

Chapter 7

EVOLUTION

Evolutionary Biology Study of history of life forms on Earth.

Origin of Life

Big Bang Explosion
↓

Origin of Universe
(20 Billion yrs ago)
↓

Clusters of Galaxies formed

(Clusters of dust, stars, cloud of gases)

Stellar distances
measured in light year

→ origin of Earth
(4.5 Billion yrs Ago)
(Galaxy - milky way galaxy)

Events After Explosion

- Temperature declined
- $H_2 + He$ formed
- Gas condensed

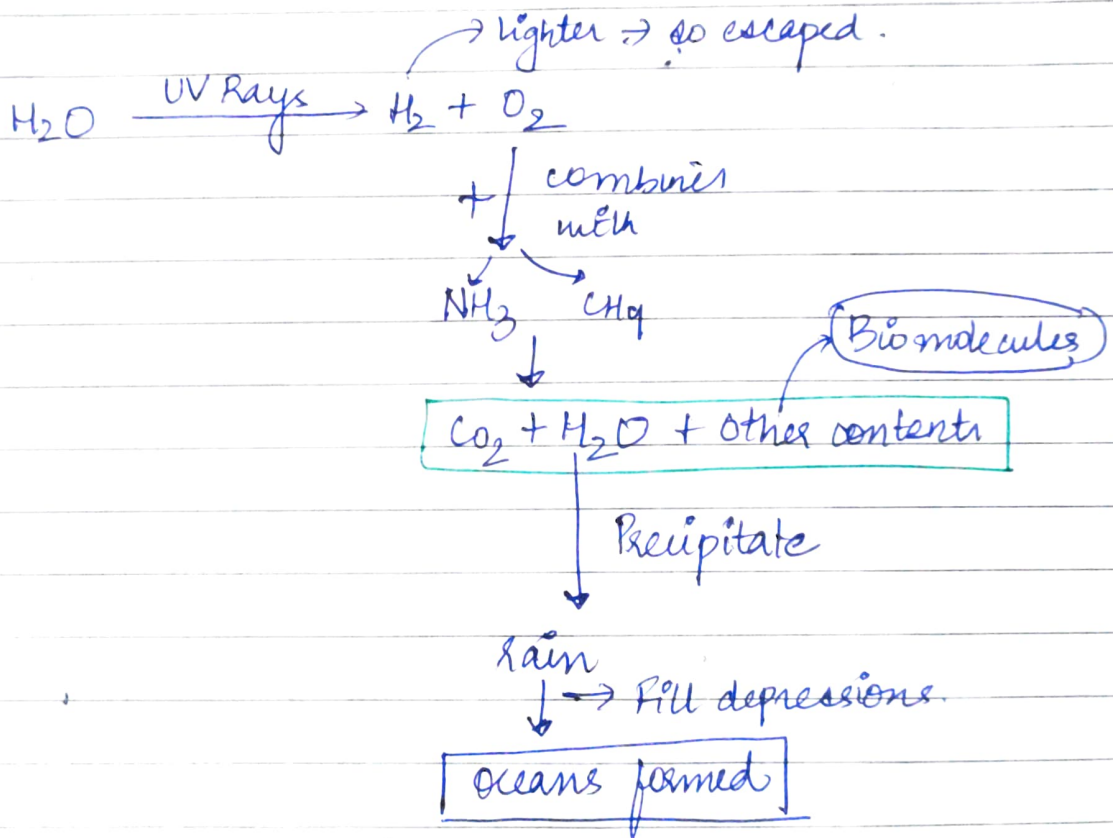
} responsible for formation
of galaxies of present
day

Origin of life on Earth

No atmosphere
More temperature

- water vapour
- Methane
- Carbon dioxide
- Ammonia

} Released from
Molten Mass
covered earth surface.



