may be lost.

- **Case III.** In this case, beetle population goes on increasing but, the bushes stat suffering from a plant disease. The amount of leaf material for the beetles is reduces so that average weight of adult beetles is reduced. The average weight of adult beetles decreases because of scarcity of food. After a few years, when bushes once again become healthy due to the absence of disease, then the average weight of beetles should once again increase, due to adequate availability of food.

16.3 SPECIATION :

- **Speciation is Origin of New Species :** A species comprises of several populations. Interbreeding is very frequent among the individuals of a population and is occasional among the populations of a species whereas inter breeding is absent among the individuals of different species. There is a free gene flow within the members of a population and a free gene flow could be maintained among the members of different population of a species, provide an opportunity to interbreed. But free gene flow between two species does not occur on account of marked difference in their genotype, it means new species arise by the establishment of reproductive isolation (intrinsic barrier to interbreeding of natural population)



The separation of species populations in due course of time

Consider that beetle population has become very large and has spread over a mountain range. The individual beetles feed mostly on a few nearby bushes throughout their life time. So, in this huge population of beetles, there will be sub-populations in neighborhood. The process of reproduction will occur mostly within these sub populations or rarely between two different sub-populations. So, gene flow will take place between two different sub populations. If, however between two such sub-populations a large river or a creeping glacier or a mountain cut develops then the two populations will be further isolated. The levels of gene flow will further decrease between two populations. Over generations the process of natural selection and genetic drift will further isolate two sub-populations of beetles. Now, members of these two sub-groups will be incapable of reproducing even after they meet each other.

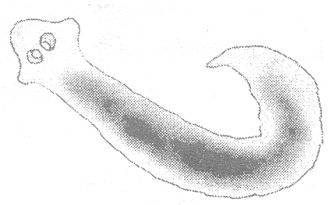
There can be a number of ways by which interbreeding between two beetles of two subgroups stop. The changes in DNA structure or number of chromosomes will make the gametes incompatible and prevent fertilization. The morphology of reproductive organs may change, which prevents compatibility and fertilization. The difference in the Behaviour of male and female will also prevent mating. The organisms may have developed different breeding periods.

16.3 (d) Evolution by Stage:

The evolution in an organism or its organs from simple to complex forms has taken place in stages. It is has taken bit by bit over generation. The evolution cannot takes place by a single DNA change. Let us take few examples.

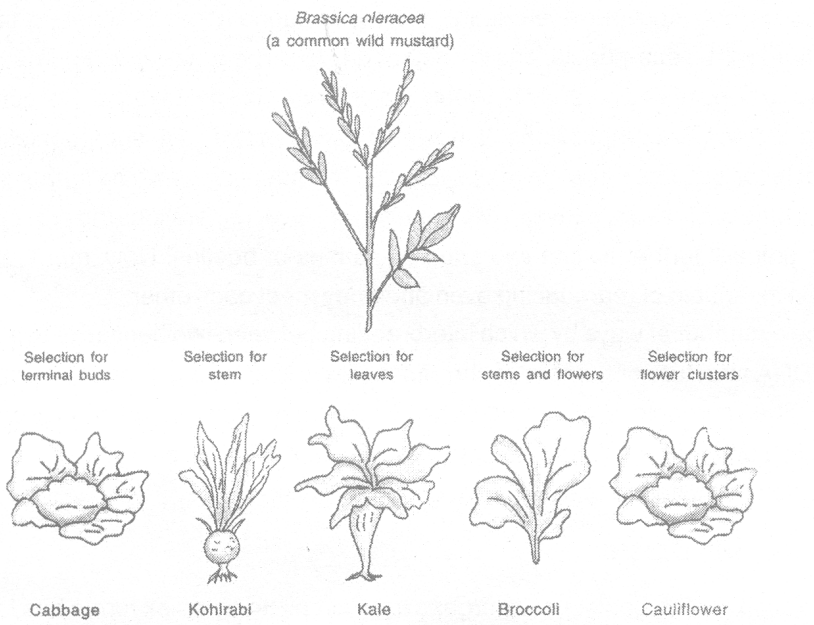
(i) Feathers were firstly developed dinosaurs, but they could not fly. Probably, it was developed to provide insulating in cold weather. Later on feathers developed in birds, where they were used for flight. This indicates that birds are closely related to reptiles (dinosaurs were reptiles). Also indicates that the character which developed for one function is late on used for different function.

