



Evolution

Introduction

Evolution

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

↓ Resulted in

Parameters	Origin of Universe	leading to → Origin of Earth
Time scale	20 billion years ago	4.5 billion years ago
Feature	Comprises cluster of galaxies (starts, clouds of gas, dust)	Occurred in solar system of Milky Way galaxy

Events after expansion of universe:

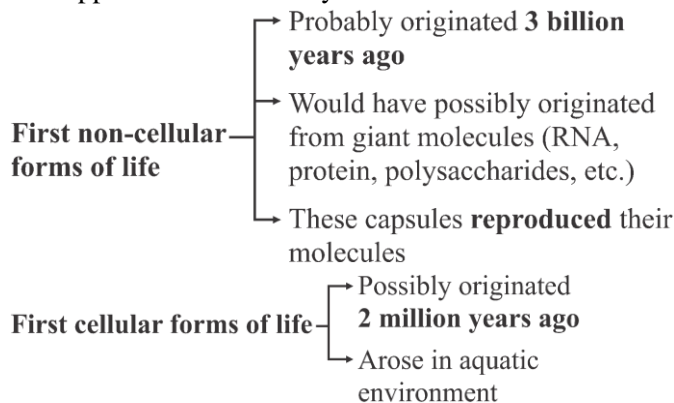
- Temperature declined
- $H_2 + He$ formed
- Gases condensed
- Galaxies formed

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.
- $H_2O \xrightarrow{\text{U.V. rays}} H_2 + O_2$
- $\left. \begin{array}{l} NH_3 \\ CH_4 \end{array} \right\} + O_2 \rightarrow CO_2 + H_2O + \text{other contents}$

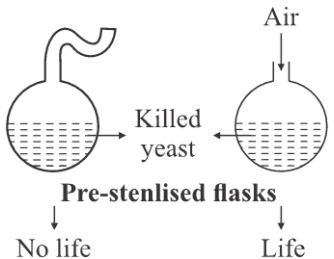
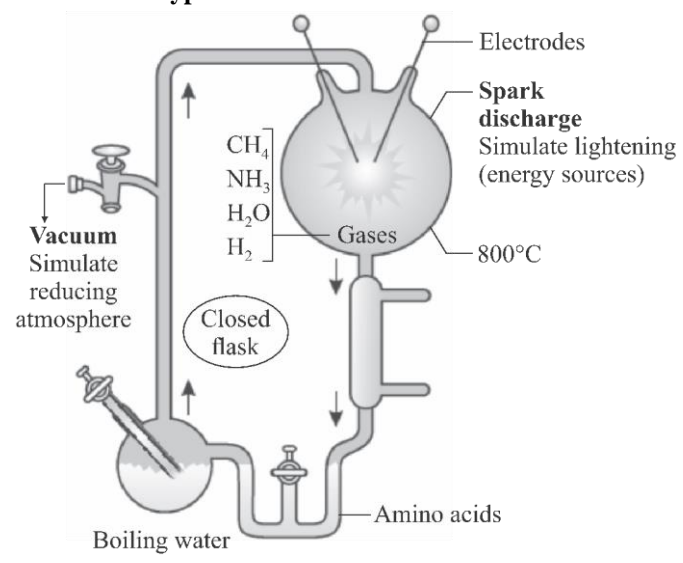
Origin of Life:

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



- 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 outer space 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	Louis Pasteur 	<ul style="list-style-type: none"> Life comes only from preexisting life He showed that in pre-sterilised flasks, life did not come from “killed yeast”
Oparin-Haldane hypothesis or Chemical Evolution 		<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 forms 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 the radioactive-dating method.
- Fossils of different life forms in different sedimentary layers indicate 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

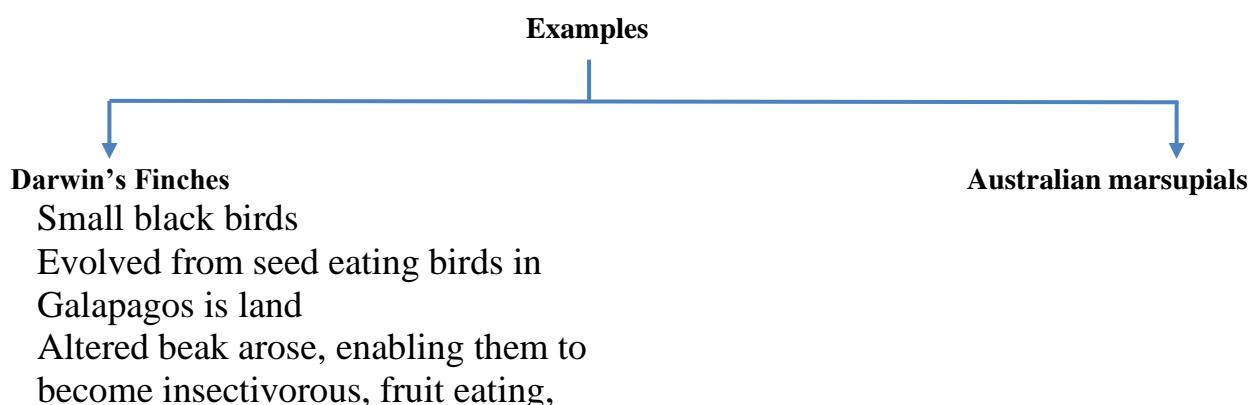
Examples of Evolution by Anthropogenic Action