→ Ozone layer formed

Origin of life

→ Life appeared - almost 4 Billion yrs ago
↳ (after 500 million years after formⁿ earth)

* 1st non cellular form of life - 3 billion yrs ago

[Interactn of carb, pro, fats covered with a memb]
polysaccharide, RNA

↓
Protobionts [precursor of prokaryotic cell]
or Coacervate or Proto cells

RNA
polysac
protein

lipid memb

Protobionts

* 1st cellular life

- Possibly 2 million years ago
- Arose in water

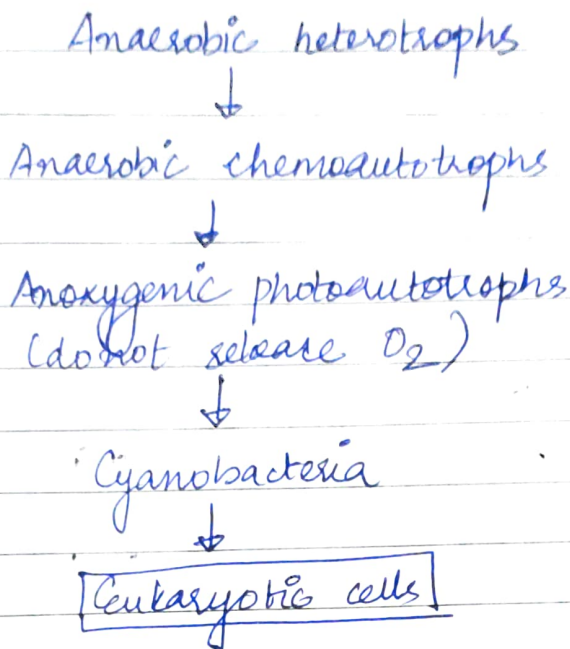
C
H
O
P
N
S
NH₂

lightening
interact

Simple
sugar
A_n, FFA,
NTd

Poly
saccharide
protein
lipids, DNA
RNA

Protobionts



Theories for Origin of life

① Theory of special creation :

- All organism created as such (x)
- Earth 4000 years old (x)

② Panspermia/ Cosmozoic Theory :

(units of life)
Life came from outer space (spores)
(supported by Astronomers and Early Greek thinkers)

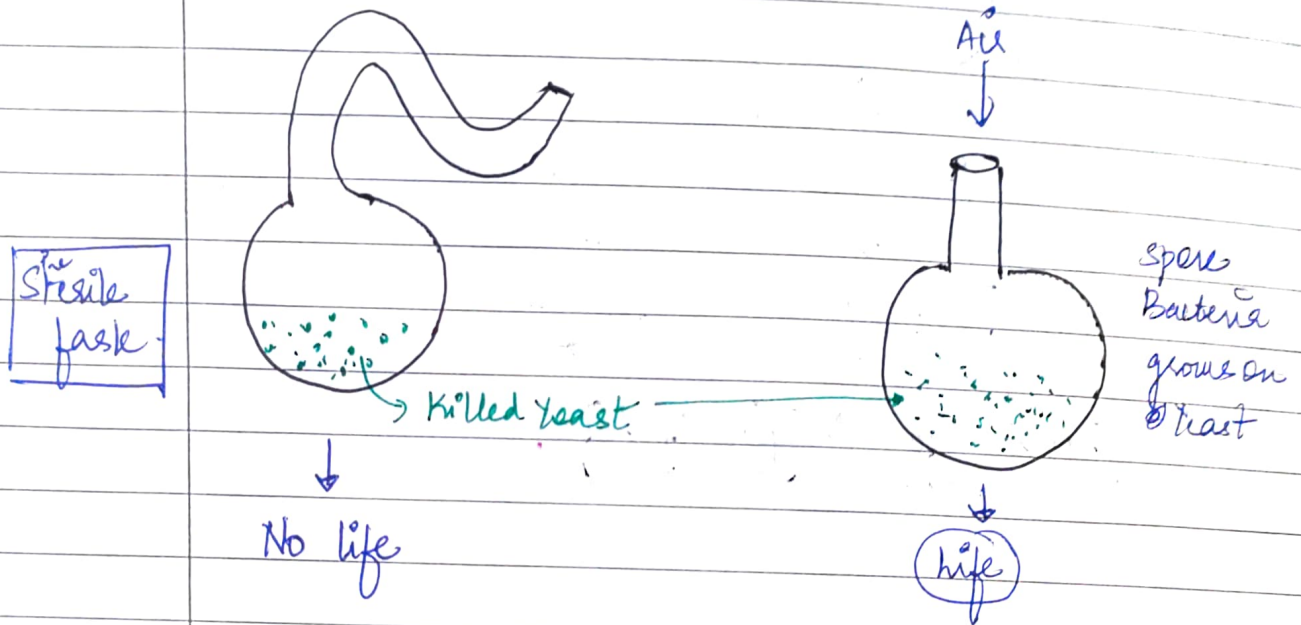
③ Theory of spontaneous Generation (Abiogenesis)