(ii) Eyes for the first time developed in Planaria. Rudimentary eyes present in Planaria and just photosensitive eyespots. Simple as well as compound eyes have developed in insects and crustaceans. Eyes have also developed in Octopus and vertebrates. The structure of the eye in each of these organisms is different enough for them to have separate evolutionary origins.



Planarian has very simple eyes

(iii) Man has been taking the advantage of genetic variations for improving the qualities of domesticated plants and animals. He selected the individuals with desired characters and separates them from those which do not have such characters. The selected individual are interbred. This process is termed as artificial selection. If it is repeated for many generations it produces a new breed with desired characters.



Some crop plants produced by selective breeding

(iv) By this selections process, very dissimilar looking structures may evolve from a common ancestral design. One of the classical examples is wild cabbage plant. Humans have cultivated wild cabbage as a food plant, and generated different vegetables from it by selection even more than two thousand years ago. The various crop plants developed from wild cabbage plants are :

- **Cabbage :** it is selected for its terminal buds, where there is a very short distance between leaves.
- **Kohlrabi :** It is selected for its swollen stem position.
- **Broccoli :** It is selected for its flowers (arrested flower development) and stem.
- **Cauliflower:** it is selected for its flower cluster (sterile flowers). The other way of tracing evolutionary relationship depend on the changes in DNA during reproduction. If we compare the DNA of different species then we can directly estimate how much DNA has changed during the formation of these species.

16.4 ORIGIN OF LIFE :

Several theories have been put forward to explain the origin of life.

16.4 (a) Theory of Special Creation :

According to this theory life was created by some **Super Natural Power (God).** This theory has not evidence, hence it is a rejected theory.

16.4 (b) Theory of Spontaneous Generation :

According to this theory life is originated repeatedly from nonliving materials, automatically from time to time. This theory was supported by **Thales** and **Aristotle.**

16.4 (c) Theory of Biogenesis :

Scientist like **Redi, Lazzaro Spllanazani, Louis Pasteur** proposed and proved the biogenesis concept of **Huxley** and **Harvey** that new organism arises from pre-existing ones.

16.4 (d) Cosmozoic Theory :

It states that, life came to earth from some heavenly bodies in the form of spores and seeds.

16.4 (e) Modern Theory (Naturalistic Theory) :

Life originated upon earth by a long series of physiochemical changes which brought about a gradual evolution of first inorganic and then organic compounds (chemical evolution). It results in the formation of protoplasm. This includes -

(i) Oparin - Haldane Theory.

- It independently proposed the origin of life by chemical evolution.
- Oparin's views were later on published in his book **"The origin of life".**
- According to this theory earth was formed about 4600 million years ago. The atoms of nitrogen, hydrogen, oxygen, argon, carbon etc. formed the primitive atmosphere.
- The atmosphere was reducing because hydrogen atoms were most numerous and most reactive in the primitive atmosphere.
- As, the earth began to cool, it's matter began to condense. But still it was so hot that water could exist only in vapour form.
- Large quantities of H_2, N_2, water vapours, CH_4 and NH_3 were present, but free oxygen was not present in significant amount.
- Further fall in temperature allowed H_2O to remain in liquid form so that oceans and water bodies were formed containing large amounts of dissolved NH_3, CH_4, HCN, nitrides, carbides and various gases.
- Reacting with water and it's oxygen, simple saturated hydrocarbons such as CH_4 formed unsaturated hydrocarbons like ethylene, acetylene. Later aldehydes, ketones, alcohols and organic acids were formed.
- Abundant energy was available in the form of heat, cosmic rays and lightening. Using this energy, the organic molecules of ocean water formed complex compounds like amino acids, sugar, glycerol, fatty acids, nitrogenous organic bases etc.
- These molecules further formed large linear polymers, or macromolecules like protein, carbohydrates, and fats, the oceanic water became a rich mixture of organic compound called **"Prebiotic soup".**

(ii) Stanley Miller and H.C. Urey Experiment [Experiment for verification of prebiotic soup] :

