



Evolution

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- ❖ **Evolutionary biology** is the study of history of life forms on earth
- ❖ **Stellar distances** are measured in light years
- ❖ **Big ban explosion** (Singular huge explosion)

↓ Resulted in

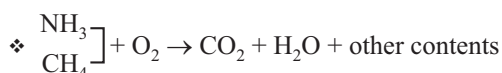
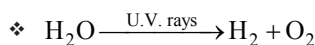
Parameters	Origin of Universe <small>leading to</small> → Origin of Earth	
Time scale	20 billion years ago	4.5 billion years ago
Feature	Comprises cluster of galaxies (stars, clouds of gas, dust)	Occurred in solar system of Milkyway galaxy

Events after expansion of universe:

- ❖ Temperature declined
- ❖ $H_2 + H_3$ formed
- ❖ Gases condensed
- ❖ Galaxies formed

Events after expansion of universe:

- ❖ No atmosphere existed on early earth.
- ❖ Water vapours, methane, carbon dioxide and ammonia released from molten mass covered the surface.



Origin of Life

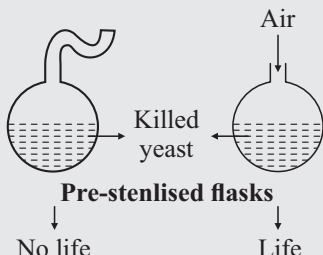
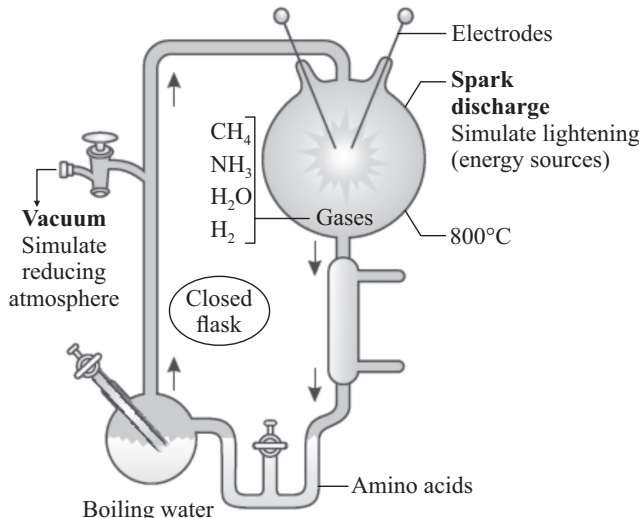
- ❖ Life appeared 500 million years after the formation of earth, i.e., almost 4 billion years ago.

- ❖ **First non-cellular forms of life**
 - Probably originated **3 billion years ago**
 - Would have possibly originated from giant molecules (RNA, protein, polysaccharides, etc.)
 - These capsules **reproduced** their molecules
- ❖ **First cellular forms of life**
 - Possibly originated **2 million years ago**
 - Arose in aquatic environment

- ❖ This version of Biogenesis i.e., the first form of life arose slowly through evolutionary forces from non-living molecules is accepted by majority.

Theories for Origin of Life

Theory	Proponents	Significance
Special creation	Conventional religious literature	<ul style="list-style-type: none">❖ All living organisms that we see today were created❖ Diversity was always the same since creation and will be the same in future also❖ Earth is 4000 years old
Cosmozoic Panspermia	Early Greek thinkers, Astronomers	<ul style="list-style-type: none">❖ Life came from outerspace❖ Units of life called spores were transferred to different planets including earth
Spontaneous generation	—	<ul style="list-style-type: none">❖ Life came out from decaying and rotting matter like straw, mud etc.❖ Disapproved by Louis Pasteur

Theory of Biogenesis	<p>Louis Pasteur</p> 	<ul style="list-style-type: none">❖ Life comes only from pre-existing life❖ He showed that in pre-sterilised flasks, life did not come from “killed yeast”
<p>Oparin-Haldane hypothesis or Chemical Evolution</p> 		
<ul style="list-style-type: none">❖ Formation of life was preceded by chemical evolution i.e., formation of diverse organic molecules from inorganic constituents.❖ First form of life could have come from pre-existing non-living organic molecules (e.g. RNA, proteins, etc.)❖ This hypothesis was proved by Miller's experiment, 1953, S.L. Miller (American scientist)❖ In similar experiments, other observed formation of sugars, nitrogen bases, pigments and fats.		

Evidences of Evolution

1. Palaeontological evidences (Evidences from fossils):

- + Fossils are remains of hard parts of life forms found in rocks.
- + Age of fossils is determined by radioactive-dating method.
- + Fossils of different life forms in different sedimentary layers indicates the geological period in which they existed (epochs, periods, eras).


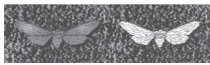
2. Embryological evidences:

- + Proposed by **Ernst Haeckel**.
- + Based upon the observations of certain features during embryonic stage common to all vertebrates that are absent in adults e.g., embryos of all vertebrates develop a row of vestigial gill slits functional only in fish and not found in other adult vertebrates.
- + It was disproved by **Karl Ernst von Baer**. He noted that embryos never pass through the adult stages of other animals.