Life from decaying and rotting matter like straw, mud, etc.

disproved by Louis Pasteur

④ Theory of Biogenesis (Louis Pasteur)

- ↳ life comes from preexisting life.
- ↳ Expt - Swan neck expt.



⑤ Theory of chemical Evolution (accepted)

→ Russia → England
(Oparin Haldane Hypothesis)

(proposed by Oparin & Haldane)
life came from non living things

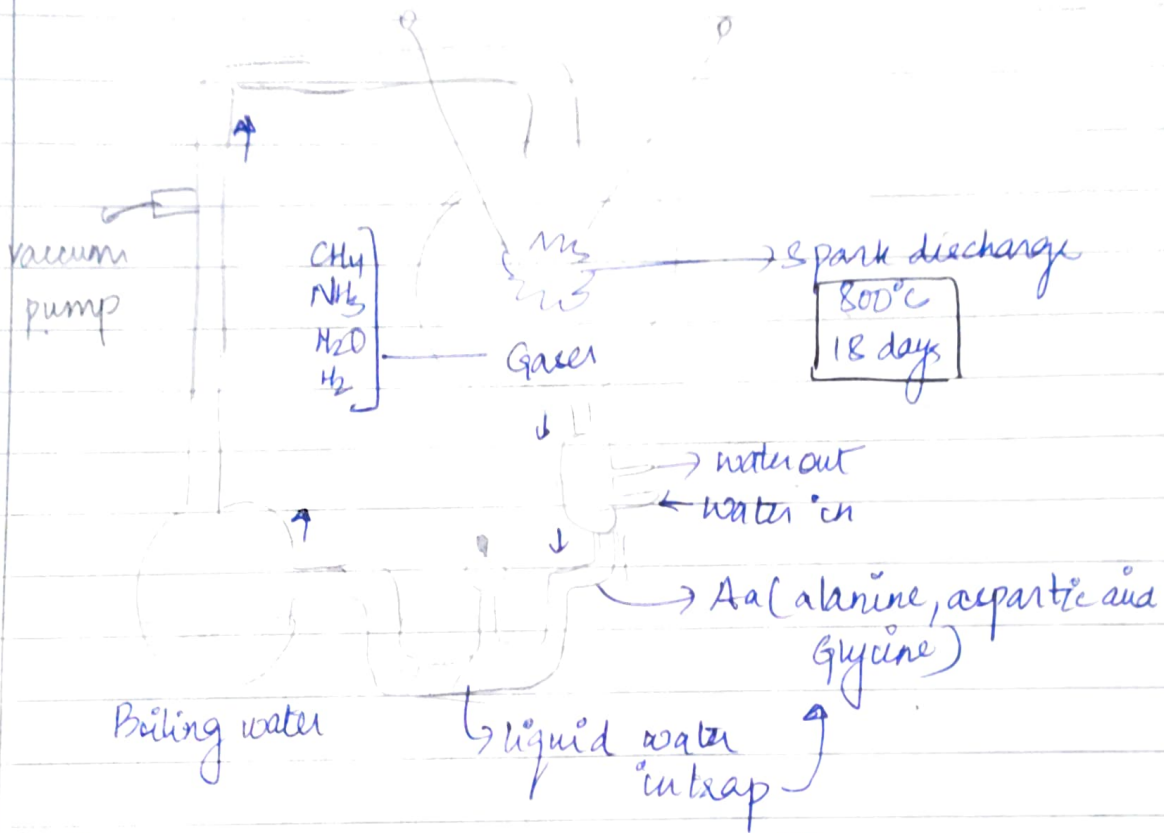
Abiogenesis first
(Origin of life from non living things)

Biogenesis
(life → life)

Life originated in hot
dilute soup / Haldane soup
of oceans → chemicals
interacted → 1st life
↓
Protoplasm → cell

→ Proved chemical evolution (1953) / /

Essay 9 Miller's Experiment $\text{CH}_4:\text{NH}_3:\text{H}_2 - 2:1:2$



[sugars, fats were also formed]
 N_2 Bases, pigments. → Similar Expt.