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 areas (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

Adaptive Variation:

Process of evolution of different species in a given geographical area starting from a point & radiation to other areas of habitat.



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

Ex. : Placental mammals, Australian marsupials.

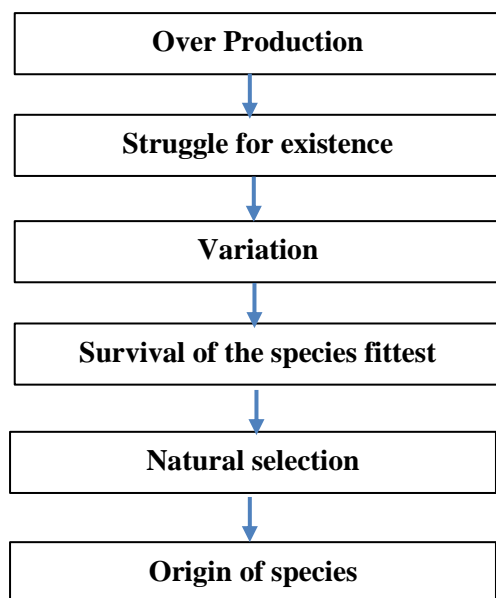
Theories for the evolution of life forms:

Lamarck's theory of evolution

- Given by French naturalist Lamarck
- **Main postulates:**
 - Use and disuse of organs
 - Inheritance of acquired characters
- Example : Long neck in Giraffes is attributed to stretching the neck while foraging leaves on tall trees.

Darwin's theory of natural selection:

- Darwin visited Galapagos island, Ship – H.M.S. Beagle
- He got influenced by Thomas Malthus Darwin's postulates:



Two key concepts of Darwin theory :

- Natural selection
- Branching descent -The process of developing a new species from a single common descent
- Alfred Wallace, a naturalist who worked in Malay Archipelago had also come to similar conclusions as Charles Darwin around the same time.
- Artificial selection : By intensive breeding programme, man has created breeds that differ from other breeds (e.g., dogs)

Mutation theory:

- Given by Hugo de Vries in first decade of 20th century.
- Worked on evening primrose
- New species originate as a result of mutations which are single step (saltation) large, random and direction variations arising suddenly in a population.

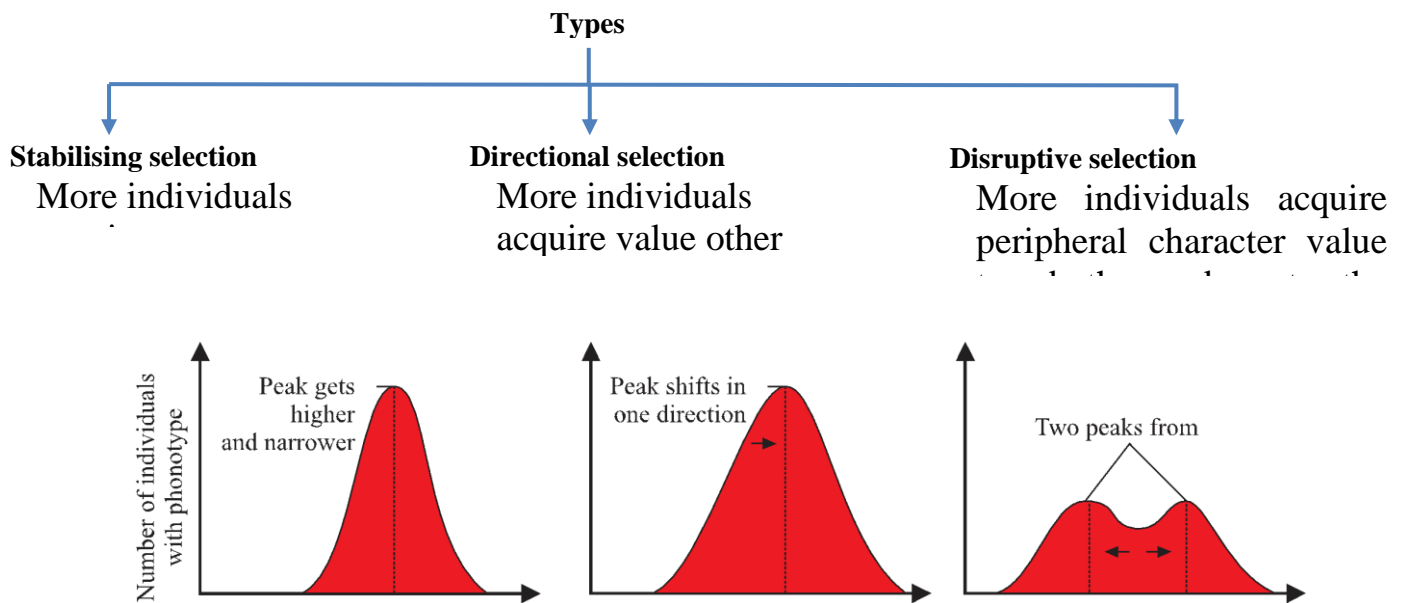
Hardy-Weinberg Principle:

- Allele frequencies in a population are stable and are constant from generation to generation. This is called genetic equilibrium.
- The gene pool (total genes and their alleles in a population) remains constant.
- Sum total of all the allelic frequencies is 1 and is represented as : $p + q = 1$ [p = Frequency of recessive allele (a) : q = Frequency of dominant allele (A)]

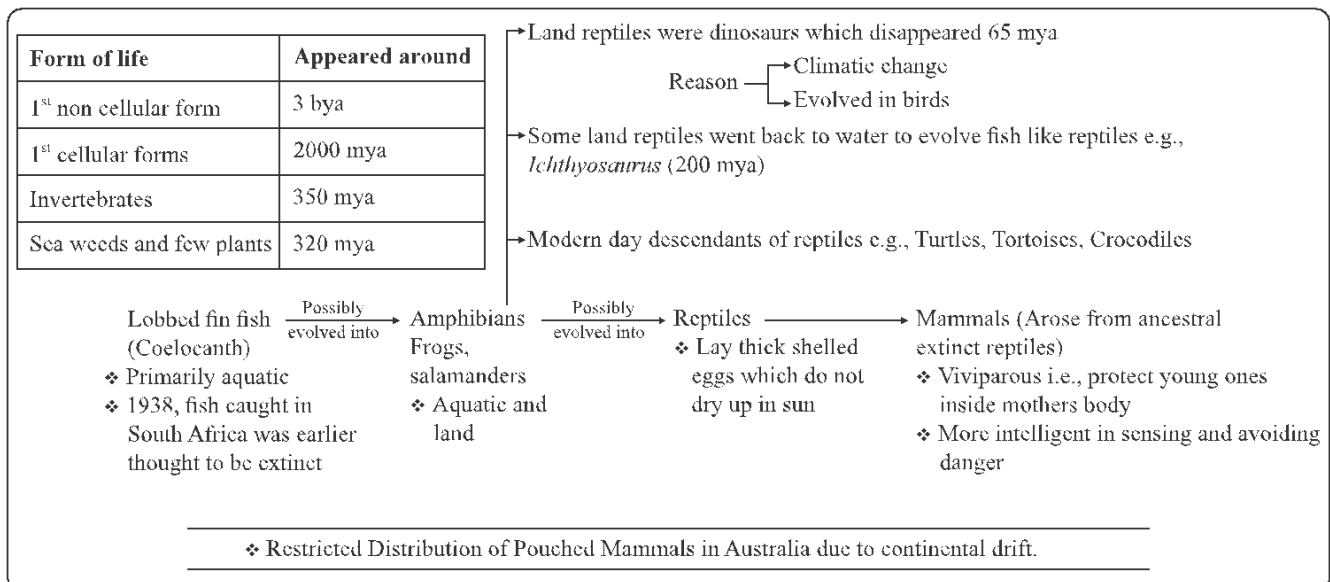
$p^2 + q^2 + 2pq = 1$ [p^2 = Frequency of homozygous dominant (AA); q^2 = Frequency of homozygous recessive (aa); $2pq$ = Frequency of heterozygotes (Aa)]

Factors affecting Hardy weinberg law

1. Gene migration
2. Genetic recombination
3. Mutation
4. Genetic drift
5. Natural selection



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	<ul style="list-style-type: none"> ❖ 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	<ul style="list-style-type: none"> ❖ First human-like being, the hominid ❖ Probably did not eat meat
<i>Homo erectus</i>	1.5 mya	900 cc	<ul style="list-style-type: none"> ❖ Fossils discovered in Java in 1891 ❖ Probably ate meat
Neanderthal man	1,00,000-40,000 years back	1400 cc	<ul style="list-style-type: none"> ❖ 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)	–	<ul style="list-style-type: none"> ❖ Arose in Africa and moved across continents and developed into distinct races



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