3. Morphological and anatomical evidences

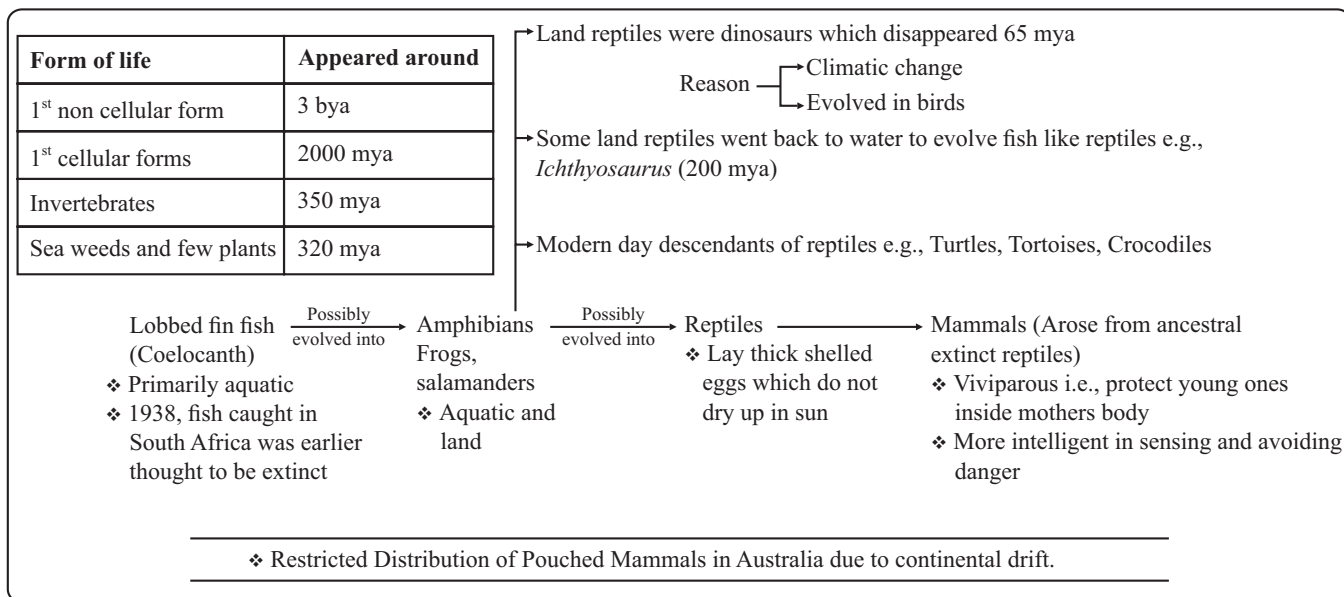
Parameters	Homologous organs	Analogous organs
Common ancestry	Yes	No
Anatomical structures	Similar but developed along different directions due to adaptations to different needs.	Not similar but resulted in selection of similar adaptive features in different groups of organisms, thus, evolving for the same function.
Function performed	Different	Similar
Type of evolution	Divergent	Convergent

Examples of Evolution by Anthropogenic Action

Parameters	Before industrialization (1850s)	After industrialization (1920s)
Figure		
Tree trunks	White, covered by lichens	Became dark due to deposition of soot and smoke
White moths	More	Less
Melanised moths	Less	White winged moths
Predators feed on	Melanised moths	White winged moths

- ❖ Lichens do not grow in polluted area (**pollution indicator**).
- ❖ **Agent of natural selection:** Predator/birds.
- ❖ Moths that were able to camouflage themselves (i.e., hide in the background) survived **but no variant is completely wiped out**

A Brief Account of Evolution



Origin and Evolution of Man

Human ancestors	Years back	Cranial capacity	Specific features
<i>Dryopithecus</i> } <i>Ramapithecus</i> }	15 mya	100 cc 150-300 cc	More ape-like } Hair and walked like More man-like } Gorillas and chimpanzees
<i>Australopithecus</i>	2 mya	500 cc	❖ Few fossils of man-like bones have been discovered in Ethiopia and Tanzania. ❖ 3-4 mya, man-like primates walked in East African grasslands. ❖ They were probably not taller than 4 feet but walked upright . ❖ Evidence shows they hunted with stone weapons but essentially ate fruit .
<i>Homo habilis</i>	–	650 cc – 800 cc	❖ First human-like being, the homind ❖ Probably did not eat meat
<i>Homo erectus</i>	1.5 mya	900 cc	❖ Fossils discovered in Java in 1891 ❖ Probably ate meat
Neanderthal man	1,00,000-40,000 years back	1400 cc	❖ Lived in near East and Central Asia ❖ Used hides to protect their body and buried their dead
<i>Homo sapiens</i>	75,000-10,000 years ago (ice age)	–	❖ Arose in Africa and moved across continents and developed into distinct races