



Chapter - 7

Evolution

Artificial Selection : It is the process carried out by man to select better breeds of plants and animals.

Founders Effect : A genetic drift in human population where a population in a new settlement have different gene frequency from that of the parent population. The original drifted population said to be founder.

Gene Pool : Sum total of all the genes in a population.

Genetic Drift : Chance elimination of genes of certain traits from a population due to migration or death.

Panspermia : Units of life in the form of so called spores, which were transferred to earth from outer space, as believed by some scientists.

Saltation : Single step large mutations.

Speciation : It is the formation of new species from the pre-existing ones.

Organic (Biological) Evolution : Changes in the characteristics/features of organisms or groups of such population over a number of generations.

Homologous organs : These have same basic structure and embryonic origin but perform different functions in different species.

Example :

Plants—Thorns of *Bougainvillea* and tendrils of cucurbita

Animals—Forelimbs of whales, bat, cheetah and human

Analogous organs : These organs are different in their basic structure and embryonic origin but perform similar functions.

Example :

Animals—Wings of insects and birds

Plants—potato and sweet potato.

Human Evolution : *Ramapithecus* → *Australopithecines* → *Homo habilis*
Homo erectus → *Homo sapiens* → *Homo sapiens sapiens*.

The Theories of Origin of Life

1. Theory of Special Creation : According to this theory God has created life within 6 days.

2. Theory of Spontaneous Generation : According to this theory life originated from decaying and rotting matter like straw and mud.

3. Panspermia Theory : According to this theory life came from space in the form of spores called Panspermia.

4. Modern Theory or Oparin-Haldane Theory : According to this theory life originated upon earth spontaneously from non-living matter. First inorganic compounds then organic compounds were formed in accordance with ever changing environment conditions. This is called chemical evolution. The conditions on earth were high temperature, volcanic storms, reducing atmosphere (without free oxygen) containing methane and ammonia.

Experimental Evidence for abiogenesis (Miller's Experiment) : Stanley Miller in 1953 demonstrated in a laboratory that electric discharges can produce complex organic compounds from a mixture of methane, ammonia, water vapours and hydrogen. In this experiment he found that simple organic compounds including some amino acids are formed. In similar experiments others observed the formation of sugar, nitrogen bases, fats and pigments.

He used Spark chamber with two electrodes (to provide 75000 volts of energy for simulation of lightning), a flask for boiling (Simulation for evaporation and circulation) to a temperature of 800°C and a condenser (simulation of raining and, Haldane's Soup). He used mixture of gases like CH₄, NH₃, H₂ and water vapours to simulate conditions of primeval atmosphere.

Molecular evidences : These evidences show common ancestry based on parallel nucleic acid and amino acid sequences as well as universal genetic codes, e.g. Human and chimpanzee DNA is 98.2% same and protein Cytochrome c is similar.

Evidences from embryology : These evidences based on comparative development studies of embryo of different vertebrates based upon the observation during embryonic stage of all vertebrates.

The embryo of vertebrates develop a row of gill slit, but these gill slits are functional only in fish.

Ernest Haeckel's biogenetic law : This law states that "ontogeny (development of the embryo) recapitulates phylogeny (development of race)."

e.g. Vertebrate head at embryonic stage has vestigial gill slits like fishes.

Divergent evolution : Development of different functional structures from a common ancestral form is called divergent evolution, e.g. Development of Homologous organs.

Convergent evolution : Development of similar adaptive functional structures in unrelated groups of organisms, e.g. Development of Analogous organs.

Parallel evolution : When more than one adaptive radiation appeared to have occurred in an isolated geographical area then it is called parallel evolution.

e.g. Australian marsupials and placental mammals (corresponding)

Industrial Melanism : It is an adaptation where moth living in the industrial area developed melanin pigments to match their body colour to the tree-trunk. Before Industrialisation in England, it was observed that there were more white-winged moths on trees than dark-winged moths (melanised moths). After industrialisation (in 1920), there were more dark winged moths in some areas. After industrialisation, trees got covered by smoke. So whitewinged moth were picked up by the birds but dark-winged moths escaped and survived. Thus, industrial melanism supports the evolution by natural selection.

Adaptive radiation : The process of evolution of different species in a geographical area starting from a point and literally radiating to other habitats is called adaptive radiation. Examples : (i) Darwins finches found in Galapagos Island (ii) Marsupials of Australia.

Evolution of Plants : Unicellular Multicellular → Algae → Rhynia type plants → Cycads → Gnetales → Dicot → Monocot.

Hardy-Weingberg principle : The allele frequencies in a population are stable and is constant generation to generation. Sum total of all the allele frequencies is 1.

i.e. $P^2 + 2pq + q^2 = 1$ (Where p and q are frequency of Allele A and a)

Factors Affecting Hardy-Weinberg Equilibrium : Gene migration, Genetic drift, Mutations, Recombination, Natural Selection. Some Facts :

Brief Account of Evolution

- 2000 mya : first cellular forms of life appeared on earth
- 500 mya : invertebrates formed
- 350 mya : jawless fish evolved probably, fish with stout and strong fins evolved which can move on lands as well as go back to water.

- 320 mya : Sea weeds and few plants existed probably.
- In 1938 : Fish caught in south Africa happened to be a coelocanth which was thought to be extinct. These animals are called lobefins (evolved into first amphibians)
- 200 mya : Some of land reptiles went back into water to evolve into fish like reptiles e.g. *Ichthyosaurs*. Land reptiles were Dinosaurs. Biggest Dinosaurs *Tyrannosaurus rex* (20 feet in height, have huge dagger like teeth.)
- First mammals were like shrews—They were small sized, viviparous intelligent.

