Chapter-5

EVOLUTION

Evolutionary biology :

- It is the study of history of life forms on earth.
- Stellar distances are measured in light years
- What we see today is an object whose emitted light started its journey millions of year back and from trillions of kilometres away and reaching our eyes now.
- The origin of life is considered a unique event in the history of universe.

Universe

- The universe is very old – **almost 20 billion years old**.
- Huge clusters of galaxies comprise the universe.
- Galaxies contain stars and clouds of gas and dust. Considering the size of universe, earth is indeed a speck.
- The **Big Bang** theory attempts to explain to us the origin of universe. It talks of a **singular huge explosion** unimaginable in physical terms.
- The **universe expanded** and hence, the temperature came down. **Hydrogen and Helium formed sometime later**. The gases condensed **under gravitation** and formed the galaxies of the present day universe.

Earth

- In the **solar system** of the **milky way galaxy**, earth was supposed to have been formed about **4.5 billion years back**.
- There was no atmosphere on early earth.
- **Water vapour, methane , carbondioxide and ammonia** released from molten mass covered the surface.
- The UV rays from the sun broke up water into **Hydrogen and Oxygen and the lighter H_2 escaped.**
- **Oxygen combined with ammonia and methane to form water, CO2 and others**.
- The ozone layer was formed. As it cooled, the water vapor fell as rain, to fill all the depressions and form oceans.

Origin of life

- The origin of life is considered a unique event in the history of universe Life appeared **500 million years** after the formation of earth,
  i.e., almost **four billion years back**.
- There are several theories to explain the origin of life. Some of the theory are given below

1. Theory of panspermia/ cosmozoic theory

Early Greek thinkers thought units of life called **spores (Cosmozoa)** were transferred to different planets including earth. 'Panspermia' is still a favourite idea for some astronomers

2. Spontaneous generation of life/ /theory of abiogenesis

For a long time it was also believed that life came out of decaying and rotting matter like straw, mud, etc. This was the theory of spontaneous generation.

Louis Pasteur by careful experimentation demonstrated that life comes only from pre-existing life. He showed that in pre-sterilised flasks (Swann necked flask), life did not come from killed yeast while in another flask open to air, new living organisms arose from 'killed yeast'. Spontaneous generation theory was dismissed once and for all. However, this did not answer how the first life form came on earth.

3. Theory of biogenesis

According to theory living organisms are formed from pre existing life.

4. Theory of special creation

Religious literature tells us about the theory of special creation. This theory has **three connotations**.

i) All living organisms (species or types) that we see today were created as such.
ii) The diversity was always the same since creation and will be the same in future
iii) The earth is about **4000 years old**

5. Chemical evolution/Organic evolution

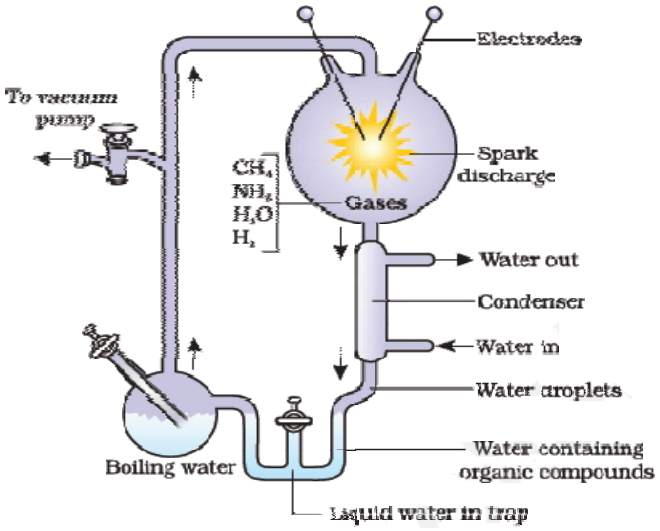
- **Oparin of Russia and Haldane of England** proposed Chemical evolution.
- According to this theory the first form of life could have come from **pre-existing non-living organic molecules (e.g. RNA, protein, etc.)** and that formation of life was **preceded by chemical evolution**,
  i.e., formation of **diverse organic molecules from inorganic constituents**.
- **The conditions on primitive earth were – high temperature, volcanic storms, reducing atmosphere containing CH_4, NH_3, etc.**

Experimental proof of chemical evolution

- ✓ **In 1953, S.L. Miller,an American scientist** created similar conditions in a laboratory scale similar to that of primitive earth.
- ✓ **He created electric discharge in a closed flask (Sparkle discharge apparatus) containing CH_4, H_2, NH_3 (2:2:1) and water vapour at 800^{0}C.**He observed formation of **amino acids**.
- ✓ In similar experiments others observed, formation of **sugars, nitrogen bases, pigment and fats**.
- **Analysis of meteorite content also revealed similar compounds indicating that similar processes are occurring elsewhere in space.** With this limited evidence, chemical evolution was more or less accepted

The **first non-cellular forms** of life could have originated **3 billion years** back. It would have been giant molecules (RNA, Protein, Polysaccharides, etc.).

- The first cellular form of life did not possibly originate till about **2000 million years ago**. These were probably single-cells. All life forms were in water environment only. This version of a biogenesis, i.e., the first form of life arose slowly through evolutionary forces from non-living molecules is accepted by majority.



Diagrammatic representation of Miller's experiment

Evidences of evolution.

Evidences Supporting evolution is given below .

1.Paleontological evidence
2.Comparative anatomy and morphology
3. Biochemical evidence
4. Embryological evidence

1. Paleontological evidence

Study of fossils is called **paleontology**. Fossils are remains of hard parts of life-forms found in rocks. They represent extinct organisms (e.g., Dinosaurs).

- Different-aged rock sediments contain fossils of different life-forms who

probably died during the formation of the particular sediment.

- Some of them appear similar to modern organisms. They represent extinct organisms (e.g., Dinosaurs).
- A study of fossils in different sedimentary layers indicates the geological period in which they existed (epochs, periods and eras).
- The study showed that life-forms varied over time and certain life forms are restricted to certain geological times pans. Hence, new forms of life have arisen at different times in the history of earth

❖ ***The age of the fossils are calculated by radioactive dating***

2. Embryological evidence

- It is proposed by **Earnst Heckel**.
- According to his observation certain features are common to all vertebrates during their **embryological stage**. It is absent in their adult (Ontogeny repeats phylogeny/ re capitulation theory)
- Eg: appearance of **vestigial gill slit** behind the head during embryological development in all vertebrates. But it is functional only in fishes
- This observation was d**isproved by Von Baer**. He noted that embryos never pass through the adult stage of other animal

3. Comparative anatomy and morphology

Comparative anatomy and morphology shows similarities and differences among organisms of today and those that existed years ago. Such similarities can be interpreted to understand **whether common ancestors were shared or not.**

a) Homologous organs

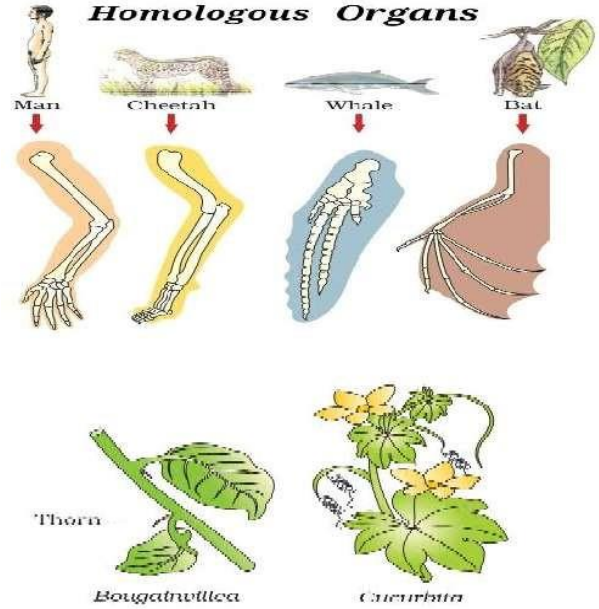
- Homologus organs are organs having **same structure** and origin **but different functions**. This phenomenon is called **homology**.
- **Homology indicates common ancestry.**
- Such organs are developed due to **divergent evolution**. **Homology indicates common ancestry**

Eg:1) whales, bats, Cheetah and human (all mammals) share similarities in the pattern of bones of forelimbs

Though these forelimbs perform different functions in these animals, they have similar anatomical structure – all of them have humerus, radius, ulna, carpals, metacarpals and phalanges in their forelimbs. Hence, in these animals, the same structure developed along different directions **due to adaptations** to **different needs**. This is **divergent evolution** and these structures are **homologous**

Eg;2)The thorn and tendrils of *Bougainvillea* and *Cucurbita* represent homology

Eg;3) Vertebrate hearts or brains



b) Analogous organ

- Organs having **same function** but different structure and origin. This phenomenon is called Analogy.
- Such organs are developed due to **Convergent evolution**.(Different structures evolving for the same function and hence having similarity)

Eg;1)Wings of butterfly and of birds look alike. They are not anatomically similar structures though they perform similar functions.

