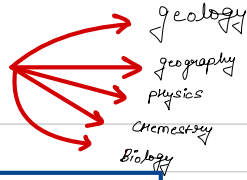


Dr. Nikhil Kumar
(8745949085)

Evolution



Darwin → Descent with Modification

genetic with Modification

- Lineage
- Mass Extinction
- Act of unfolding

ORIGIN OF UNIVERSE.

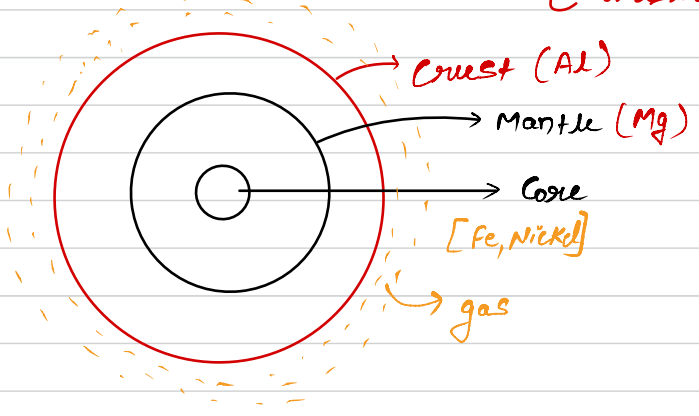
BIG BANG THEORY

- 20 B year ago univers formed.
- Explosion → Expansion

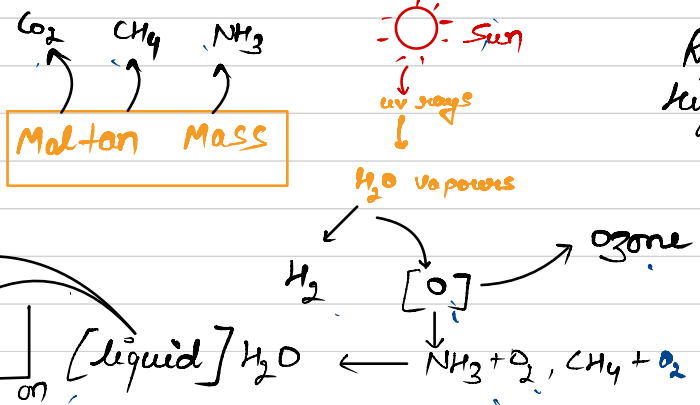


→ distance b/w earth & star measure light yr.
↓
galaxies → Milky way
(Akash Ganga)

Cooling →

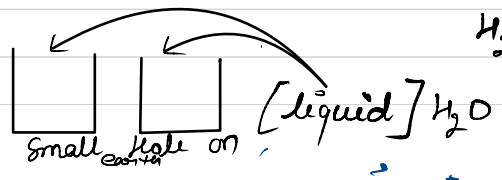


* H_2 & He gas



Reducing high temp] life originate

* earth → 4.5 Bya
life - 4 Bya } 500 million years.



Theory of origin of life.

1. Theory of Special Creation

- given by father Saurez.
- life & life supporting system development in 6 days.

★ Acc. to Hindu Mythology - life was created in one day by Lord Brahma.

- 1st Man - Manu
- 1st women - Shradha.

- Heaven + earth + void
- Darkness
- Light, plants, animals.
- 6th days - 1st Man - adam
- 1st women - even
- [Supposed to develop from the rib of Adam]

- life - come 4000 yrs ago.
- No change
- Individual created as such.