Life from Non living

* Analysis of meteorites
↓

* Similar compounds
↓

* Similar process somewhere in space.

Evidences of Chemical

①

Paleontological Evidences

Fossils — ^{preserved} remains of organisms.



[age determined by Radioactive Dating method]

Archaeopteryx



Reptilian features

- jaws with teeth
- fingers with claws

Avian feature

- Beak
- feathers

Dinosaurs → fossils

→ layers indicate geological period.

②

Embryological Evidence



→ Proposed by Ernst Haeckel

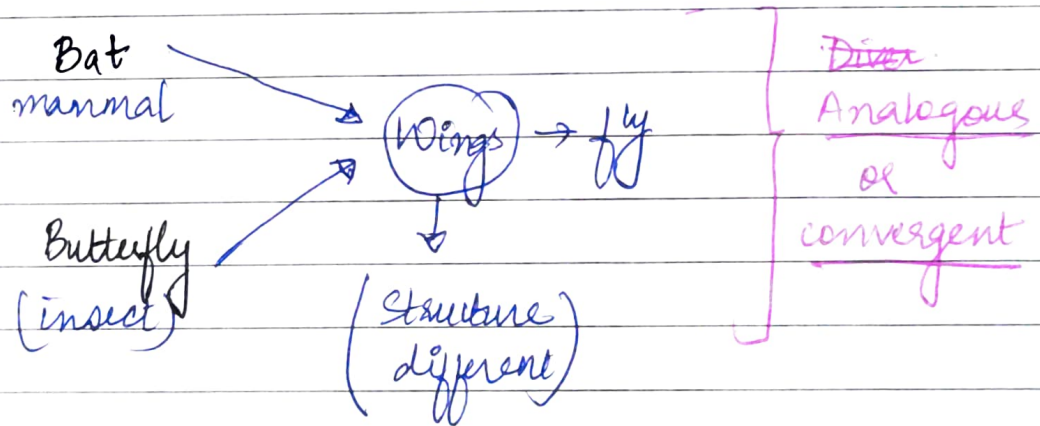
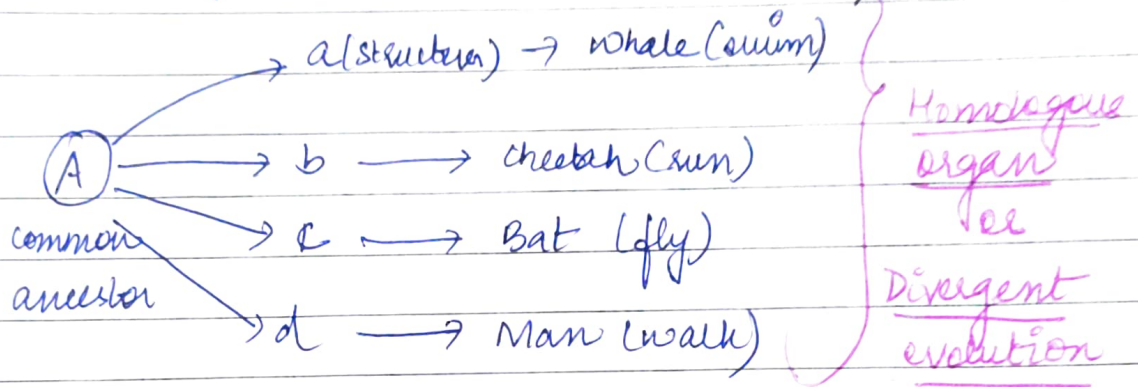
→ disproved by Karl Ernst Von Baer

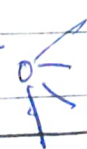
(embryo never passes through adult stages of other animals)

(Embryonic development stages common to all vertebrates)

