Evolution

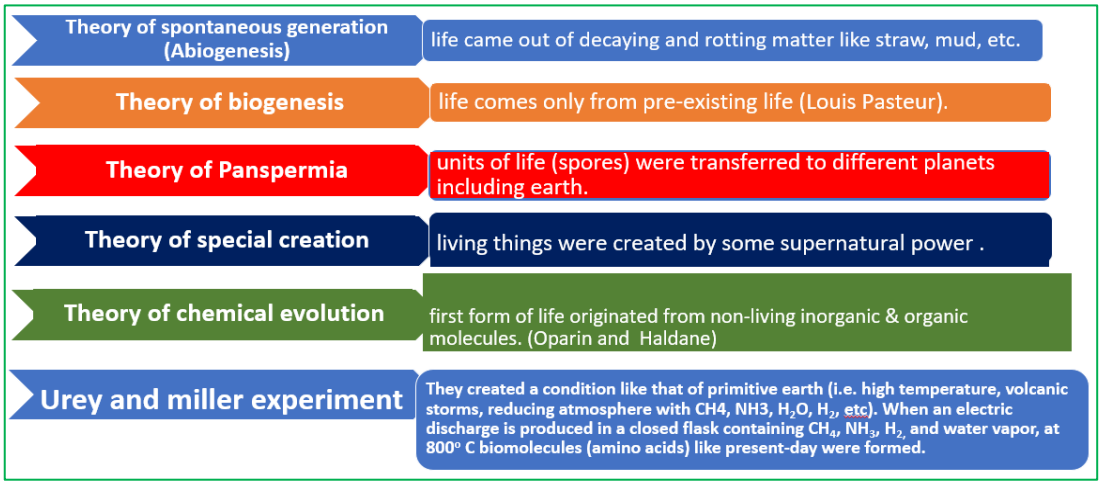
key words

Evolution	This is a process of gradual change that takes place over many generations, during which species of animals, plants, or insects slowly change some of their physical characteristics
Big bang theory	Explains the origin of the earth
Homologous organs	organs having the same basic structure but different functions.
Analogous organs	organs having different basic structures but having similar appearances and performing similar functions.
Adaptive radiation	This is an evolutionary process of organisms that are grouped into a wide variety of types adapted to specialized modes of life.
branching descent	The process of developing a new species from a single common descendant is known as branching descent
Natural selection	The process through which populations of living organisms adapt and change
Saltation	Single-step large mutation
mya	Million years ago

ORIGIN OF LIFE (Big Bang Theory)

The single huge explosion resulted in the origin of the universe about 20 billion years ago. The earth was formed about 4.5 billion years ago. There was no atmosphere on early Earth. Water vapor, CH_4, CO_2 & NH_3 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 is combined with ammonia and methane to form water, CO_2, etc. The ozone layer was formed. As it cooled, the water vapor fell as rain and formed oceans. Life appeared four billion years back.

THEORIES OF THE ORIGIN OF LIFE



EVIDENCE FOR EVOLUTION

1- **Fossils**: Fossils are remnants of life forms found in rocks (earth's crust). The study of fossils is known as Palaeontology.
Fossils provide evidence for phylogeny (evolutionary history or race history). E.g., Horse evolution, Used to study the connecting link between two groups of organisms (E.g. Archaeopteryx), to study extinct animals (E.g. Dinosaurs), to study geological periods by analyzing fossils in different sedimentary rock layers.

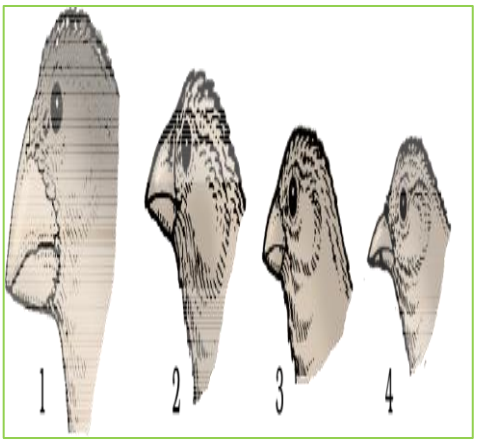
2- **Morphological & Anatomical evidence**