2. Spontaneous theory -

- life originated from dead matter / Non living matter

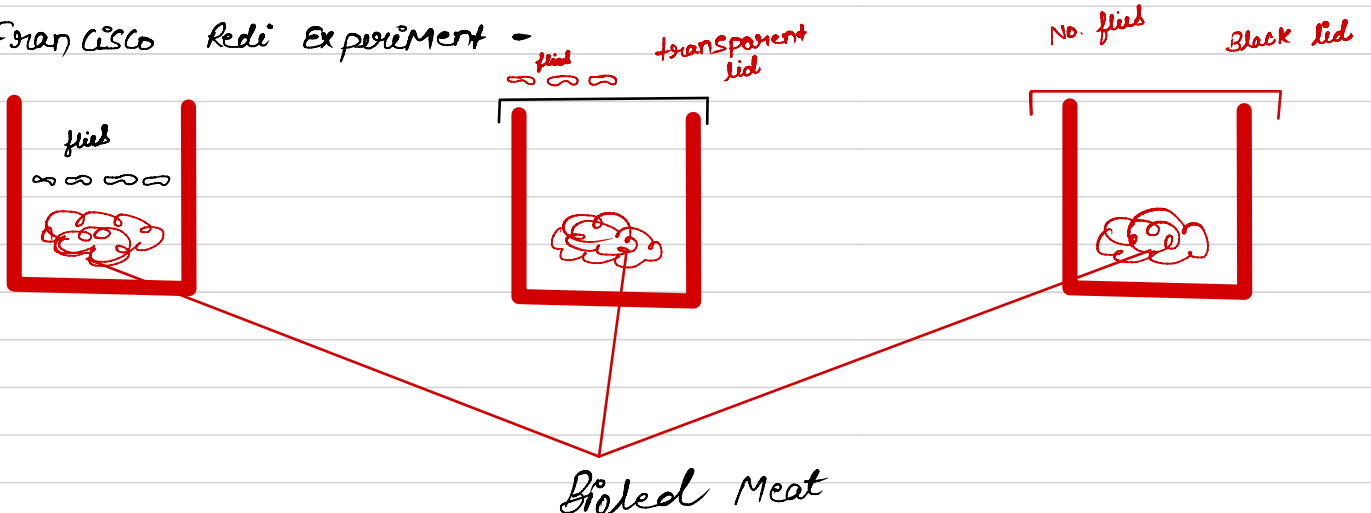
eg. Flies developed from Rotten Meat.

- Round worms developed from horse tail.
- Frog, tortoise developed from Mud of river.

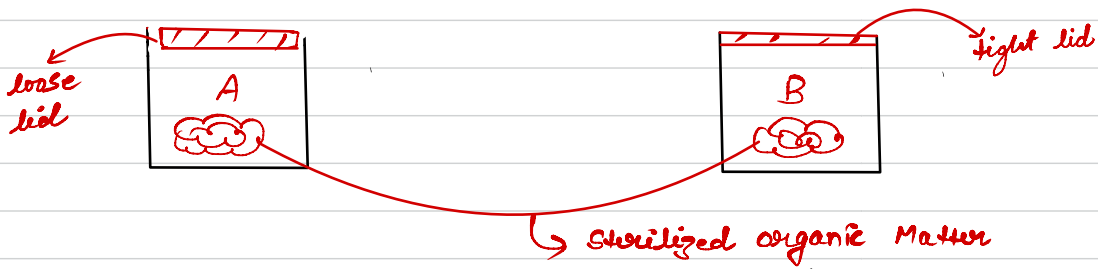
★ Acc. to von Helmont, if a shirt wet with sweat kept with wheat in an Almirah for few days, mice will developed.