- This experiment verified the **Oparin Haldane theory** by creating [stimulating] in their laboratory the probable conditions on the primitive earth.
- They built an apparatus of glass tubes and flasks and created as atmosphere containing H_2, CH_4, NH_3, H_2O in one chamber - energy was also supplied by electric sparks.
- The resultant mixtures were allowed to condense. Experiment was run for one week. Chemical composition of the liquid revealed **glycine, alanine** and **aspartic acid.**

- Thus biotic synthesis of organic molecules was confirmed

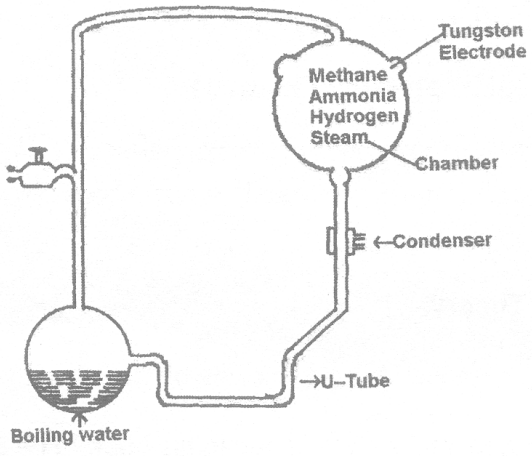


Fig : Miller's Experiment

16.5 ORGANIC EVOLUTION :

(i) Though life originated by chemical evolution on the primitive earth. It was later replaced by organic evolution.

(ii) Organic evaluation states **"Descent with modification"** i.e. present day complex living organism have evolved from earlier simpler organisms by small but gradual changes which have occurred over million of years.

(iii) Though living organisms show great diversity in size, structure, function, Behaviour etc. They also show basically similar metabolic process indicating some common ancestors.

16.6 FOSSILS :

- The plants and animals that lives in remote past have in many cases left proofs of their existence in the form of remains in the rocks. These are called as **fossible.**
- Paleontology **is the study of fossils.**
- **Leonardo-a-vinci** is called as the father of Paleontology.
- Founder of modern paleontology is **George Cuvier.**

16.6 (a) Fossils Can be of Three Different Types :

(i) Petrified : Replacement of some of the organic parts by mineral deposits is called as **petrification.**

(ii) Moulds and casts : Moulds are hardened and fossilized mud that surrounds a dead organism. Sometimes the moulds are found with petrified fossils of the organisms and then they are called as **casts.**

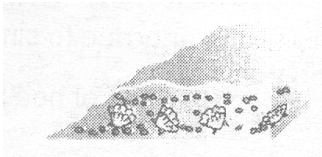
(iii) Prints : Foot prints or prints of wings, skin, leaves, stem etc. made in soft mud which subsequently became fossilized.

16.6 (b) Dating of Fossils :

It is also called as the **"clock of fossils".** It is the process of determining the age of fossils. This include the following 3 methods.

(i) Lead method (ii) Radio Carbon method (iii) Potassium-Argon method

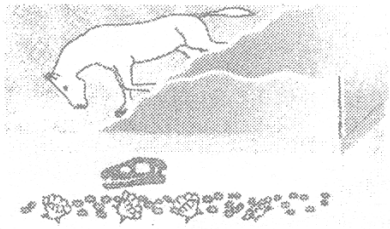
How do fossils form layer by layer ?



Let us start 100 million years ago. Some invertebrates on the sea bed die, and are burred in the sand. More sand accumulates, and sandstone forms under pressure.

Millions of years later, dinosaurs living in the are die, and their bodies, too, are buried in mud. This mud is also compressed into rock, above the rock containing the earlier invertebrate fossils.

Again millions of years later, the bodies of horse-like creatures dying in the area are fossilized in rock above these earlier rocks.



Much later, erosion by, say, water flow ears away some of the rock and exposes the horse-like fossils. As we big deeper, we will find older and older fossils.