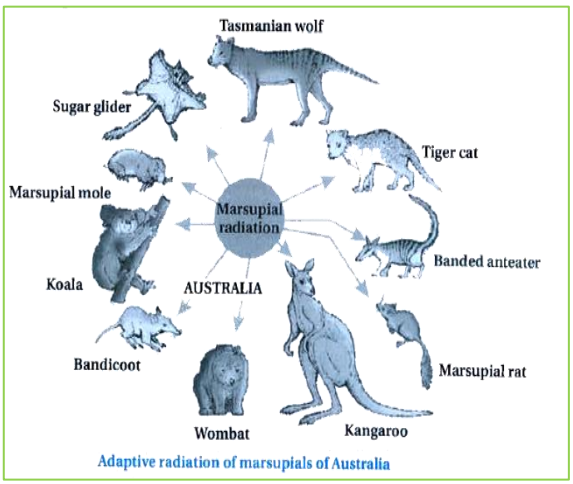
Homologous organs	These organs have similar structures and origins but different functions. The origin of homologous organs is due to Divergent evolution. Homology indicates common ancestry.	The human hand, Whale's flippers Bat's wing & Cheetah's foot humerus, radius, ulna, carpals, metacarpals & phalanges

		Thorns of Bougainvillea and tendrils of Cucurbita
Analogous organs	These organs have similar functions but different structures & origins. The origin of analogous organs is due to Convergent evolution. It is the evolution by which unrelated species become more similar to survive and adapt to similar environmental conditions.	Wings of insects and birds Eyes of Octopus and mammals Flipper of Penguins and Dolphins. The trachea of insects and lungs of vertebrates Sweet potato & Potato

3- Adaptive radiation

This is the evolution of different species from an ancestor in a geographical area starting from a point. It is a type of divergent evolution. E.g., Darwin's finches in Galapagos Islands,
Australian marsupials (Marsupial radiation), Placental mammals in Australia
When more than one adaptive radiation appears in an isolated geographical area, it results in convergent evolution. E.g., Australian Marsupials and Placental mammals





Adaptive radiation of marsupials of Australia

4- Embryological evidences

Proposed by Ernst Haeckel

- He observed that all vertebrate embryos have some common features that are absent in adults.
- For E.g., all vertebrate embryos develop vestigial gill slits just behind the head. But it is functional only in fish and not found in other adult vertebrates.

5- Biochemical evidence

Organisms show similarities in proteins, genes, another biomolecules & metabolism. It indicates common ancestry.

Lamarckism (Theory of Inheritance of Acquired characters)

- It is proposed by Lamarck.
- It states that the evolution of life forms occurred by the inheritance of acquired characters.

Acquired characters are developed by the use & disuse of organs.

Evolution by use of organs	Evolution by disuse
The long neck of a giraffe	Disappearance of limbs in snakes

Darwinism

(Theory of Natural selection)

- Proposed by Charles Darwin.
- It was based on observations during a sea voyage is sailing sail ship called H.M.S. Beagle.
- Alfred Wallace (who worked in the Malay Archipelago) had also come to similar conclusions.
- Work of Thomas Malthus on populations influenced Darwin.
- Darwinism is based on 2 key concepts: Branching descent and Natural selection

Natural selection is based on the following facts:

Heritable minor variations	Limited natural resources	Struggle for existence	Survival of the fittest

Darwin Finches- Darwin observed many varieties of finches on the same island. All varieties of finches had evolved from original seed-eating finches. There was an alternation in beaks enabling some to become insectivorous and some vegetarian.

MUTATION

- Hugo de Vries proposed the Mutation Theory of evolution.
- He conducted experiments in evening primrose

HARDY-WEINBERG PRINCIPLE

- It states that allele frequencies in a population are stable and are constant from generation to generation in the absence of disturbing factors.
- the allelic frequency in a population will remain constant from one generation to the next in the absence of disturbing factors.