Criticism of the theory

1. Francisco Redi Experiment -

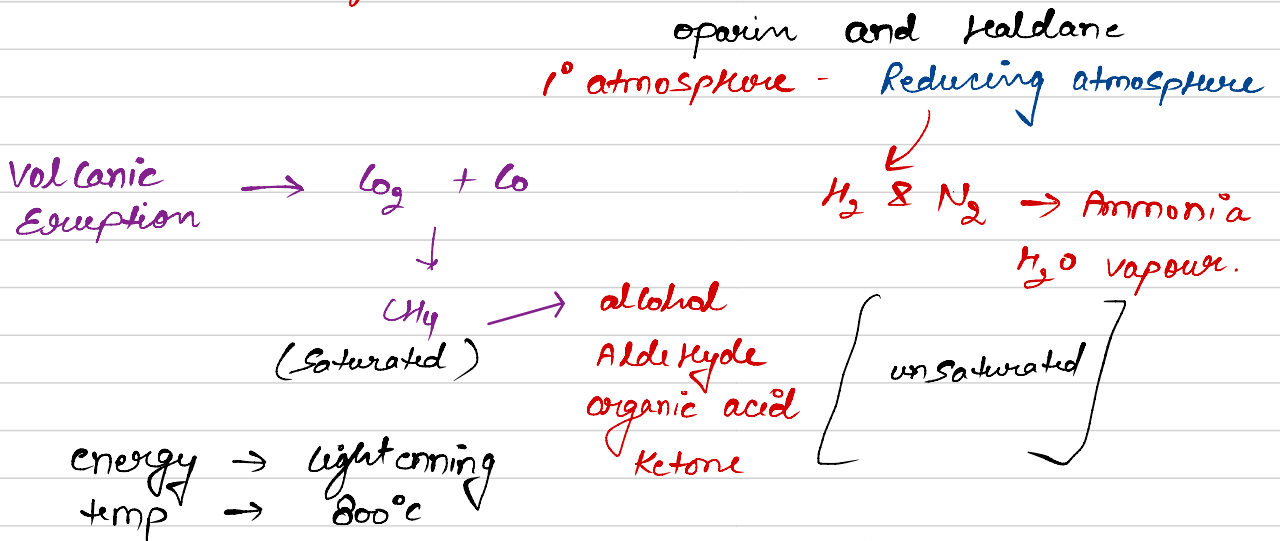


Spallanzini Exp.



- Some Contamination was observed in 'A' container
- Air Spread Microscopic life.