16.7 MORPHOLOGICAL EVIDENCES :

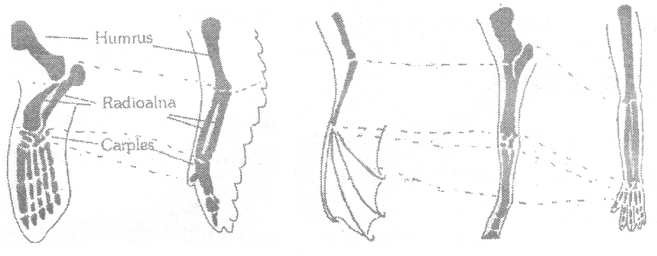
16.7 (a) Homologous Organs or Homology :

[Same structure but different function] Homology can be defined at the relationship between the structures which have similarity due to common ancestors, although these structures may show difference in their function. **.e.**

(i) fore limbs of vertebrates having pentdactyl limbs of similar origin and similar arrangement of bones, muscles etc.

(ii) Legs of different insects.

(iii) Teeth of man.

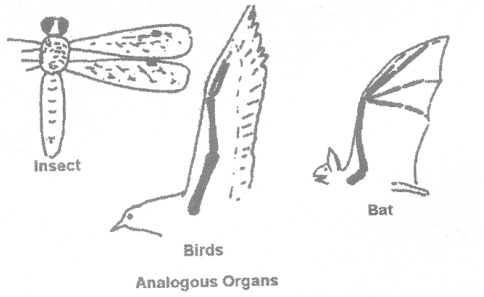


Whale **birds** **Bat** **Horse** **Man**

16.7 (b) Analogous Organs or Analogy :

[Different structure but similar function] Analogy can be defined as a relationship between structures, which though differ anatomically but would have superficial similarity due to similar function.

e.g. **(i)** Wings of insects and wings of birds (ii) Sting of bee and scorpion.
(iii) Find of fishes and flipper of whales.

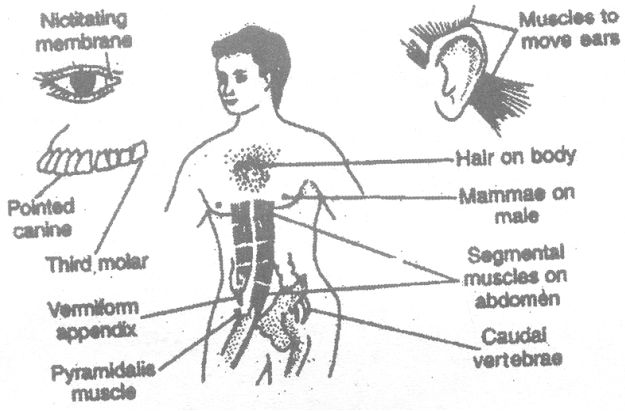


Analogous Organs

16.7 (c) Vestigial organs :

Those organs which have no longer function are known as **vestigial organs. These** organs have reduced structurally as well as functionally.

- It appears that these organs were well developed in ancestors but due to their reduced or less use they became functionless.



Vestigial organs of man

- There are many vestigial organs in human body e.g.
  (i) Vermiform appendix in man (ii) External ear in man
  (iii) Nictitating membrane (iv) Wisdom teeth

16.8 Common Ancestry and Inter-relationship :

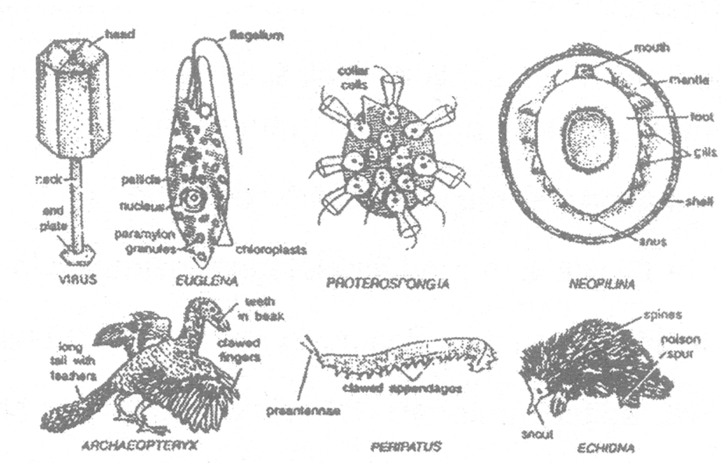
- Various organisms are interconnected.
- Their resemblance suggest a common ancestry **e.g.**
- (i) Heart of fish is two chambered
  (ii) Heart of amphibian is three chambered
  (iii) Hearts of birds and mammals are four chambered

16.9 CONNECTING LINKS:

Animals are sharply differentiated and classified into phyla and classes but there are some existing animals which represent an intermediate position between the two groups. Such organisms are called as connecting links e.g.