Eg;2) The eye of the octopus and of mammals

Eg;3) The flippers of Penguins and Dolphins.

Eg;4) Sweet potato (root modification) and potato (stem modification)

- So one can say that it is **the similar habitat** that has resulted in selection of similar adaptive features in **different groups** of organisms but toward the same function. It results in the **formation of analogous organs.**

3. Biochemical evidence

Similarities in proteins and genes performing a given function among diverse organisms give clues to common ancestry.

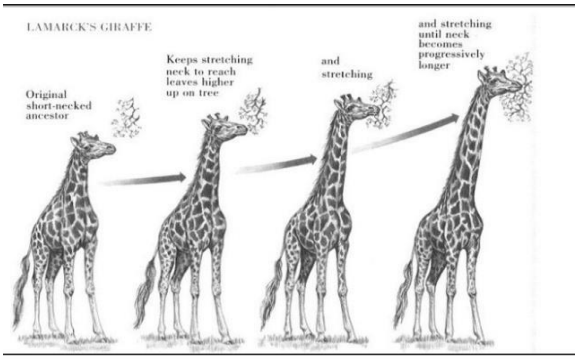
Horticulutre: The art or practice of garden cultivation and management

Lamarck

- He was a **French Naturalist**.
- **Even before Darwin,** he proposed that evolution of life forms had occurred but driven **by use and disuse of organs.**

✓ **Lamarckism consist of 4 main points**
- **New needs**
- **Use and disuse theory**
- **Inheritance of acquired character**
- **Origin of new species**

- He gave the examples of **Giraffes** who in an attempt to **forage leaves** on tall trees had to adapt by elongation of their necks. As they passed on this acquired character of elongated neck to succeeding generations, Giraffes, slowly, over the years, came to acquire long necks.
- Nobody believes this conjecture any more.



Charles Darwin

- Theory of **special creation** were strongly challenged during the **nineteenth century.**
- Based on observations made during a sea voyage in a sail ship called **H.M.S. Beagle round the world**, concluded that existing living forms share similarities to varying degrees not only among themselves but also with life forms that existed millions of years ago. Many such life forms do not exist anymore.
- There had been extinctions of different life forms in the years gone by just as new forms of life arose at different periods of history of earth.
- There has been gradual evolution of life forms. Any population has built in variation in characteristics. **Those characteristics which enable some to survive better in natural conditions (climate, food, physical factors, etc.) would outbreed others that are less-endowed to survive under suh natural conditions.**
- Another word used is **fitness of the individual or population**. The fitness, according to Darwin, refers ultimately and only to reproductive fitness. Hence, those who are better fit in an environment, leave more progeny than others. These, therefore, will survive more and hence are selected by nature.
- He called it **natural selection** and implied it as a **mechanism of evolution.**
- **The essence of Darwinian Theory about evolution is natural selection**.

- The main features of Darwinian's theory of natural selection is as follows
  1. **Over production**
  2. **Variation**
  3. **Survival of fittest/Natural selection**
  4. **Origin of new species**

- The work of **Thomas Malthus (His book name : Principles of populations)** on populations influenced Darwin

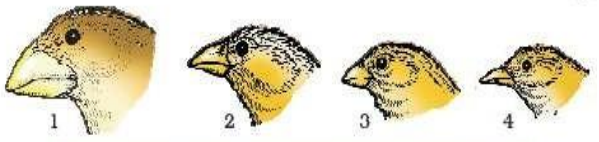
- **Alfred Wallace**, a naturalist who worked in Malay Archipelago had also come to similar conclusions around the same time

Adaptive radiation/ Divergent evolution

- The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called **adaptive radiation**.

Eg:1) : Galapogos finches

- Darwin went to Galapagos Islands. There he observed an amazing diversity of creatures. Of particular interest, small black birds later called **Darwin's Finches** amazed him.
- He realised that there were many varieties of finches in the same island. All the varieties, he conjectured, evolved on the island itself.
- From the **original seed-eating** features, many other forms with altered beaks arose, enabling them to become insectivorous and vegetarian finches.

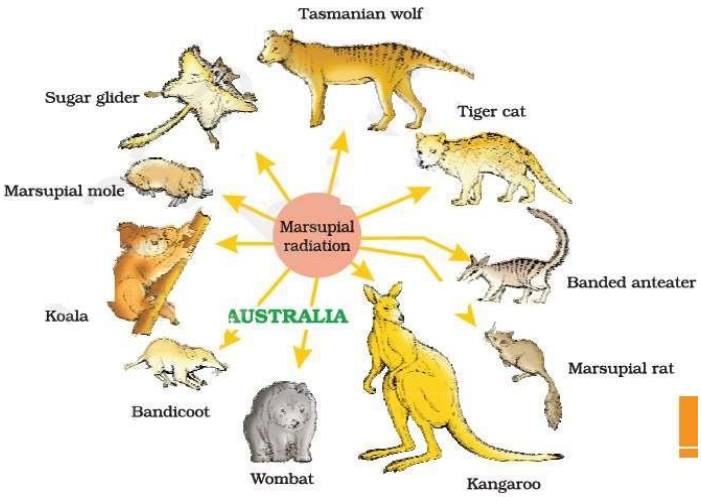


Variety of beaks of finches that Darwin found in Galapagos Island

Eg:2) Australian marsupials.

A number of marsupials, each different from the other evolved from an ancestral stock, but all within the Australian island continent.

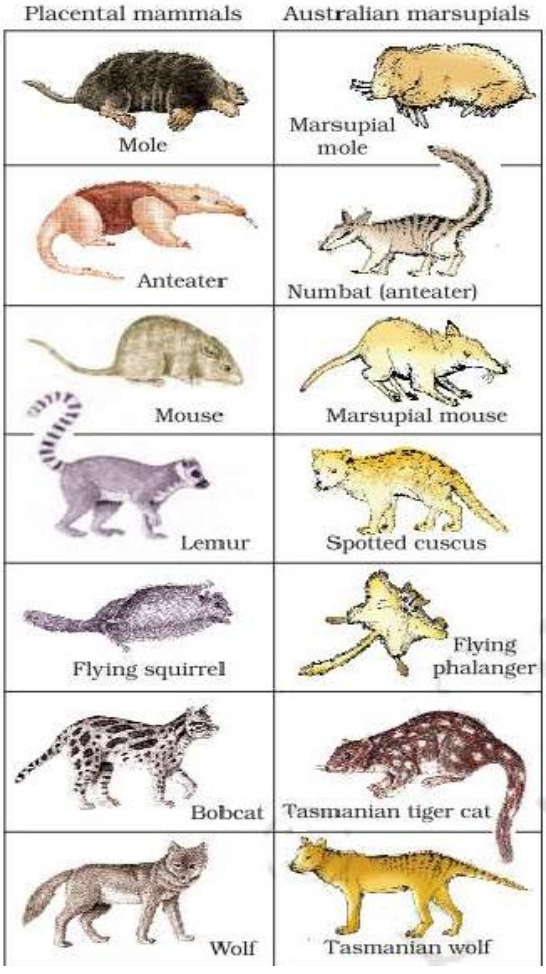
Eg:3) Placental mammals in Australia



Convergent evolution

When more than one adaptive radiation appeared to have occurred in an isolated geographical area (representing different habitats), one can call this convergent evolution