CHEMICAL EVOLUTION of LIFE.



Simulation Experiment

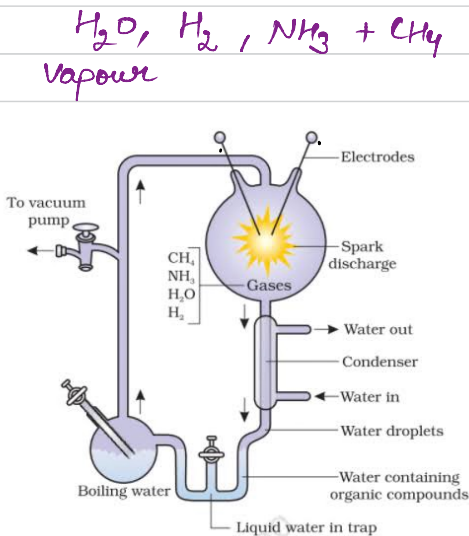
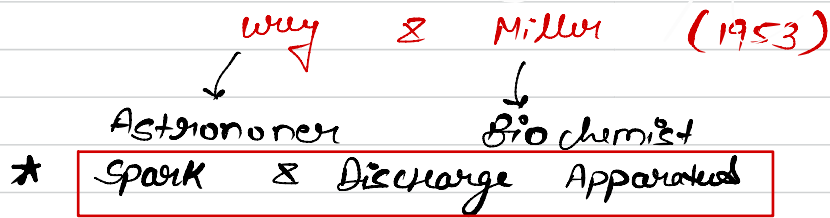
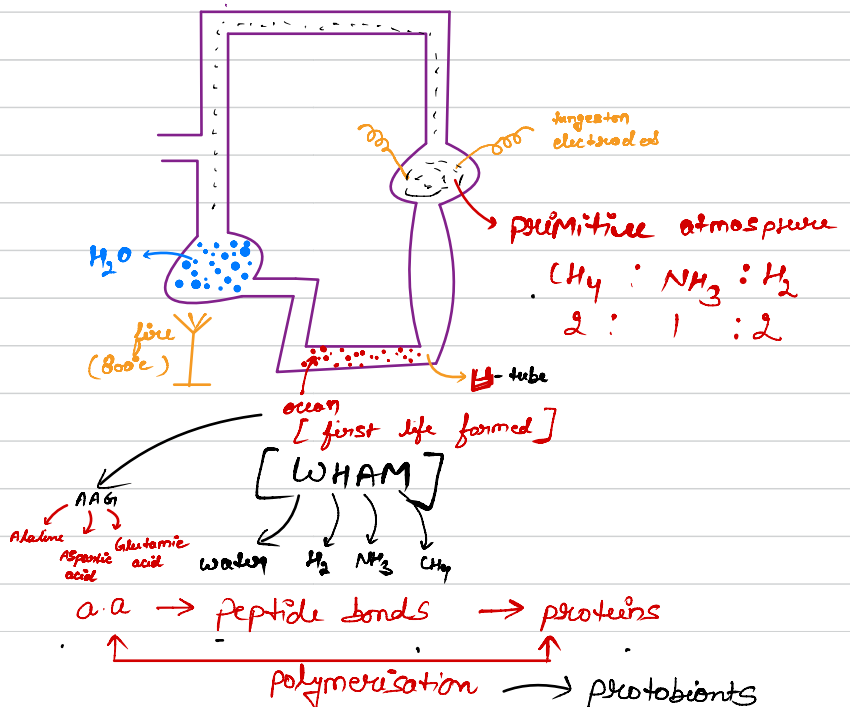
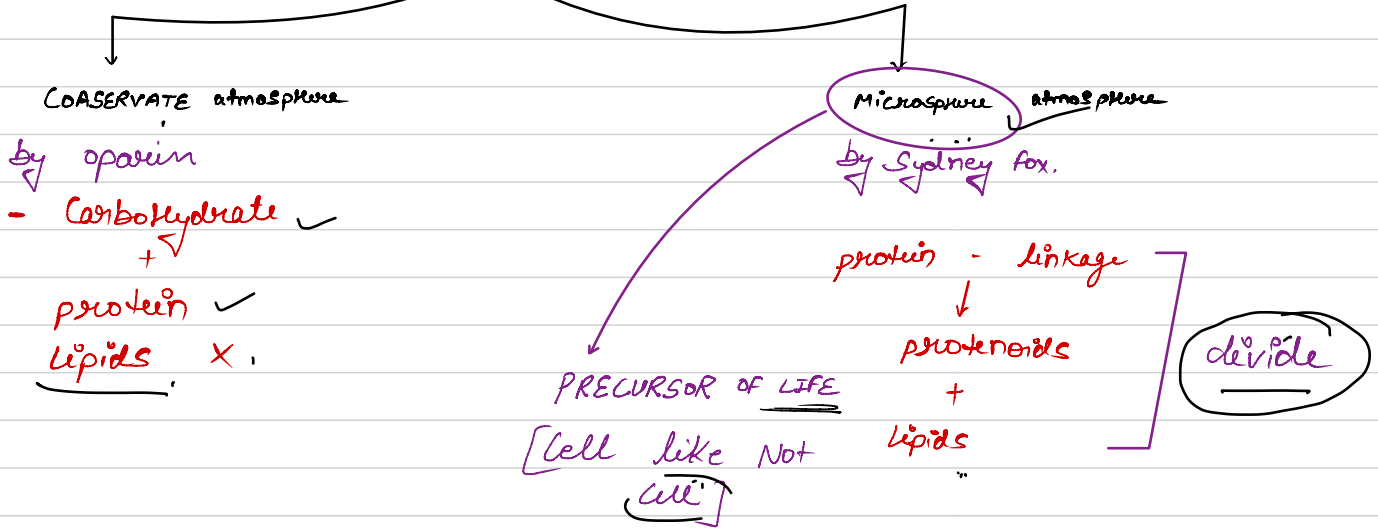