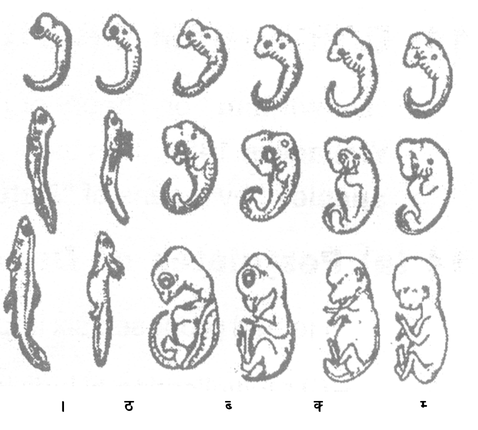
(i) Lung fish shows connection between fishes and amphibians.
(ii) Amphibian show connecting links between fishes and reptiles.

(iii) Virus shows connecting links between living and non-living.
(iv) Euglena shows connecting link between and animals.
(v) Protopongia between protozoa and porifera.



16.10 Embryological Evidences :

- Embryology can be defined as a branch of science that deals with study of development of an organisms from zygote to an adult form inside the egg or mother's womb.
- The study of embryo's form various organisms reveals similarity in the early stages of embryo development and this theory suggests that these organisms have evolved from common ancestors.
  e.g. Embryos of fish, tortoise, child, rabbits and m an show the similarity during embryo development.



थ्पह रू बवउचंतपेवद व ्जंहमे पद जीम कमअमसवचउमदज व ्अमतजमइतंजम मउइतलवे
।ण थ्पीए ठए ैसंउंदकमत ब्ण ज्वतजवपेमए क्ण बीपबाए म्ण बंसिए थ्ण भ्नउंद

16.11 PALENTOLOGICAL EVIDENCES :

- Palaentology is a branch of science that deals with the study of fossils.
- The study of fossils of some of the organisms show similarity between the two groups, e.g. Fossils of **Archaeopteryx** shows characteristics of both reptiles and birds.

16.12 EVIDENCES FROM ATAVISM (REVERSION) :

Sometimes in some individuals such characters appear which were supposed to be present in their ancestors but were lost during the course of development. This phenomenon is known as **atavism or reversion.** Atavism proves that animals developing atavistic structures have evolved from such ancestors in which these structures were fully developed **e.g.**

(i) Human baby with tail
(ii) Cervical fistula
(iii) Long and pointed canine teeth represent carnivorous accentors.
(iv) Large and thick body hair reflect our relationship with apes.
(v) Presence of extra nipples (more then two)

16.13 EVIDENCES FROM PHYSIOLOGY AND BIOCHEMISTRY :

Different organisms show similarities in physiology and biochemistry. Some clear examples are-

(i) Protoplasm : Structural and chemical composition of protoplasm is same from protozoa o mammalia.

(ii) Enzymes : Enzymes perform same functions in all animals like trypsin digests protein from Amoeba to man, amylase digests starch from porifera to mammalia.

(iii) Blood : Chordates show almost same composition of blood.

(iv) ATP: This energy rich molecule is formed for biological oxidation in all animals.

(v) Hormones : Secreted in different vertebrates perform same functions.

(vi) Hereditary material : Hereditary material is DNA in all organisms and is basic structure is same in all animals.

(vii) Cytochrome C: It is a respiratory protein situated in the mitochondria of all organisms. Physiology and biochemistry thus prove that all animals have evolved from some common ancestor.

16.14 DARWINISM OR THEORY OF NATURAL SELECTION :

"Darwinism" or Theory of natural selection was proposed jointly by **Charles Darwin** and **Alffred Wallace** in 1859. This theory was later on explained by **Charles Darwin** in his Book "**The origin of species"** by means of **"Natural Selection"** (1859)

16.14 (a) Postulates of Darwinism :

He had proposed six important postulates namely

(i) Multiplication of individual of species in a geometric proportion.

(ii) Existence of variation.