Eg: Placental mammals in Australia appears to be 'similar' to a corresponding marsupial **e.g.,Placental wolf and Tasmanian wolf**



Industrial Melanism

- Interesting observation **supporting evolution by natural selection** comes from **England**.
- In a collection of **moths** made in **1850**s, i.e., before industrialisation set in, it was observed that there were **more white-winged moths on trees than dark-winged** or melanised moths.
- However, in the collection carried out from the same area, but after industrialisation, i.e., in **1920**, there were more dark-winged moths in the same area, i.e., the proportion was reversed.
- The explanation put forth for this observation was that 'predators will spot a moth against a contrasting background'. During post industrialization period, the **tree trunks became dark due to industrial smoke and soots.** Under this condition the white-winged moth did not survive due to predators, dark-winged or melanised moth survived**.**
- **Before industrialisation set in, thick growth of almost white-coloured lichen covered the trees** - in that background the white winged moth survived but the dark-coloured moth were picked out by predators. **the lichens can be used as industrial pollution indicators**They will not grow in areas that are polluted. Hence, moths that were able tocamouflage themselves, i.e., hide in the background, survived. This understanding is supported by the fact that in areas where industrialisation did not occur e.g., in rural areas, the count of melanic moths was low.
- **This showed that in a mixed population, thosethat can better-adapt, survive and increase in population size**

Evolution by anthropogenic action

- Evolution by anthropogenic action refers to how human activities can influence the process of evolution in other species. This is a relatively recent phenomenon compared to the vast timescale of natural evolution.

  Eg:1

  The excess use of herbicides, pesticides, etc., has only resulted in selection of resistant varieties in a much lesser time scale.

  Eg:2
- microbes against which we employ antibiotics or drugs against eukaryotic organisms / cell. Hence, resistant organisms /cells are appearing in a time scale of months or years and not centuries.
- This also tells us that evolution is not a directed process in the sense of determinism. It is a stochastic process based **on chance** events in nature and chance mutation in the organisms

  - **Branching descent and natural selection are the two key concepts of Darwinian Theory of Evolution**

Types of Natural selection

- Natural selection is a process in which heritable variations enabling better survival are enabled to reproduce and leave greater number of progeny.
- A critical analysis makes us believe that variation due to mutation or variation due to recombination during gametogenesis, or due to gene flow or genetic drift results in changed frequency of genes and alleles in future generation.
- Natural selection can lead to stabilization, Directional or disruptive

a) Stabilsing selection/Normalizing selection

- Here more individuals acquire mean character value. This occurs when the environment does not change.
- Fossil evidence shows that , many species remain unchanged for long period of geological time.
- One of the most stable environment on earth is the deep sea.

Eg: Birth weight of human. The heaviest and lightest babies have the highest mortality

b) Directional selection

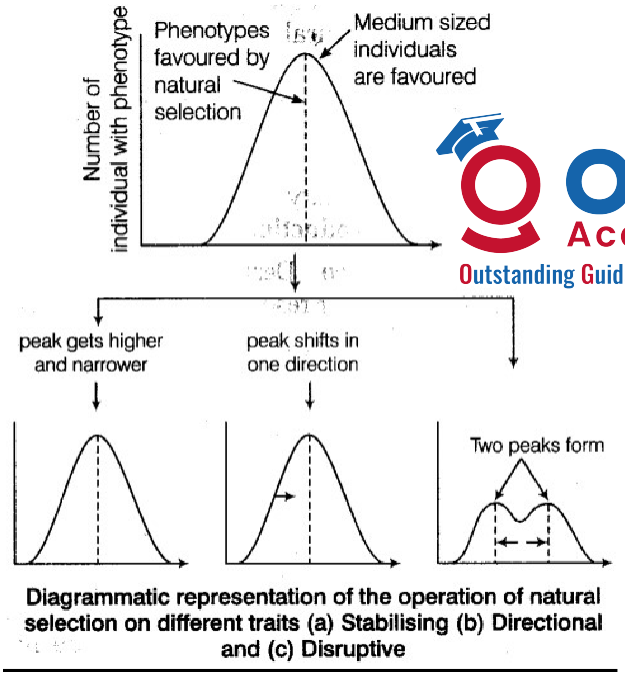
Here more individuals acquire value other than the mean character

Eg:Industrial melansim

c) Disruptive selection

Here more individuals acquire peripheral character value at both ends of the distribution curve

Eg: adaptive radiation



Diagrammatic representation of the operation of natural selection on different traits (a) Stabilising (b) Directional and (c) Disruptive

Hugo deVries

- Darwin **either ignored or kept silence** about the factors Mendel talked about.
- In the first decade of twentieth century, **Hugo DeVries** based on his work on **evening primrose** brought forth the idea of **mutations** – large difference arising **suddenly** in a population.
- He believed that it is mutation which causes evolution and not the minor variations (heritable) that Darwin talked about.
- Mutations are random and directionless while Darwinian variations are small and directional.
- Evolution for Darwin was gradual while Devries believed mutation caused speciation and hence called it **saltation (single step large mutation**).
- Studies in **population genetics**, later, brought out **some clarity on this**.

HARDY-WEINBERG PRINCIPLE

- Proposed by G.H Hardy and Wilhelm Weinerg.
- This principle says that
  'Allele frequencies in a population are stable and is constant from generation to generation'.
- **The gene pool (total gene sand their alleles in a population) remains a constant**. This is called **genetic equilibrium.**
- **Sum total of all the allelic frequencies is 1.**

P+q=1

Disturbance in genetic equilibrium, or Hardy- Weinberg equilibrium, i.e., change of frequency of alleles in a population would then be interpreted as resulting in evolution.

$(p + q)^2 = p^2 + 2pq + q^2 = 1$

Where:

p = the frequency of allele A
q = the frequency of allele a
p^2 = the frequency of individual AA
q^2 = the frequency of individual aa
2pq = the frequency of individual Aa

Five factors are known to affect Hardy Weinberg equilibrium. These are

i) Gene migration or gene flow,
ii) Genetic drift,
iii) Mutation,
iv) Genetic recombination and
v) Natural selection.

Gene migration or gene flow,

- When migration of a section of population to another place and population occurs, gene frequencies change in the original as well as in the new population.
- New genes/alleles are added to the new population and these are lost from the old population. There would be a gene flow if this gene migration, happens multiple times.

Genetic drift

- Change in gene frequency occurs by chance, it is called genetic drift.

(c) Sixteen percent of the population of Europe is Rhesus negative. Use the Hardy-Weinberg equation to calculate the percentage of this population that you would expect to be heterozygous for the Rhesus gene. Show your working. (2)

$q^2 = \frac{16}{100}$

$q = \sqrt{0.16} = 0.4$

$p = 1 - 0.4 = 0.6$

$2pq$ = heterozygotes = $2 \times 0.6 \times 0.4 = 48\ \%$

Qn. If the frequency of 'A' is 0.4 then find out the frequency of 'B' Allele and heterozygous genotype in a random mating population at equilibria

Ans:

Qn.**A gene locus has two alleles A and a. If the frequency of dominant allele A is 0.4, then the frequency of homozygous dominant, heterozygous and homozygous recessive individuals in the population is ?**

Ans:

Qn. 360 out of 1000 individuals in a population have a genotype of AA while 480 have Aa genotype. The rest 160 belong to aa. Frequency of allele A in this population is

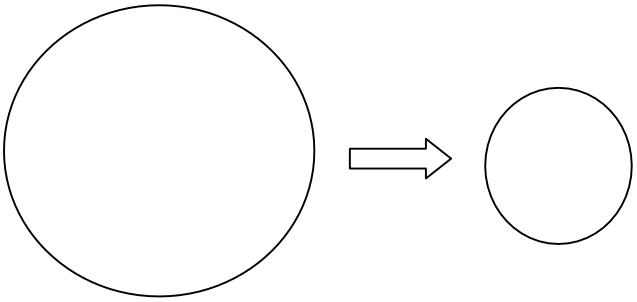
Ans:

Qn. A sampled "a" population has 36% of homozygous recessive genotype (aa). Then the frequency of allele "a" is

Ans:

The Founder Effect

- ✓ The **founder effect** is change in allele frequency that occurs when a new population is established by a very small number of individuals from a larger population.
- ✓ Here the change in allele frequency is so different in the new sample of population that they become a different species. The original drifted population becomes founders and the effect is called **founder effect**.