③ Morphological And Anatomical Evidence

Homologous and Analogous structure



Parameter	Homologous organ	Analogous organ
① Anatomical structure origin	Similar	Not similar
② Function	Different	Similar
③ Evolution	Divergent 	Convergent  Come All

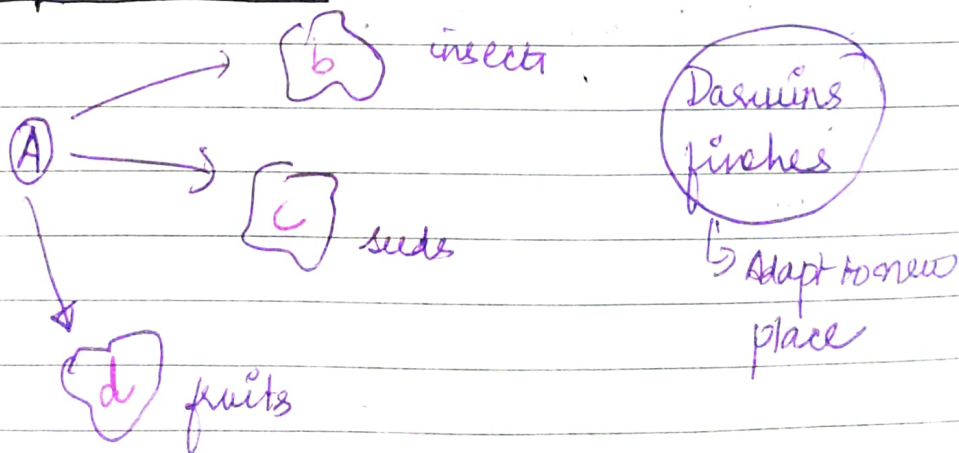
Homologous

- ① Thorns of Bougainvillea → Stem
and
Tendrils of cucurbits → Stem
- ② Four limbs of whale, cheetah, bat, man
- ③ Vertebrates brain and Heart.

Analogous

- ① Sweet Potato and Potato → Storage of food
(Root) (Stem)
- ② Eye of octopus and mammals
- ③ wings of Bat and Butterfly, Birds
- ④ Flippers of Penguins and Dolphins (swimming)

Adaptive Radiation



* Adaptive Radiation

Process of evolution where diff species start from 1 pt and literally radiate to other areas.

Habitat changes → feeding habit changes.

Examples:

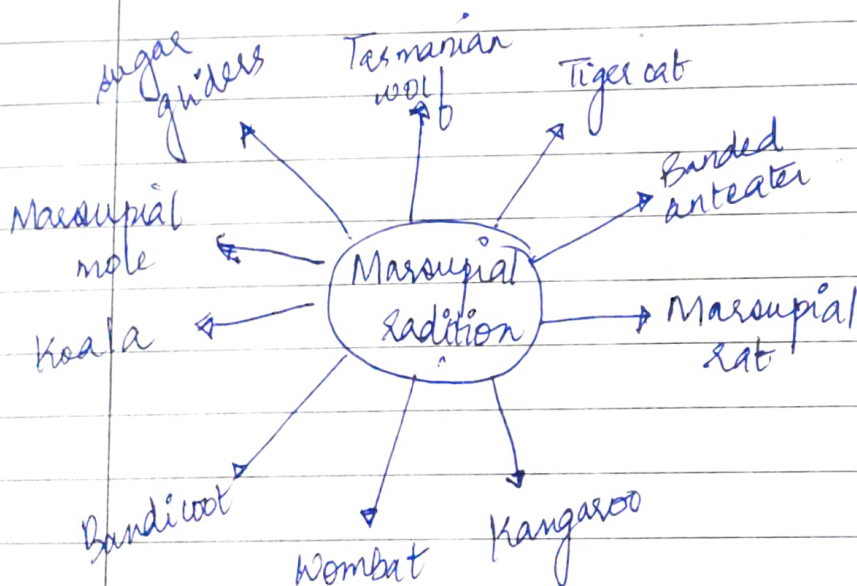
a) Darwin's finches → Galapagos Island

→ Evolved from seed eating birds

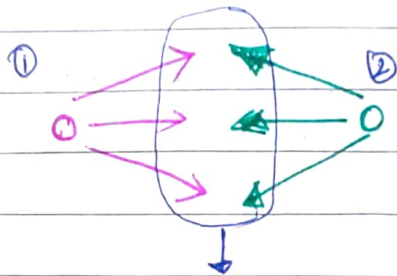
↙
Insectivores

↘
vegetarian

b) Australian Marsupials



(Adaptive radⁿ in diff place: of australia)