(iii) The operation of natural selection on the existing variability in order to select the best fitted variations.

(iv) Due to geometric multiplication and due to the availability of limited food and space for these individuals the struggle for existence is seen. Since the requirement of the members of the same species would be similar, such a struggle would be more intense amongst the members of the same species.

(v) **Variations :** They are rule of nature and proved to the beneficial for between existence.

(vi) **Natural selection :** Natural selection is the principle element of Darwin's theory. The principle by which the preservation of useful variations is brought about was called as **natural selection.**

16.14 (b) Merit of Darwinism :

(i) The major achievement of Darwin was to recognize one of the major factor in adaptation i.e. natural selection.

16.14 (c) Demerits of Darwinism :

(i) In Darwin's natural selection principle the death of the unit and the survival of the fittest was conceived.

(ii) Darwin's also believed that the natural selection operates on variations but he did not consider the possibility of the origin of new hereditary variations, which are really responsible for origin of species.

(iii) Darwin also did not distinguish between hereditary and environmental variations.

16.14 (d) Neo-Darwinism :

- It is a modified form of Darwinism, along with the recent researches of **Weisman, Mendel, Huxley, Gates, Devries** etc.
- They performed various experiments to remove objections against Darwin's Theory.
- **Neo - Darwinism comprises three important postulates :**

(i) Genetic variability : It means the variation that occur in the genetic constitution of an organism. They cold be of following types :

(A) Chromosomal aberrations [deletion, duplication, translocation and inversion]

(B) Chromosomal numbers [haploidy, polyploidy etc.]

(C) Gene mutation

(D) Hybridization

(ii) Natural selection : According to Neo - Darwinism the organism which is more adapted towards environment matures first and produces more progenies, as compaired to less adapted organism.

- It shows positive selection method.
- It can overcome environmental stress.
- It produces greater progeny than others

(iii) Reproductive isolation : it is the failure of interbreeding between the related groups of living organisms and is essential to prevent the dilution of differences between the genetically different species.

16.15 LAMARCKISM :

First theory of evolution was proposed by **Jean Baptiste de Lamarck** (1744 - 1829) Book **Philosophie Zoologiuie** (1809). The term **Biology** was given by **Lamarck & Treviranus.**

16.15 (a) Basic Concepts of Lamarckism :

(i) Internal Vital Forces : Some internal forces are present in all organisms. Bu the presence of these forces organisms have the tendency to increase the size of organs or entire body.

(ii) Effect of environment and new needs : Environment influences all types of organisms. Changing environment gives rise to new needs. New needs or desires produce new structures and change habits of the organism.

(iii) Use and disuse of organs : If an organ is constantly used, it would be better developed whereas disuse of organ results in its degeneration.

(vi) Inheritance of acquired characters : During the life time of an organism new characters develop due to internal vital forces, effect of environment, new needs and use and disuse of organs. These acquired characters are inherited from one generation to another. By continuous inheritance through many generations these acquired characters tend to make new generation quite different from its ancestors resulting in the formation of new species.

- **Examples in support of Lamarckism :**

(i) Long neck and large fore limbs of Giraffe.

(ii) Aquatic birds stretch their toes and developed webs.

(iii) Snakes have lost their legs.

(iv) Deer become a good runner by the development of strong limbs and streamlined body.

(v) Retractile claws of carnivorous animals.

16.16 (b) Criticism of Lamarckism :

(i) According to first concept organisms tends to increase their size but it is not a universally truth, e.g. Among angiosperms the trees seem to have been primitive and the shrubs, herbs and grasses evolved from trees but the size is reduced during evolution.

(ii) Second concept is false as we can't have a sprout wings wishing to fly like birds.

(iii) The third concept have some truth like the well developed biceps of black smith and less developed wings in flightless birds. But this concept also have many objection like the eyes of regular reader do not increase in size and power with increasing age, the constantly beating heart maintains a constant size through generations.

(iv) Forth concept is completely false because acquired characters are not inherited.

16.17 WEISMANN :

Weismann cut off tails of rats for about twenty two generations but there is no reduction in the size of the tail. On the basis of this experiment Weismann proposed the **theory of continuity of germplasm.**

16.17 (a) According to Weismann :

- Two types of mattes are present in organisms, sometoplasm and germplasm.
- Sometoplasm in somatic cells and germplasm in germinal cells.
- Sometoplasm dies with the death of an organism while germplasm is transferred into next generation.
- If any variation develops in germplasm it is inherited while if variation develops in sometoplasm it is not transmitted.