Feature	Darwinian theory on evolution	Hugo de Vries (Mutation Theory)
Mechanism of Evolution	Gradual change through natural selection	Sudden large mutations (saltations)
Variations	Small, heritable variations	Large, sudden mutations
Speciation	Gradual process over many generations	Immediate formation of new species

A brief account of evolution

- ✓ About **2000 million years ago** (mya) the first cellular forms of life appeared on earth
- ✓ The mechanism of how non-cellular aggregates of giant macromolecules could evolve into cells with membranous envelop is not known
- ✓ Some of these cells had the ability to release O2.
- ✓ The reaction periods could have been similar to the light reaction in photosynthesis where water is split with the help of solar energy captured and channelised by appropriate light harvesting pigments.
- ✓ Slowly single-celled organisms became multi-cellular life forms.
- ✓ By the time of **500 mya**, **invertebrates** were formed and active.
- ✓ **Jawless fish** probably evolved around **350 mya.**
- ✓ **Sea weeds and few plants** existed probably around **320 mya**.
- ✓ The first organisms that invaded land were plants. They were widespread on land when animals invaded land.
- ✓ Fish with stout and strong fins could move on land and go back to water. This was about 350 mya. In 1938, a fish caught in South Africa happened to be a **Coelacanth** which was thought to be extinct. These animals called **lobefins** evolved into the first amphibians that lived on both land and water. These were ancestors of modern day frogs and salamanders.
- ✓ The amphibians evolved into reptiles. **They lay thick shelled eggs which do not dry up in sun unlike those of amphibians.**
- ✓ In the next **200 millions** years or so, reptiles of different shapes and sizes dominated on earth. **Giant ferns**

(pteridophytes) were present but they all fell to form **coal deposits slowly.**

- ✓ Some of these land reptiles went back into water to evolve into **fish like reptiles** probably **200 mya** (**e.g. *Ichthyosaurs***).
- ✓ The land reptiles were, of course, the dinosaurs. **The biggest of them, i.e., *Tyrannosaurus rex*was about 20 feet in height and had huge fearsome dagger like teeth**.
- ✓ About **65 mya**, the dinosaurs suddenly disappeared from the earth. We do not know the true reason. **Some say climatic changes killed them. Some say most of them evolved into birds**.Small sized reptiles of that era still exist today.
- ✓ The first mammals were like **shrews**. Their fossils are small sized. Mammals were viviparous and protected their unborn young inside the mother's body. Mammals were more intelligent in sensing and avoiding danger at least.
- ✓ **When reptiles came down mammals took over this earth**.
- ✓ There were in South America mammals resembling horse, hippopotamus, bear, rabbit, etc. Due to continental drift, when South America joined North America, these animals were overridden by North American fauna. Due to the same continental drift pouched mammals of Australia survived **because of lack of competition from any other mammal.**
- ✓ Some mammals live wholly in water. **Whales, dolphins, seals and sea cows** are some examples.
- ✓ The most successful story is the evolution of man with language skills and self-consciousness.

ORIGIN AND EVOLUTION OF MAN

- ✓ About **15 mya**, primates called ***Dryopithecus and Ramapithecus***were existing. They were hairy and walked like gorillas and chimpanzees.
- ✓ *Ramapithecus*was more man-like while *Dryopithecus*was more ape-like.
- ✓ Few fossils of man-like bones have *been* discovered in **Ethiopia and Tanzania** . These revealed hominid features leading to the belief that about 3-4 mya, man-like primates walked in eastern Africa. They were probably not taller than 4 feet but walked up right.
- ✓ **Two mya, *Australopithecines***probably lived in East African grasslands. Evidence shows they **hunted with stone weapons but essentially ate fruit**. Some of the bones among the bones discovered were different. This creature was called the first human-like being the hominid and was called ***Homo habilis*.** The brain capacities were between **650-800cc**. They probably **did not eat meat.**
- ✓ Fossils discovered in **Java in 1891** revealed the next stage, i.e., *Homoerectus*about **1.5 mya.***Homo erectus* had a large brain around **900cc.***Homo erectus* probably **ate meat**.
- ✓ The **Neanderthal man** with a brain size of **1400cc lived** in near east and central Asia between 1,00,000- 40,000 years back. **They used hides to protect their body and buried their dead**.
- ✓ ***Homo sapiens* arose in Africa** and moved across continents and developed into distinct races.
- ✓ **During ice age between 75,000-10,000 years ago modern *Homo sapiens* arose.**
- ✓ Pre-historic cave art developed about 18,000 years ago. Agriculture came around 10,000 years back and human settlements started.

Ape→Drypithecus→Ramapithecus→ Australopithecus→*Homo habilis*→*Homo erectus*→ Neanderthal man→*Homo sapiens*