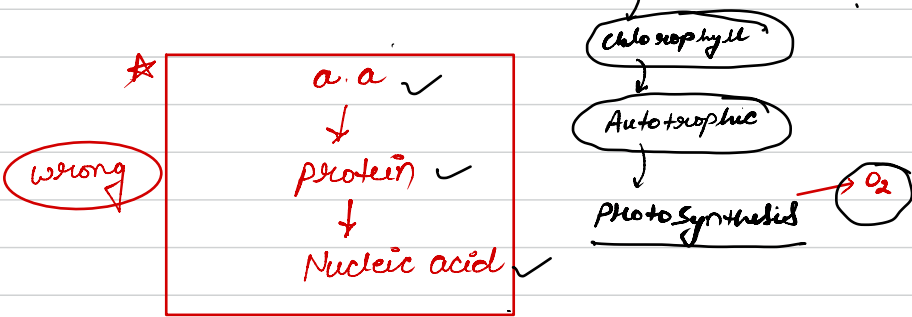
Fig: The apparatus set up by Miller and Urey to simulate conditions in the atmosphere of the primitive earth



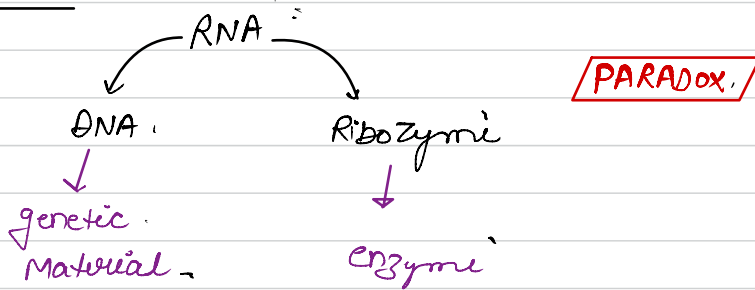
protobionts



Eubiont → Chemo Heterotrophs
→ prokaryote, Anaerobic



RNA world



All of the following theories were given for the origin of life except

- A. The big bang theory → universe
- B. Theory of panspermia → planet
- C. Theory of chemical evolution → today
- D. Theory of spontaneous generation → dead / Non-living matter

Life originated in

- A. Air
- ✓ B. Water
- C. Sun
- D. Soil

Which of the following scientists conducted an experiment to disprove the theory of spontaneous generation?

- A. Louis Pasteur
- B. S.L. Miller
- C. Oparin
- D. Haldane

Which of the following is the correct sequence of events in the origin of life?

- I. Formation of protobionts
 - II. Synthesis of organic monomers
 - III. Synthesis of organic polymers
 - IV. Formation of DNA-based genetic systems
- A. I, II, III, IV
 - B. I, III, II, IV
 - ✓ C. II, III, I, IV
 - D. II, II, IV, I

Which one of the following is incorrect about the characteristics of protobionts (coacervates and microspheres) as envisaged in the abiogenic origin of life?

- A. They were partially isolated from the surroundings.
- B. They could maintain an internal environment
- C. They were able to reproduce.
- D. They could separate combinations of molecules from the surroundings.

EVIDENCES OF EVOLUTION

Palaeontological (science of study of fossils)

fossils → Remains of dead organisms.

* Intact fossils → delay at all
- ice

* petrified fossils → turned into rock

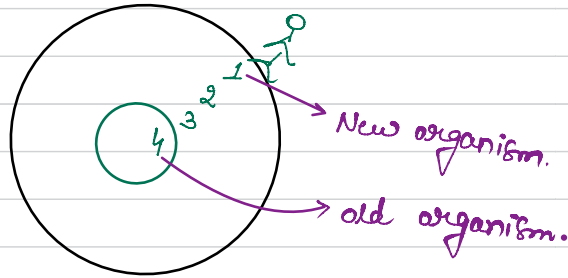
Organic → **Inorganic**

* Compression fossils, Coprolites (faeces)

* plantofossils (fossils of plants)

Geological time scale

Era → periods
↓
Epoch



* Fossils are Remains of Hard parts of life - forms found in rocks.

↓
Sedimentary rocks

* A study of fossils in different sedimentary layers indicated the geological periods which they existed.