Evolution of Man :

About 15 mya, primates called *Dryopithecus* and *Ramapithecus* were existing.

Dryopithecus : Were more ape-like, live in Asia, Africa and Europe. Walk semierect, Hand & Skull were monkey like.

Ramapithecus : First man-like, walk straight on legs, not taller than 4 feet.

Australopithecines : 2 mya, lived in east african grassland, hunted with stones, ate fruits, Teeth larger.

Homo habilis : 2 mya, brain capacity 650-800cc, did not eat meat, dentition like humans.

Homo erectus : 1.5 mya, brain capacity 900cc, ate meat, walk erect.

Homo sapiens : 5 lakhs years ago., in Africa, and spread to all parts of world.

Neanderthal man : 40,000-1,00,000 years ago, brain capacity 1400cc, broad forehead, lives in caves, use hides to protect their bodies.

Questions

VSA

(1 Mark)

1. If abiotic origin of life is in progress on a planet other than earth, what should be the conditions there?
2. Name the person who proposed that population tends to increase geometrically while food production supply arithmetically.
3. Name the scientist who had also come to similar conclusion as that of Darwin about natural selection as a mechanism of evolution. Which place did he visit to come to conclusions ?

SA-I

(2 Marks)

4. Explain Oparin-Haldane theory of chemical evolution of life.
5. How do Darwin and Huxley differ regarding mechanism of evolution ?
6. How did Louis Pasteur disprove spontaneous generation theory ?
7. What are the two key concepts of Darwinian theory evolution ?

SA-II

(3 Marks)

8. (i) State the Hardy-Weinberg principle.
(ii) When there is a disturbance in the Hardy-Weinberg equilibrium, what would it result in?
(iii) According to this principle, what is the sum total of all allelic frequencies ?
9. Classify the following as examples of homology and analogy-
 - (i) Hearts of fish and crocodile
 - (ii) Wings of butterfly and birds
 - (iii) Eyes of Octopus and Mammals
 - (iv) Tubers of Potato and sweet potato
 - (v) Thorns of *Bougainvillea* and spines of *Opuntia*
 - (vi) Thorn of *Bougainvillea* and tendrils of cucurbits.
10. Stanley Miller and Harold Urey performed an experiment by recreating in the laboratory the probable conditions of the atmosphere of the primitive earth.
 - (i) What was the aim of the experiment ?
 - (ii) In what forms was the energy supplied for chemical reactions to occur ?
 - (iii) For how long was the experiment run continuously? Name two products formed.
11. 'Industrial Melanism' in peppered moth is an excellent example of 'Natural selection'. Justify the statement.

12. Fill up the blanks left in the table showing Era, period and organism.

Era	Period	Organism
Cenozoic	a	Modern man, Mammals, Birds, rise of monocot
b	Tertiary	Rise of first Primate, angiosperm
Mesozoic	c	Gingko, Gnetales
d	Jurassic	Conifers, cycads, Reptiles
Paleozoic	e	Early reptiles (extinct)
f	Silurian	Psilophyton

13. (i) In which part of the world, Neanderthal man lived ?
 (ii) What was his brain's capacity ?
 (iii) Mention the advancement which Neanderthal man showed over *Homo erectus*.

14. Figures given below are of Darwin's finches ?



Variety of beaks of Darwin's finches

- (a) Mention the specific geographical area where these were found.
 (b) Name and explain the phenomenon that has resulted in the evolution of such diverse species in the region.
 (c) How did Darwin visit the particular geographical area?
15. Give examples to show evolution by anthropogenic action.

LA

(5 Marks)

16. Is evolution a process or the end result of a process, discuss. Describe various factors that effect Hardy-Weingberg equilibrium.

Answers

VSA

(1 Mark)

1. Very high temperature, volcanic storms, Reducing atmosphere containing CH₄, NH₃, H₂ and water vapours.
2. Thomas Malthus.
3. Alfred Wallace, Malay Archipelago

SA - I

(2 Marks)

4. The first life form could have come from the pre-existing, non-living organic molecules (like RNA, Proteins, etc.) and the formation of life was preceded by chemical evolution.
5. Darwin : Darwinian variation are small, gradual and directional Hugo de Varies : Variation are sudden, random and direction less.
6. Louis Pasteur showed that in pre-sterilized flasks, life did not come from killed yeast while in another flask open to air, new organisms arose from killed yeast.
7. Branching descent and natural selection.

SA - II

(3 Marks)

8. (i) The allele frequency in a population are stable and constant from generation to generation.
(ii) Evolution. (iii) One.
9. (i) Homology (ii) Analogy
(iii) Analogy (iv) Analogy
(v) Analogy (vi) Homology
10. (i) To prove Oparin's theory of origin of life.
(ii) Electric discharge using electrodes.
(iii) One week; Amino acids and Sugar.
11. Refer Page 131, NCERT Text book of class XII.
(a) Quaternary (b) Coenozoic (c) Cretaceous
(d) Mesozoic (e) Carboniferous (f) Paleozoic

13. (i) Near Eastern and Central Asia
(ii) 1400 c.c.
(iii) More brain capacity, use of hides to cover body and burial of dead.
14. (a) Galapagos Island.
(b) Adaptive radiation—Refer page 133, NCERT book.
(c) Through sea voyage in a sail ship called H.M.S. Beagle.
15. Excess use of herbicides pesticides etc. has resulted in selection of resistant varieties in a much lesser time scale. Same is true for antibiotic or drug resistant microbes.

LA

(5 Marks)

16. Refer page 135, NCERT Text book, Biology—XII.