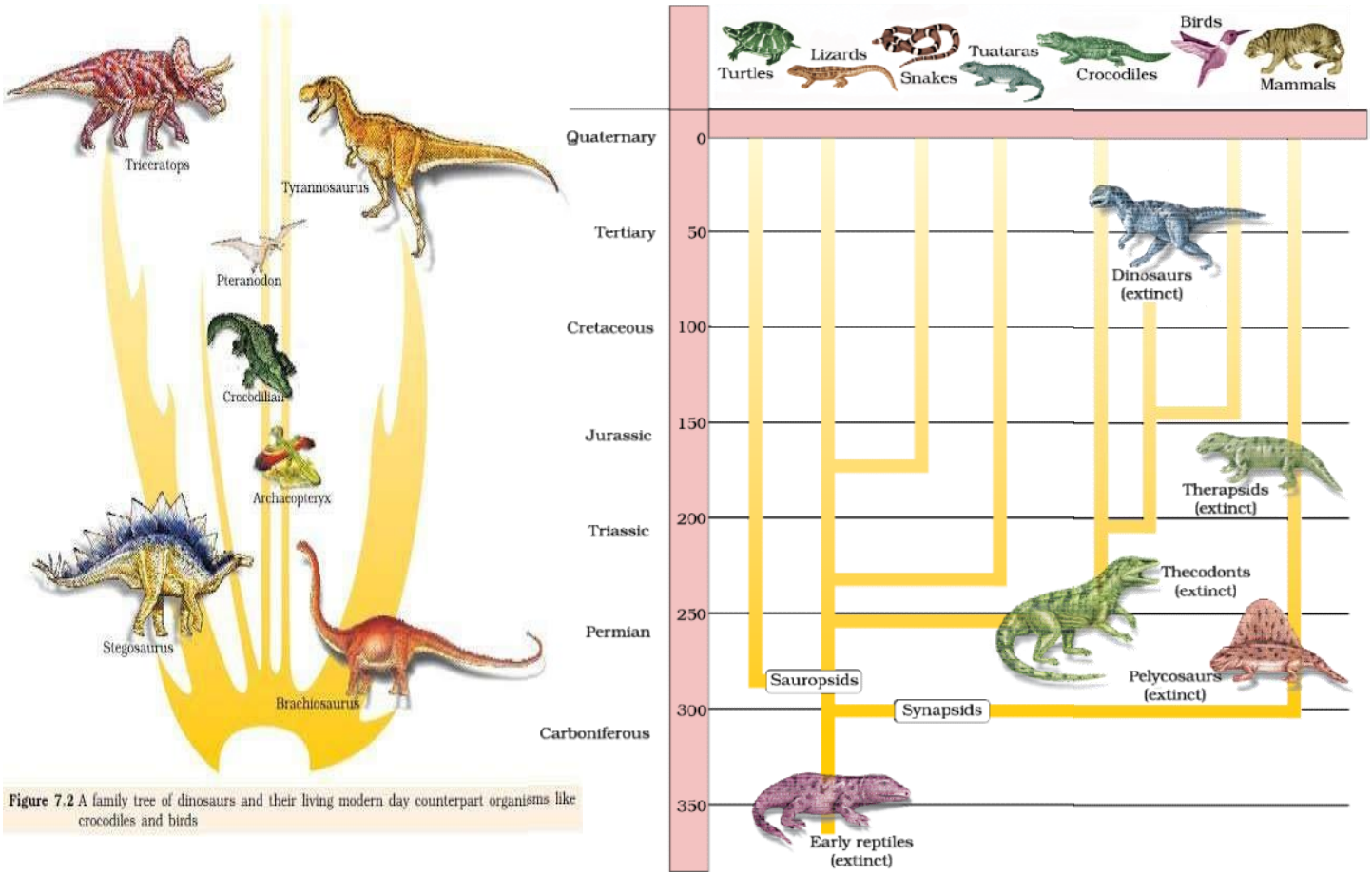
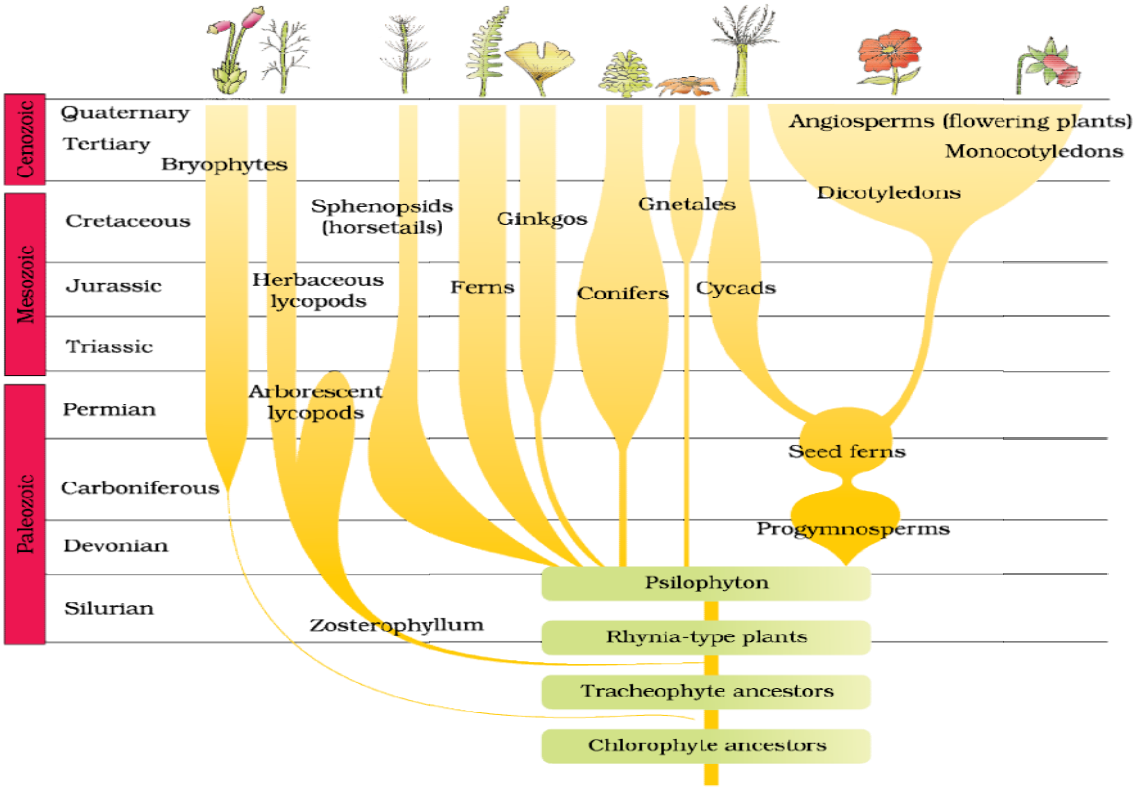
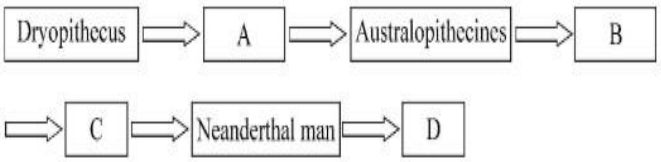


Figure 7.2 A family tree of dinosaurs and their living modern day counterpart organisms like crocodiles and birds

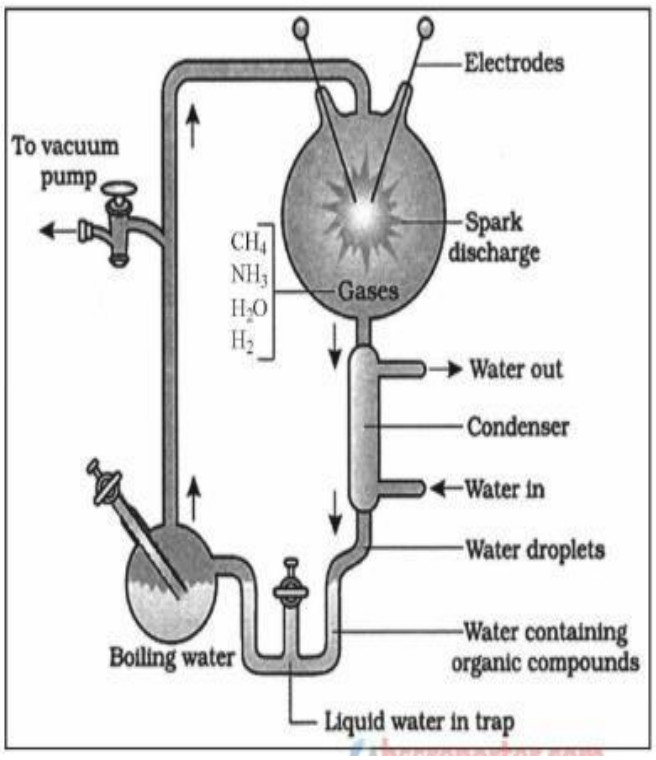


EVOLUTION

1. Differentiate between analogous organs and homologous organs and mention one example each (HSE-March-2024)(2)
2. Complete the following flow chart which shows the origin and evolution of man. (HSE-March-2024)(2)

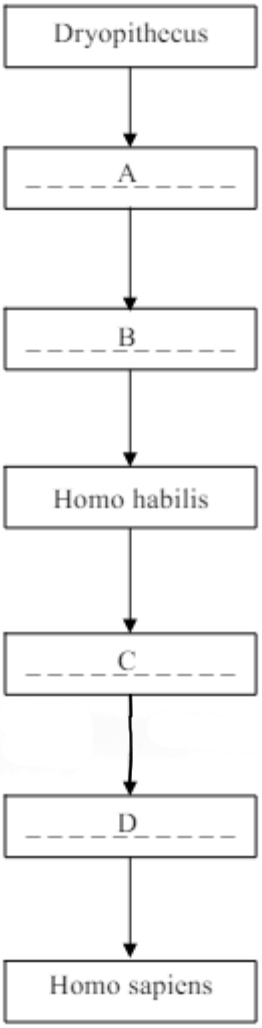


3. The process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called _____.
(HSE-JUNE-2023)(1)
4. Diagrammatic representation of an experiment is given below :
(HSE-JUNE-2023)(2)



(a) Identify the experiment.
(b) Who conducted this experiment ?
(c) Write the importance of this experiment in evolution.

5. Complete the flow-chart given below showing the evolution of man.
(HSE-JUNE-2023)(2)



6. (A) Define Analogous organs.
(B) Identify analogous organs from the given examples : (HSE-March 2023)(2)
(i) Eyes of octopus and mammals
(ii) Vertebrate hearts
(iii) Wings of butterfly and bird
(iv) Forelimbs of Cheetah and Human
Using the given terms in brackets, complete the following evolutionary stages of man : (HSE-March 2023)(2)

(Homo sapiens, Homo habilis, Homo erectus, Australopithecines)

Dryopithecus → Ramapithecus →……A…-→ ……B…… →……C…--> Neanderthal man →…….D……..