16.18 NEOLAMARCKISM :

Although Lamarckism remained controversial but some scientists gave following evidences in favour of Lamarckism they are called as **neo-lamarckians.** According to neolamarckism environment affected the inheritance of acquired characters. According to it changing environment gives rise to some physical and chemical changes in organism which effect germplasm, and these acquired characters are definitely inherited.

OBJECTIVE QUESTIONS

1. Which one of these is likely to have been absent in free form at the time of origin of life ?
(A) Oxygen (B) Hydrogen (C) Ammonia (D) Methane

2. The famous book **"Origin of Species"** was written by Charles Darwin in
(A) 1809 (B) 1859 (C) 1885 (D) 1871

3. Charles Darwin toured in a ship for five years it was
(A) Vikrant (B) Phillips (C) Alexander (D) Beagle

4. The term evolution in Biology means that
(A) fossils are old (B) life began in Sea
(C) living things constantly change (D) none of the above

5. The theory of Natural selection of Darwin to explain organic evolution was based on
(A) modification in organs through used and disuse
(B) probability of reproduction, struggle for existence and survival of the fittest
(C) Inheritance of acquired characters
(D) appearance of sudden large variations, then inheritance and survival of those having these variations

6. Homologus structures have
(A) similar origin & dissimilar function (B) dissimilar origin but similar function
(C) structurally as well as functionally similar (D) normally non-functional

7. Analogous organs are those which are
(A) structurally similar (B) functionally similar
(C) structurally as well as functionally similar (D) normally non-functional

8. The idea of "Survival of fittest" was given by
(A) Darwin (B) Herbert Spencer (C) Lamarck (D) Devries

9. Evolution is the best defined by
(A) inheritance of acquired characters (B) descent by modifications
(C) spontaneous generation (D) struggle for existence

10. Which one is not a vestigial organ in man ?
(A) Vermiform appendix (B) Plica seminualris (C) Ear muscles (D) Epiglottis

11. Who wrote the "Origin of Species" ?
(A) G.J. Mendel (B) Lamarck (C) De-Vries (D) Charles Darwin

12. When as organ is used it will develop and it is not used, it weakens to become vestigial. Who could have said this theory ?
(A) Darwin (B) De-Vries (C) Lamarck (D) Mendel

13. Fossils are
(A) fovea in the retina of vertebrate eye (B) remains of organisms presents in the rocks
(C) the fossa present in the bones (D) foramens through which nerves pass

14. An experiment to prove that organic compounds were the basis of life, was performed by
(A) Oparin (B) Miller (C) Melvin (D) Fox

15. Connecting link between Reptiles and Birds is
(A) dimetrodon (B) dodo (C) archaeopteryx (D) sphenodon

16. According to the Neo-Darwinian theory which of the following is responsible for the origin of new species?
(A) Mutations (B) Useful variations
(C) Mutations together with natural selection (D) Hybridization.

17. Fossils are dated now by
(A) stratigraphic position (B) amount of calcium residue
(C) association with other animals (D) radioactive carbon contents

18. Nucleoprotein gave most probably the first sign of
(A) life (B) amino acid (C) soil (D) sugar

19. According to one of the most accepted theory the earth atmosphere before any life has originated consisted of water vapour, hydrogen, NH_3 and

(A) methane (B) nitrogen (C) oxygen (D) carbondioxide

20. Origin of life is due to

(A) spontaneous generation (B) God's will

(C) effect of sun rays on mud (D) chemical evolution

SUBJECTIVE QUESTIONS

SHORT ANSWER TYPE QUESTIONS

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

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

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

LONG ANSWER TYPE QUESTIONS

4. Explain how sexual reproduction gives rise to more viable variations that asexual reproduction ? How does this affects the evolution of those organisms that reproduce sexually ?

5. How is the equal genetic contribution of male and female parents ensured in the progeny ?

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

ANSWERS

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	A	B	D	C	B	A	B	A	B	D
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	C	B	B	C	C	D	A	A	D