fossil → age of fossil
↓
Sedimentary rock

RELATIVE DATING

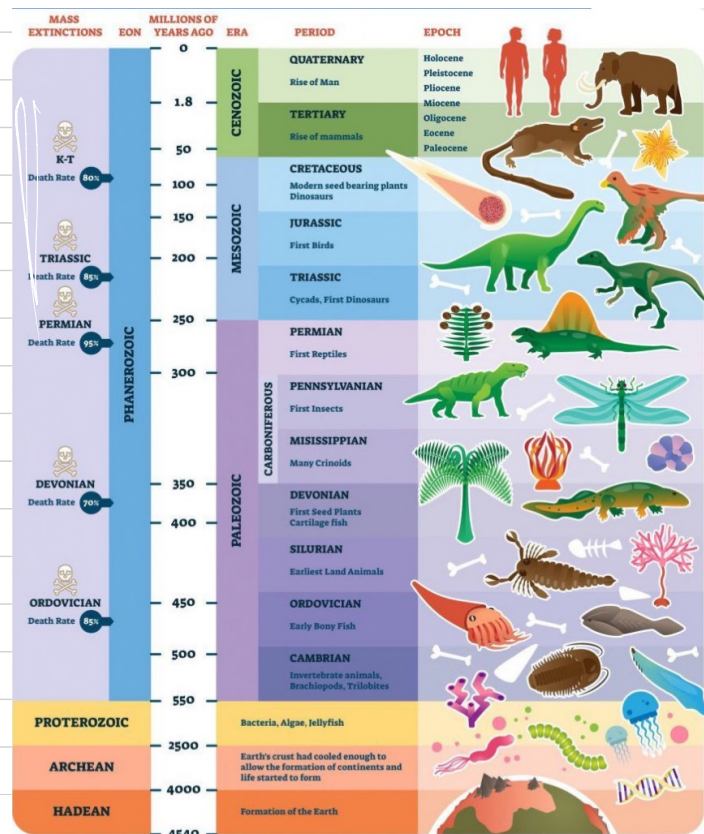
ABSOLUTE DATING

uranium → Lead

$u > L$ $L > U$

Recent old

fossils fossils



Archaeopteryx
 Missing link
 ↓ Extinct
 ↘ Connecting link

Reptiles and birds → linked

- feathers
- pentadactyl limbs
- sternum without hulk.

Reptiles → birds

evolution of horse

Phylogeny

equation - equus - Modern horse



- * Right toes
- * Brain size ↑
- * Reduction in no. of toes.
- * Molars - serration → grazing

Comparative Anatomy

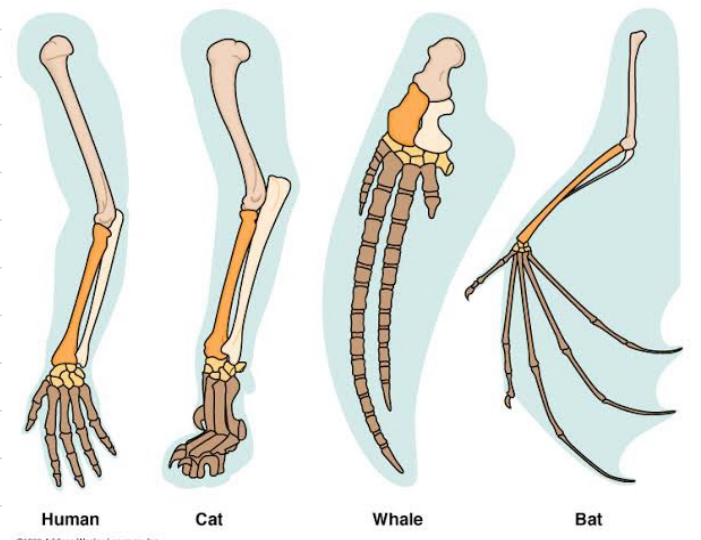
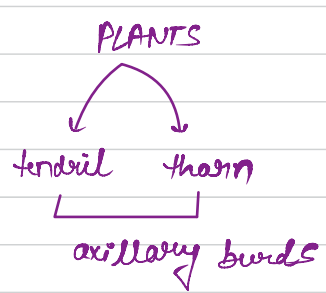
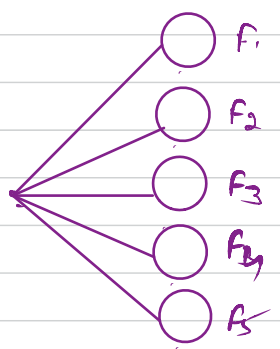
DIVERGENT EVOLUTION