7. Allele frequencies in a population represented as p2 + 2pq + q2 = 1. Name the evolutionary principle.
(HSE- July 2022) (1) (SAY/IMP.)
8. Who proposed the 'rivet popper hypothesis' ?
(HSE- July 2022) (1) (SAY/IMP.)
9. Mention any two theories that explain origin of life.
(HSE- July 2022) (2) (SAY/IMP.)
10. Write any three factors that affect Hardy-Weinberg equilibrium.
(HSE- July 2022) (2) (SAY/IMP.)
11. Homologous organ : Divergent evolution :: Analogous organ : _____
(HSE March 2022)(1)
12. "Allele frequencies in a population are stable and is constant from generation to generation." (HSE March 2022)(3)
(a) Name the principle.
(b) Mention any four factors those affect this principle
13. Choose the correct terms from the bracket to fill in the blanks and complete the table :
(HSE March 2022)(2)

(Bigbang theory, Miller's experiment, Lamarkism, Darwinism)

	(A)		(B)
(i)	Natural selection	(a)	_____
(ii)	Chemical evolution	(b)	_____
(iii)	Origin of Universe	(c)	_____
(iv)	Use and Disuse of organs	(d)	_____

14. Identify the relationship and fill the blank (HSE August 2021)(1)
a)Homologus organs : Divergent evolution
……: Convergent evolution
15. The original seed eating finches in Galapagos island evolved into many other forms with altered beaks. Identify the evolutionary phenomenon and define it (HSE August 2021)(2)
16. a) Define Hardy-Weinberg principle
b)Mention any four factors that affect Hardy-Weinberg equilibrium
(HSE August 2021)(3)
17. Select an example for homologous organs. (HSE March 2021)(1)
(a) Eyes of octopus and mammals
(b) Forelimbs of Whales and Bats
(c) Flippers of Penguins and Dolphins
(d) Wings of Birds and Butterflies
18. Evolution of Darwin finches is an example for 'Adaptive radiation'.
(a) What is meant by 'Adaptive radiation' ?
(b) Give two other example for organisms those exhibit Adaptive radiation. (HSE March 2021)(2)
19. (a) Identify the equation related with genetic equilibrium given below :
$p^2 + 2pq + q^2 = 1$
(a) Write the factors affecting genetic equilibrium resulting in evolution.
(HSE March 2021)(3)
20. Which among the following is an example for homology ?(HSE JULY 2020)(1)
(a) The eye of the Octopus and of Mammals

(b) Sweet potato and potato

(c) Thorns and tendrils of Bougainvillea and Cucurbita

(d) Wings of butterfly and of birds

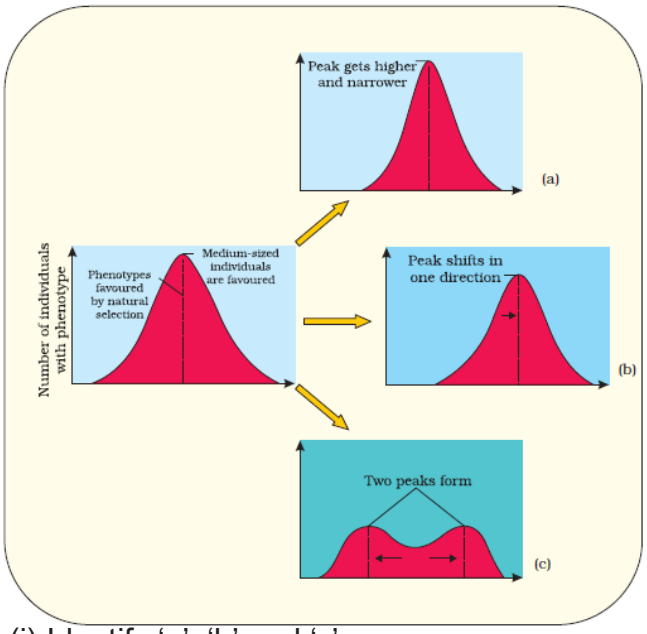
21. Define Hardy – Weinberg principle.

(b) List out any two factors affecting Hardy – Weinberg Equilibrium.

(HSE JULY 2020)(2)

22. Diagrammatic representation of the operation of natural selection on different traits isshown below :'

(HSE JULY 2020)(2)



(i) Identify 'a', 'b' and 'c'.

(ii) What is the evolutionary significance of 'b' ?

23. Which of the following human ancestor is more 'ape' like? (HSE March 2020)(1)

(a) Homo habilis

(b) Dryopithecus

(c) Australopithecines

(d) Homo erectus

24. Fill the blanks in Column A and B using appropriate terms. (HSE March 2020)(2)

Theory	Scientists
(a) Theory of natural selection	A
(b) Use and disuse of organs	B
(c) Theory of mutation	C
(d) Theory of spontaneous generation	D

25. p2 + 2pq + q2 = 1 denotes an evolutionary principle.

(HSE March 2020)(2)

(a) Name the principle.

(b) Mention any three factors affecting this.

26. Based on evolution in the geological period arrange the plants and animals in the correct order in various million years ago. Choose the appropriate organisms from the bracket.

[Reptiles, Plants, Sea-weeds, Jawless fish, Fish with stout fin]

(a) 500 m ya : _____

(b) 350 m ya : _____

(c) 320 m ya : _____

(d) 200 m ya : _____

(HSE-June-2019)(2)

27. Make a flow chart using the following terms : **(**HSE-June-2019)(2)

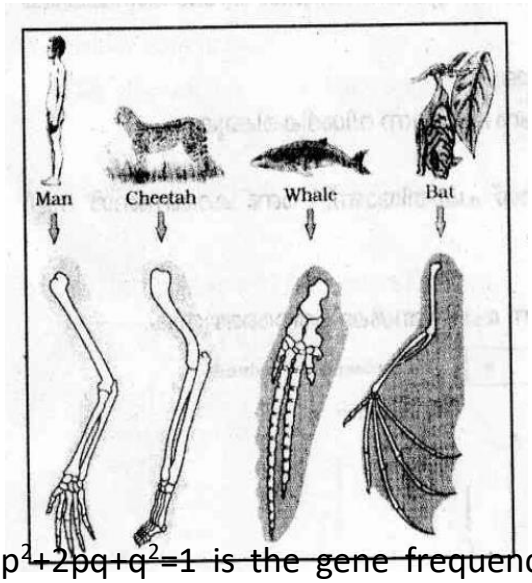
(Natural selection, Struggle for existence, Variation, Origin of species, 'Over production, Survival of the fittest]

28. Prepare a flow chart showing the evolution of modern man in the

hierarchical order of their evolution using the details given below :

Homo erectus, Homo habilis, Dryopithecus, Australopithecines, Homo sapiens, Rama pithecus, Neanderthalnman (HSE-March-2019)(2)

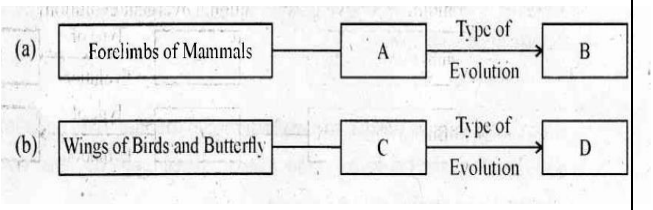
29. Some examples of evolutionary structures are given below. Classify them under suitable headings:
    (a) Forelimb of Man, Cheetah, Whale, Bat.
    (b) Wings of Butterfly, Bird.
    (c) Thorns and tendrils of Bougainvillea and cucurbita.
    (d) Vertebrate hearts or brains.
    (e) Eye of the Octopus and Mammals.
    (f)Flippers of penguins and Dolphins.
    (HSE-March-2019)(2)
30. Above homologous organs provide evidence of a particular type of evolution. (HSE-June 2018) (2)
    (a) identify the type of evolution.
    (b) What do you mean by Homologousorgans ?