Divergent → gradual with time
No change of place

Adaptive → change of ecology/habitat

(convergent evolⁿ)
(More than 1 adaptive evolⁿ)

Adaptive radiation

Divergent Radiatⁿ

Because of diff in ecological niches (area)

Because of time (gradual evolution)

One ancestor - new species

Placental and australian mammals & marsupials

Moore	→	Marsupial mole
Anteater	→	Numbat/Banded
Mouse	→	Marsupial mouse
Lemur	→	spotted cuscus
Flying squirrel	→	flying kangaroo
Bob cat	→	tasmanian tiger
Wolf	→	" wolf

* Theories for Evolution of life forms

① Lamarck's Theory

- use and disuse of organs
eg long neck in Giraffes, No legs Snake
- Inheritance of acquired characters

② Darwin Theory of Natural Selection

Ship - HMS Beagle (Galapagos Island)
Geological history of earth = Biological history

* Darwin's work was influenced by Thomas Malthus

- ↳ i) Postulates can grow exponentially.
- ii) Resources are limited
- (iii) Nature keeps control.

Darwin's Postulates

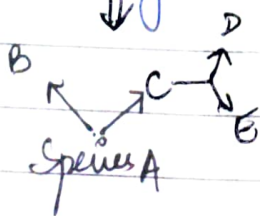
- variations are small and directional
- Evolutional - gradual process
- variations - heritable.

Better resources → more progeny

Fitness → reproductive fitness

2 Key concepts

Branching descent and Natural selection



③ Mutation Theory → given by Hugo de Vries

Evening Primrose - Plant

Evolution is a result of

Mutation → New species

↳ large

↳ single step

↳ Random

↳ directionless

↳ sudden

} Saltation (1 big mutatⁿ)

④ Alfred Wallace - Malay Archipelago (Phe)

↳ similar conclusion like Darwin.

Evolⁿ is stochastic process

↳ Random based on chance event

(Not a directed process in sense of determin)

Artificial Selection - Breeding program

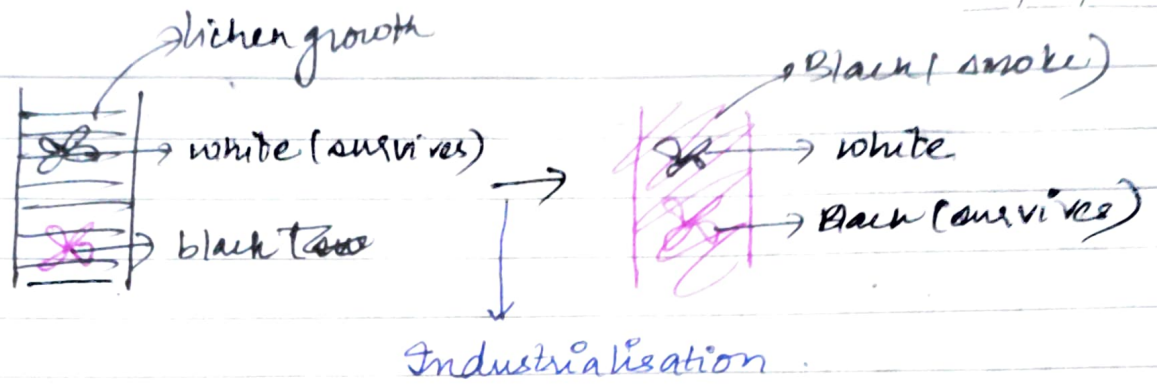
Evolution by Anthropogenic activities

① Antibiotic resistance ~~species~~ microbes

② Herbicide " varieties

③ Pesticide " "

④ Industrial melanism → Natural selection
↳ moth popⁿ



Parameter	Before (1850) industrialisation	After (1920) industrialisation
① Tree trunk	white (covered by lichens)	dark (soot + smoke deposit)
② white moth	more	less
③ melanised moth	less	more