Equation:

- Sum total of all the allelic frequencies = 1

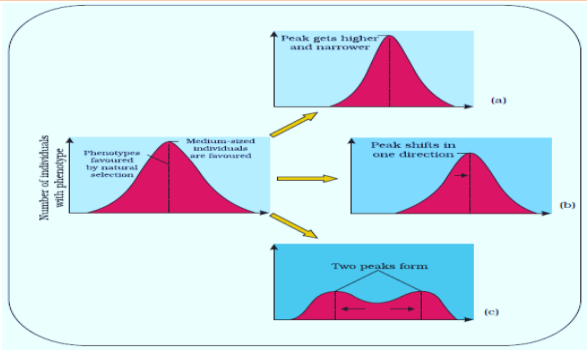
$$p2 + 2pq + q2 = 1$$

Factors affecting Hardy-Weinberg equilibrium

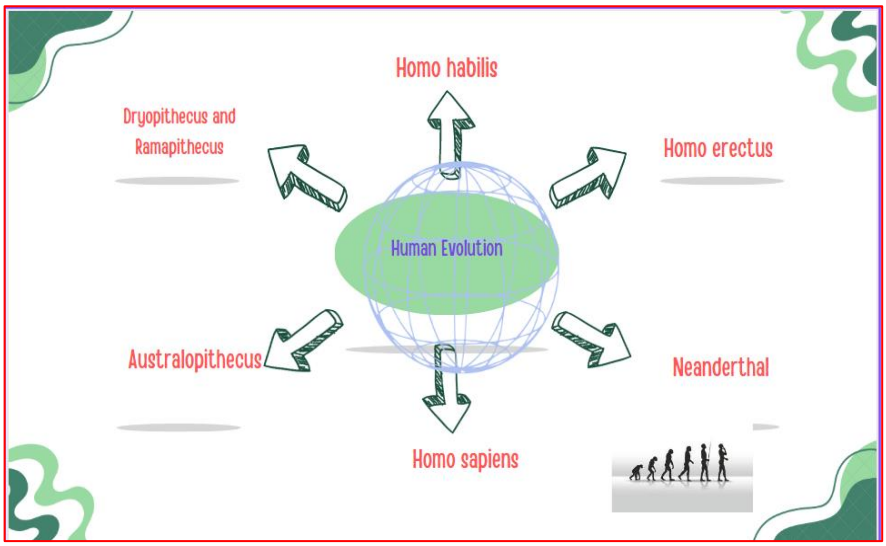
Gene Migration	Genetic drift	Mutation	Genetic recombination	Natural selection

Types of Natural selection:

Stabilizing selection	More individuals acquire mean character value.
Directional selection	Individuals of one extreme are more favoured.
Disruptive selection	It breaks a homogenous population into many different forms. Individuals of both extremes are more favoured



ORIGIN AND EVOLUTION OF MAN



Dryopithecus and Ramapithecus	About 15 mya, primates (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.
Australopithecus	About two mya, Australopithecines probably lived in East African grasslands. They hunted with stone weapons and essentially ate the fruit.
Homo habilis	Brain capacities - 650-800cc., They probably did not eat meat.
Homo erectus	About 1.5 mya, Homo erectus arose. Brain capacity- 900cc.Homo erectus probably ate meat.
Neanderthal man	Brain size- 1400cc. They used hides to protect their body and buried their dead.
Homo sapiens or modern man	Arose in Africa. During the ice age between 75,000-10,000 years ago, Homo sapiens arose.
Prehistoric cave art developed about 18,000 years ago. Evidence -Bhimbetka rock shelter in Raisen district of Madhya Pradesh. Agriculture came around 10,000 years back and human settlements started.	

IMPORTANT QUESTIONS

Very Short Answer Type Questions/ MCQ

1- Who used pre-sterilized flasks and yeast to disprove the theory of abiogenesis-

a- Pasteur
b- Darwin
c- Lamarck
d- Morgan
Ans: Louis Pasteur

2- What was the observation of Ernst Heckel regarding evidence of the origin of life?

a- Embryological support for evolution
b- Finches
c- Homology
d- Convergent evolution
Ans: A

3- What is the basis of the Darwinian theory of evolution?

a- Natural selection
b- Branching Descent
c- Mutation
d- Both a and b
Ans: D

4- (p+q)2 = p2 + 2pq + q2 = 1 represents an equation used in
a- Population genetics
b- Cytogenetics
c- bioinformatics
d- Anthropology
Answer: A

5- The abiogenesis theory of origin supports
a- spontaneous generation
b- origin of life from blue-green algae
c- origin of life is due to pre-existing organisms
d-0020 organic evolution is due to chemical reactions.
Ans: A

6- What postulate was given by Oparin and Haldane about the origin of life?