31. ~~$p^2+2pq+q^2=1$ is the gene frequency~~ of the population showing an evolutionary principle
    a) Name the principle
    b) enlist any three factors affecting this principle (HSE-June 2018)(2)
32. Prepare a flow chart of evolution of man in descending order by choosing the names given below
    (HSE-June 2018) (3)

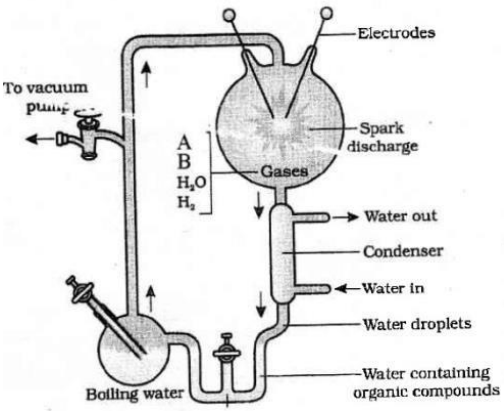
Homo sapiens, Homo erectus, Homo habilis, Austrapithecines, Ramapithicus, Neanderthal

33. Complete the boxes with the suitable words given below, :
    [Analogus, Homologus. Convergent evolution. Divergent evolution]
    (HSE-March 2018)(2)



34. Explain the factors affecting hardy-Weinberg equilibrium
    (HSE-March 2018)(2)

Diagrammatic representation of Miller experiment is given below. Answer the following questions(HSE-Model 2018)(2)



1. Name A and B
2. From those given below chose the new molecules obtained by the other scientists from similar experiment.

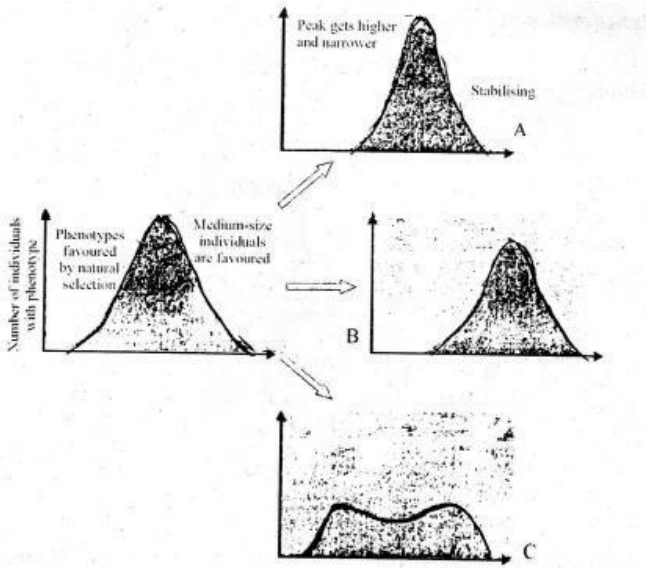
(Amino acid, sugar, fat, Alkaloid, pigment , flavanoid)

35. A collection of moths made in England during 1850, supported evolution by natural selection'
Write anote onthe process ofnatural selectionon moths influenced by industrialisation .(HSE-Model 2018)(2)

36. Arrangethe following names in ascending orderofevolution.
Homo sapiens, Ramapitrecus, Australopithecines,Homohabilis, Neanderthal, Homo erectus
(HSE-Model 2018)(3)

37. Rearrange the following in the order of their evolution period
(HSE-JUNE-2017)(1)
-Australopithecines
-Neanderthal man
-Homo sapiens
-Homo erectus
-Dryopithecus

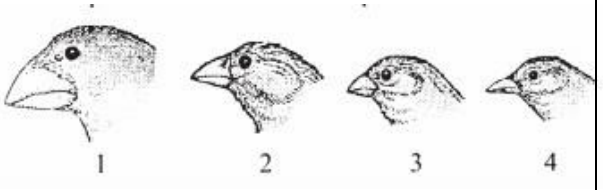
38. Diagrammatic representation of the operation of Natural selection on different trait is given. Observe it and answer the questions :
(HSE-JUNE-2017)(3)



a) What do B and C represent
b) Explain the process shown in B and C

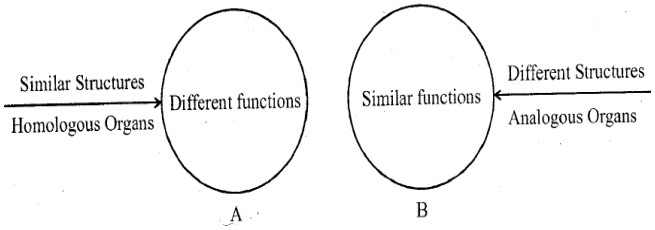
39. Z value of a frugivorousspecies are given below . which value is not applicable to continents
(HSE-March-2017)(1)
(1) 0.6 (2) 0.65 (3) 0.20 (4)0.68

40. A population of 208 people of MN blood group was sampled and it was found that 119 were MM group, 76MN blood group, 13NN group. Answer the following questions
(HSE-March-2017)(3)
a) Determine the gene frequencies of M and N alleles in the population
b) How does the above frequency affect evolution?
Or
Examine the pictures of Darwin's finches given below and answer the following questions
a) What phenomenon in evolution is represented in the picture ?
b) explain the phenomenon with the help of an additional example ?



41. Which of the following sets of gases were used in Miller's experiment?
(HSE-March-2017)(1)
(1) CH_4, NO_2, H_2O, CO_2
(2) NH_3, CH_3, H_2O, H_2
(3) H_2, CH_4, NH_3, H_2O
(4) H_2O, N, CH_4, H_2

42. Observe the diagram and answer the questions given below (HSE-June-2016) (1)



a) Identify the type of evolution in the concept diagram A and B ?

b) write example pair each for homologous and analogous organs ?

43. Statement below show features of some human fossils. Read carefully and identify the fossil (HSE-June 2016)(2)

a) Human like being with brain capacity 650-800cc

b) Lived in east and central asia with brain capacity 1400 cc

44. Which theory talks about huge explosion that lead to origin of universe ? (HSE-March 2016)(1)

45. 'Natural selction can lead to stabilisation ,directional change and disruptive change'

Explain the term stabilization, directional and disruptive change mentioned above ? (HSE-March 2016)(3)

46. Read the principle and answer the question:(HSE-March 2016)(3)

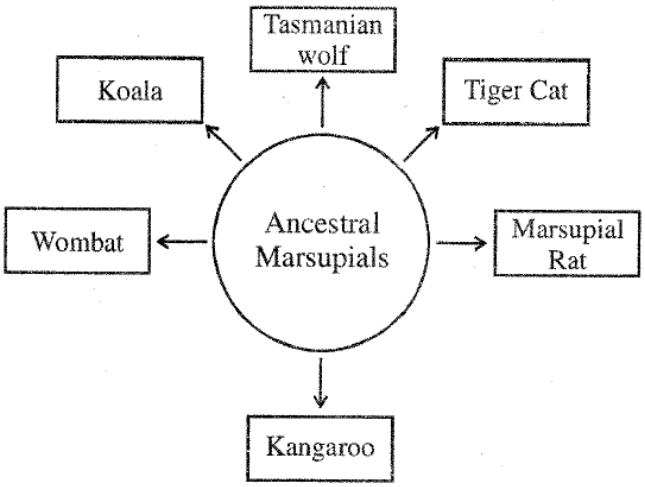
"Allele frequency in a population are stable and constant from generation to generation called genetic equilibrium"

a) Name the principle mentioned here?

b) mention any two factors affecting equilibrium ?

c) what is the significance of disturbance occur in genetic equilibrium ?

47. Observe the diagrammatic representation and answer the question (HSE-June 2015)(4)



a) Explain the phenomenon shown in the figure ?

b) How can it consider as an evidence of evolution?

c) Write any other example for this phenomenon. Explain

48. Four groups of organs are given below: Read them carefully and answer the questions (HSE-June 2015)(4)

A. Thorns of bougainvilla and Tendrils of cucurbita
B. Eyes of octopus and mammals
C. Flippers of penguin and dolphin
D. Forelimbs of cheetah and man

a) Categorize the four groups of organs as homologous and analogous organs ?

b) Based on each group of organs differentiate convergent evolution and divergent evolution ?

c) illustrate homologous and analogous organ as evidences of evolution ?