No variant is completely wiped out

*

Hardy Weinberg Principle

eg: Hair color

A

 A A
 Black

Homozygous
Dominant

B

 a a
 brown

Homozygous
recessive

C

 A a

Heterozygous

If it follows
 eq¹ → No
 evolution
 ↓

Deviation →
 Evolution ✓

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

$$p + q = 1$$

p $\Rightarrow$ frequency of dominant allele (A)
 q $\Rightarrow$ frequency of recessive allele (a)
 $2pq$ $\Rightarrow$ frequency of heterozygous allele (Aa)

p^2 = frequency of homozygous dominant = (AA)
 q^2 = frequency of homozygous recessive = (aa)

$\Rightarrow$ Allele frequency in a population are stable from generation to generation.

$\Rightarrow$ Random mating

$\Rightarrow$ Gene pool * (Total no of genes in alleles / genes in pop) is constant



* If deviation occurs $\rightarrow$ it means evolution took place

* If deviation occurs from expected value $\rightarrow$ Evolution ✓
or

(Disturbance in Genetic Equilibrium)

Q.)

A = 0.4

Homozygous dominant ?

Heterozygous ?

recessive ?

Heterozygous ?

Ans:

$p = 0.4$

$q = 0.6$

$p^2 = 0.16$

$q^2 = 0.36$

$2pq = 2 \times 0.4 \times 0.6$

$= 0.48$

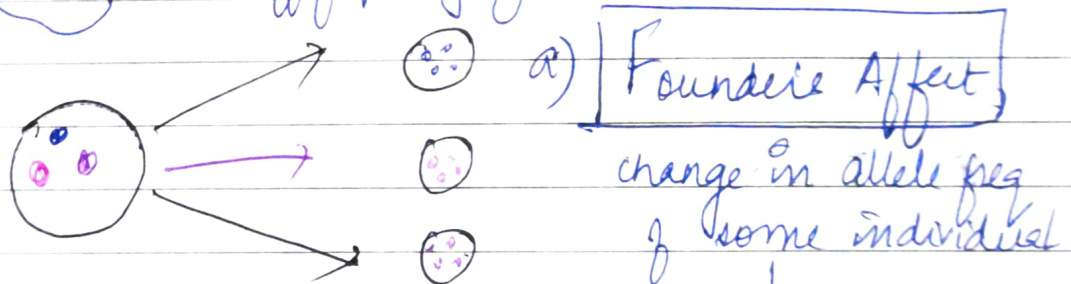
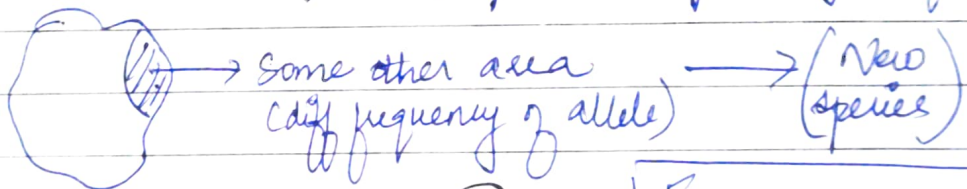
* Factors Affecting Hardy Weinberg Principle

① Gene Migration → Emigration, Immigration.
→ Multiple gene migration is Gene flow

② Genetic recombination
variation → crossing over

③ Mutation

④ Genetic Drift (Founder Effect)
↳ occurs in small popⁿ (change in gene freq.)



(random chance),

b) Bottle neck effect

when a popⁿ is greatly reduced in size



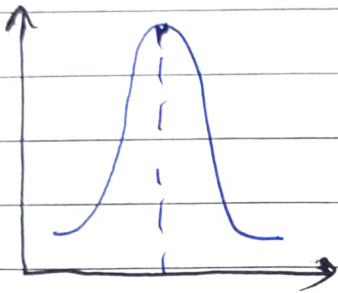
different/new place

formed new species

⑤ Natural Selection

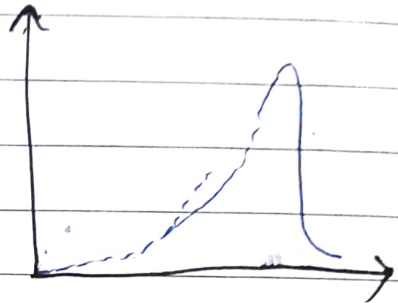
- Selection of fittest individual
- Useful variation are selected by nature.