* HOMOLOGOUS

ORIGIN → SAME
 function → different

eg. fore limbs of tetrapoda

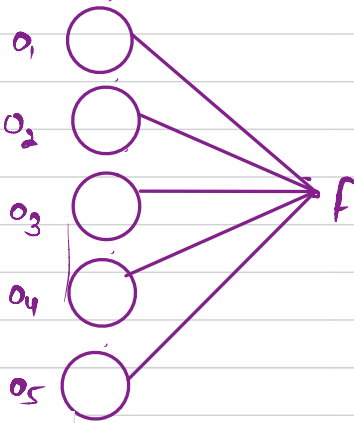
Animals



ANALOGOUS ORGANS

origin → different
function → same

CONVERGENCE EVOLUTION



(a) Wing of Bird

↓
feathers



(b) Wing of Bat

↓
extension of skin



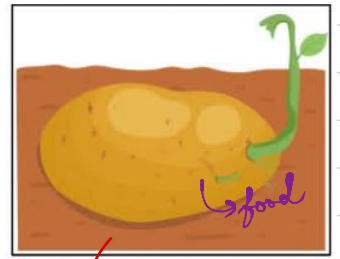
(c) Wing of Butterfly

↓
chitin



Sweet Potato

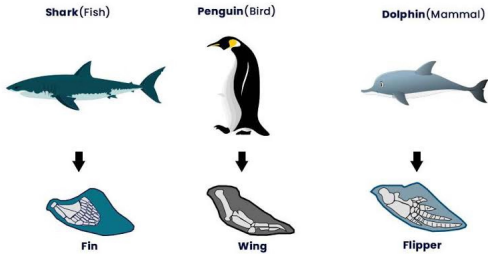
↓
root



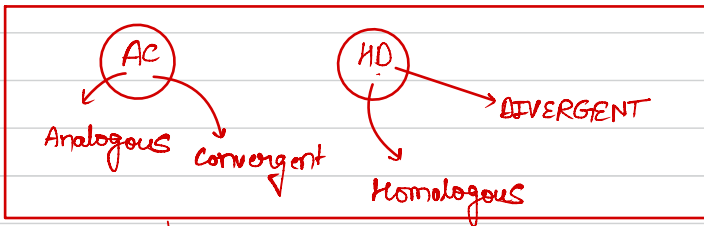
Potato

↓
stem

Q. Homology & Analogy which have common Ancestor?

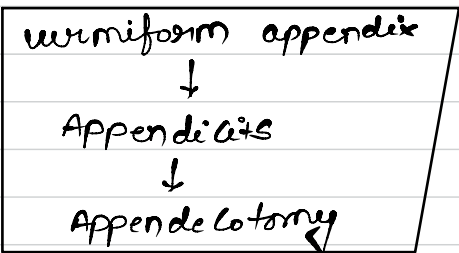


back



VESTIGIAL ORGANS.

Characters suddenly appears which were supposed to be present in their ancestors but were lost during the course of development.



- * Reformation of tail is called ATAVISM
- * More than three pinna. (Auricular muscle)
- * Nictitating Membrane
- * pointed canine

Vestigial organ

- Organ which are present in reduced form and don't perform any function.
- Fully functional and complete in ancestors.
- Example of Lamarckism.

- Human baby with tail
- Cervical fistula - in some human babies an aperture is present on neck behind the ear called as cervical fistula. It represents pharyngeal gill slits which were present in aquatic vertebrate ancestors.
- Long and pointed canine teeth represents carnivorous ancestors.
- Large and thick body hair reflect our relationship with apes.
- Extra nipples (more than two)

Vestigial organs in Human body-

- Human body possess about 180 vestigial organs
e.g

- Nictitating membrane
- Muscles of pinna
- Vermiform appendix
- Coccyx
- Canine teeth
- Third molars

- Segmental muscles of abdomen
- Caecum
- Body hairs
- Nipples in male
- Ear pinna

Peripatus is a connecting link between

- Mollusca and echinodermata
- Annelida and arthropoda
- Coelenterata and porifera
- Ctenophora and platyhelminthes

Which of the following structures is homologous to the wing of a bird?

- Hindlimb of rabbit
- Flipper of whale
- Dorsal fin of a shark
- Wing of a moth

Analogous structures are a result of

- Shared ancestry
- Stabilising selection
- Divergent evolution
- Convergent evolution

The wings of a bird and the wings of an insect are

- Phylogenetic structures and represent divergent evolution
- Homologous structures and represent convergent evolution
- Homologous structures and represent divergent evolution
- Analogous structures and represent convergent evolution.

Connecting link

Organism which possess character of two separate groups.

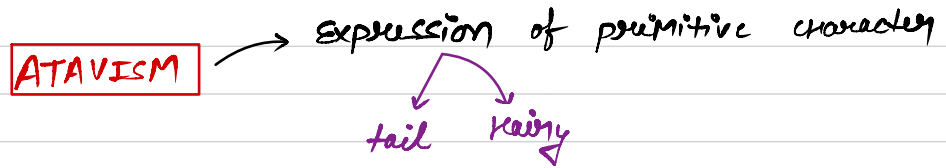
One being primitive and other is advance group.

Examples -

- Virus** : Between living and non living
- Euglena** : Between plants and animals
- Proterospongia** : Between protozoa and porifera
- Neopiffna** : Between mollusca and annelida
- Peripatus** : Between annelida and arthropoda
- Archaeopteryx** : Between reptiles and birds
- Balanoglossus** : Between nonchordates and chordates
- Chirnera** : Between cartilaginous fish and Boney fish
- Lung fish (Protopterus)** : Between fishes and amphibia
- Platypus** : Between reptiles and mammals
- Echidina** : Between reptiles and mammals.