49. Match the following
(HSE-March-2015)(2)

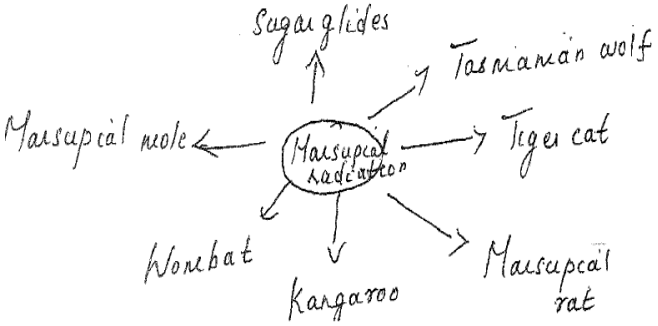
(a) Natural selection	(1) Convergent evolution
(b) Inheritance of acquired characters	(2) Genetic drift
(c) Analogous structures	(3) Charles Darwin
(d) Gene flow by chance	(4) Lamarkism

50. The above shown pictures are beaks of a particular type of bird seen in an island during Darwin's journey
(HSE-March 2015)(2)
a) identify the bird and name the island?
b) write the significance of this process in evolution ?

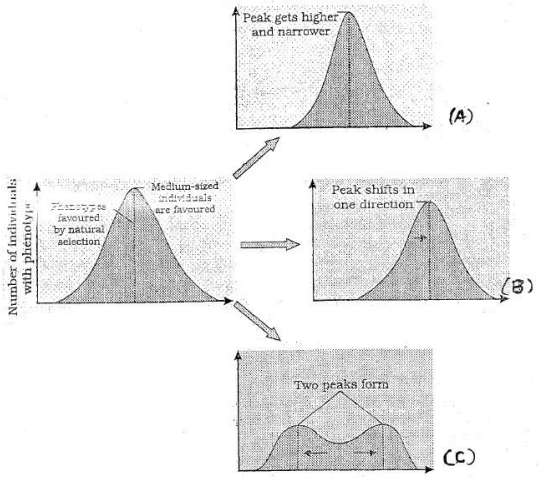
51. Arrange the following in a hierarchical manner in ascending order based on their period of evolution.
(HSE-June 2014)(1)

Homoerectus, Ramapithecus, Australopithecus, Homo sapiens, Neanderthal man

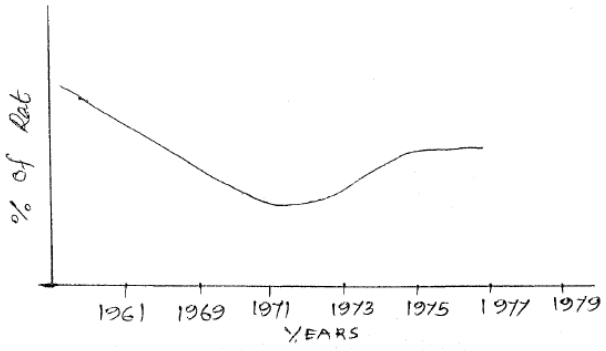
52. a)The diagram given below shows a particular type of evolutionary process in Australian marsupials. Identify the evolutionary phenomenon and comment on
b)Give another example for such type of evolutionary process and explain ?(HSE-June 2014)(3)



53. Given below is the diagrammatic representation of operation of natural selection on different traits
a) Identify the type of natural selection A,B, and C with explanation of each.
b) Define Hardy-weinberg principle?
(HSE-March 2014)(4)



54. A specific rat population was controlled for about decade by a poison. After population decline for about 10 years, the rat population was increased and stabilized.



Resistance to poison is governed by a dominant autosomal gene 'R'. In 1975 majority of the resistant animals are heterozygous at this locus (Rr)

a) What was the major genotype of rat population before 1961

A)RR B)Rr C)rr

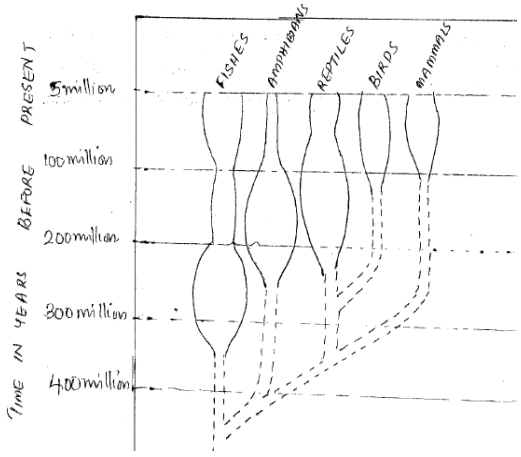
D)R is absent as it produced by a mutation

b) What explanation you give for the development of resistance against poison in these rats ?

c) "This illustration can be used to explain theory of evolution" Substantiate(HSE May-2013)(2)

55. The diagram shows how the number of species in different group of vertebrates has changed between 400 million years ago and 5 million years ago. The wider a block indicate the more species there are

(HSE-May 2013)(3)



a) Which is the species found most at 200 million years ago ?

b) Birds are most close relative to which group of organism?

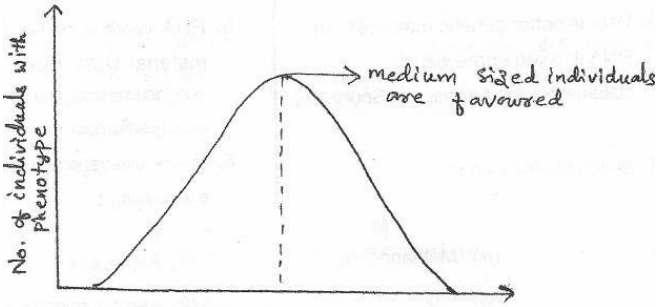
c) what is the trend observed in the evolution of amphibians?

56. Arrange the following examples under two heads viz-Homologous organ and analogous organ(HSE-March 2013)(2)

- Fore limb of whale and bat
- Wings of butterfly and bat
- Heart of man and cheetah
- Eye of octopus and mammal

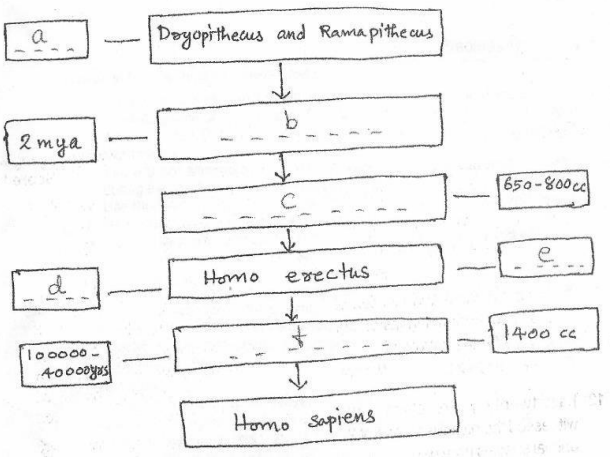
57. Theory of chemical evolution is a version of theory of abiogenesis. Analyze the statement.
(HSE March -2013)(2)

58. Diagrammatic representation of the operation of the natural selection in a population is given (june-2012)(1)



Redraw the diagram when nature select large sized and small sized individuals

59. Complete the flow chart showing the evolution of man using age, name and brain capacities of fossils
(June-2012)(3)



60. Note the relationship between the first pair and complete second pair (March-2012)(1)

a) Natural selection : Darwin
Inheritance of acquired character
:.....

b) Heart of vertebrate : Homologous organ
flipper of penguin and Dolphin
:.....

61. A collection of peppered moths made in England during different period is given below (March-2012)(1.5)

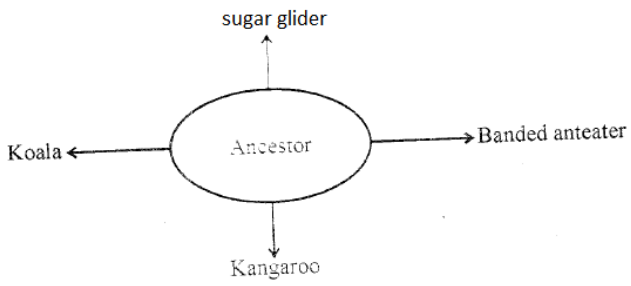
Types of moths	Years		
	1850	1920	1980
White winged moth	1200	305	1150
Dark winged moth	315	1100	302

a) What is your observation ?

b) Name the evolutionary process behind this process?

c) write the reason for decreased number of white winged moth in 1920 ?

62. An evolutionary process occurred in the evolution of marsupial mammals in Australia is given below ? (March-2012)(1.5)



a) Name this evolutionary process?

b) suggest another example for this phenomenon ?

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