① Stabilising Selection



- Mean characters are selected
- Extreme popⁿ are eliminated
eg: weight/physical strength

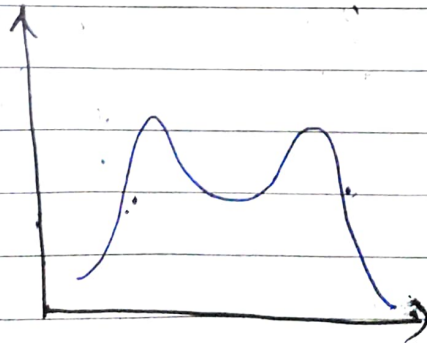
② Directional Selection



- acquire value other than mean

③ Disruptive Selection

acquire value @ both ends of distribution curve



Brief Account of Evolution

* Proterozoic Era (1)

- 2000 mya
- 1st cellular form of life
- Some cells - release O_2 in photosynthesis
- Single celled $\rightarrow$ Multicellular

(2)

- * 1938 - Coelacant fish - South Africa - (which was thought to be extinct)
 $\rightarrow$ Hobofins $\rightarrow$ 1st Amphibian

(1) * Palaeozoic Era

- 500 mya : Invertebrate
- 400-600 mya - 1st land org (plant)
- 400 mya - Arthropods on land
- 350 mya - Jawless fish (start) ^{with}
move on land or go back to H_2O $\rightarrow$ (Amphibians)
- 320 mya - Sea weeds / few plants
- Amphibians $\rightarrow$ reptiles
(lay thick shelled eggs - not dry)
- Next 200 my - reptiles on earth
Giant ferns (pteridophytes)
 $\rightarrow$ coal deposits

(4) * Mesozoic Era

- $\rightarrow$ 200 mya - land reptiles back to H_2O $\rightarrow$ fish like reptiles (eg Ichthyosaurs)
- $\rightarrow$ land reptiles - Dinosaur
Tyrannosaurus rex - largest
 $\rightarrow$ 20 ft, dagger like teeth

* Cenozoic Era (5)

- 65 mya - Dinosaur suddenly disappeared
- 1st mammals - (shrew like) (small fossils)
- South America - horse, hippopotamus, bear, rabbit - continental drift. South + North America $\rightarrow$ overide
- Australian marsupial survived due to lack of competition

350 mya lobe fins



1st amphibians



265 mya Reptiles



65 mya Dinosaurs



1st mammals

HUMAN EVOLUTION

more ape like

Dryopithecus (15 mya)



Ramapithecus
(more man like)



Australopithecus (3-4 mya)



Homo habilis (Hominid)



Homo erectus



Homo sapiens
neanderthalensis



Homo Sapiens
fossilis
(Cro-magnon man)



(Homo sapiens sapiens)

Human ancestors	Years back	Cranial Capacity	Characteristics
<i>Dryopithecus</i> <i>Ramapithecus</i>	15 mya		more ape like } hairy, walked like Gorillas more ape like } and chimpanzees.
<i>Australo- pithecus</i>	2 mya		Few fossils - man like bones (Ethiopia, Tanzania); Man like walked in East African grassland; Not taller than 4 ft, walked upright Hunted with stones, fruit eating
<i>Homo habilis</i>		650 cc - 300 cc	1st human like beings, Hominid Did not eat meat
<i>Homo- erectus</i>	1.5 mya	900 cc	Fossil - Java (1983) Probably consumed meat
Neanderthal man	100000 - 40000 yrs	1400 cc	East and central Asia used hides (skin) to protect their body and buried their dead.
<i>Homo sapiens</i>	75000 - 10000 yrs	1350 cc	Arose in Africa → Diff races Skull of baby chimpanzee is more like human than adult chimp

* Prehistoric cave art - 18000 yrs ago
 Enlène rock shelter - Raisen dist of NP
 * Agriculture : 10000 yrs ago