Ans: The first form of life could have come from pre-existing non-living organic molecules. evolution.

7- **Which scientist come to the same conclusion as Darwin?**
Ans: Alfred Wallace (worked in the Malay Archipelago)

8- **Give two examples of adaptive radiation.**
And: Darwin finches, Australian marsupials.

9- **What is speciation? What is the main cause of speciation according to Hugo DeVries?**
Ans: speciation is the formation of new species.
The mutation is the main cause of speciation.

10- **Would you consider the wings of a butterfly and a bat as homologous or analogous?**
Ans: It is an example of the analogous organ as the basic structure is different but the function is the same.

11- **State the significance of biochemical similarities among diverse organisms in evolution.**
Ans: Similarities in biochemicals like DNA, help in deriving the line of evolution. Organisms with more similar DNA sequences show the same ancestor.

12- **What do you mean by panspermia?**
Ans: Early Greek thinkers thought units of life called spores were transferred to different planets including Earth.

Short answer types of questions

1- **What is the founder effect? Mention its importance,**
Ans: When a population gets separated from the existing population it becomes the founder of a new population. This is known as the founder effect. The founder effect affects the genetic diversity of a population.

2- **Explain convergent evolution by giving a suitable example.**
Ans: when two different species with different ancestors tend to develop similar traits during the course of evolution Examples: Some of the marsupials of Australia resemble placental mammals that live in similar habitats to other continents.

3- **Illustrate contribution of the Lamarck to the understanding of evolution?**
Ans: he proposed the theory of Inheritance of Acquired characters, Use, and disuse of organs.

4- **identify the following pairs as homologous of analogous organs:**
(i)Sweet potato and potato (ii) Eye of Octopus and eye of mammals.
(iii)Thorns of Bougainvillea and tendrils of Cucurbits (iv)Forelimbs of bat and whale.
Ans: (i) and (ii) Analogous organs, (iii) and (iv) Homologous organs.

5- **Compare the brain capacity of Homo habilis and Homo erectus.**
Ans: Homo habilis- 650-800cc, Homo erectus- 900cc

Long Answer Type Question

1- **Describe the three different ways by which natural selection can affect the frequency of a heritable trait in a population. Provide a diagram also in support of your answer.**
Ans- The three different ways by which natural selection can affect the frequency of a heritable trait in a population are
(i)Stabilisation It results in a greater number of individuals acquiring the mean character value, i.e., variation is much reduced.
(ii) Directional change It results in more individuals acquiring value other than mean character value, i.e., the peak shift towards one direction.
(iii) Disruption In this more individuals acquire peripheral character value at both ends of the distribution curve, i.e., two peaks are formed at the periphery
Fig, 7.8 page 136, NCERT

2- **Diagrammatic representation of Miller's experiment and label any ten parts.**
Ans: fig 7.1, page 128 NCERT

3- **Which law states that the sum of allelic frequencies in a population is constant? Write its mathematical formula used to derive allelic frequency. List the five factors that influence the law.**
Ans: The law is Hardy-Weinberg equilibrium.
Mathematical equation- P2 + 2pq + q 2= 1 where p and q are allelic frequencies

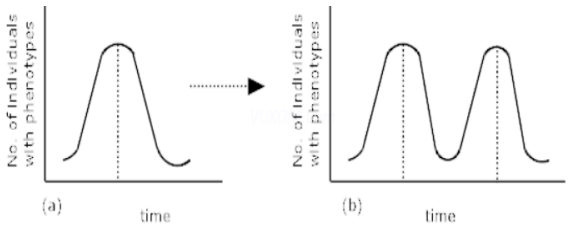
Factors affecting are - Genetic drift, Mutation, Gene flow, Genetic Recombination, Natural Selection

4- Study the figures given below & answer the following question.

i) Under the influence of which type of natural selection would graph (a) become like (b).

ii) What could be the likely reason for new variations arising in a population.

iii) Who suggested natural selection as the mechanism of evolution?



Ans: (i) Disruptive & elective.

(ii) Individuals at the extremes contribute more offspring compared to those in the centre & produce two peaks in the distribution of a trait.

(iii) Charles Darwin

5- Explain the evolution of human beings in a sequential manner.

Ans: Dryopithecus and Ramapithecus - 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.

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