Q. which one shows common Ancestry

- A) Homologous only
- B) Analogous only
- C) Vestigial only
- D) Both A and C



★ EMBRYOLOGICAL

given by Haeckel

Recapitulation theory

(ontogeny Recapitulates phylogeny)

① ★ Mammalian embryo

Fish - Amphibian → Reptile

② ★ embryo - Reptiles, bird, mammals

↓
Pharyngeal gill slits.

③ embryo of whale

↓
Hair → Before birth → loses Hair

MOLECULAR EVIDENCE



★ ATP act as energy currency protein

★ trypsin → universal enzyme

↓
a.a

↓
DNA sequence

↓
Evolutionary Relationship

HUMAN

CHIMPANZEE

3, 6

3, 6

→ chromosome

Karyotyping

↓
Bands - AT Rich

→ Similar type of Banding

Biogeographical Evidences

The study of patterns distribution of animal and plant in different parts of earth is called biogeography.

Alfred Russel Wallace-divide the whole world into 6 major biogeographical region.



ADAPTIVE RADIATION

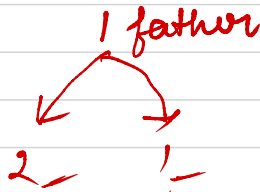
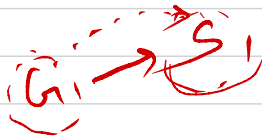
This process of evolution of different species in a given geographical area starting from a point and literally radiating to other areas of geography (habitats) is called adaptive radiation.

Example

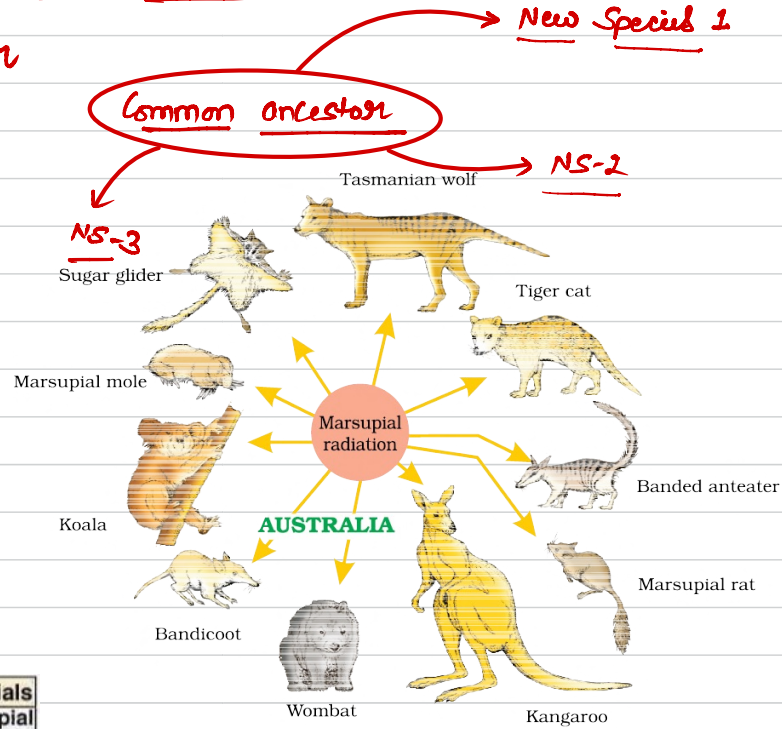
- Darwin finches
- Australian Marsupials.

When more than one adaptive radiation appeared to have occurred in an isolated geographical area lead to convergent evolution.

- Method of Speciation



eg. Australian Marsupials

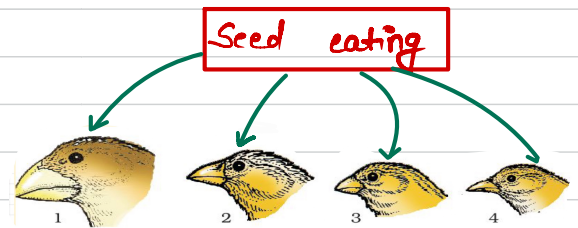


Convergent Evolution

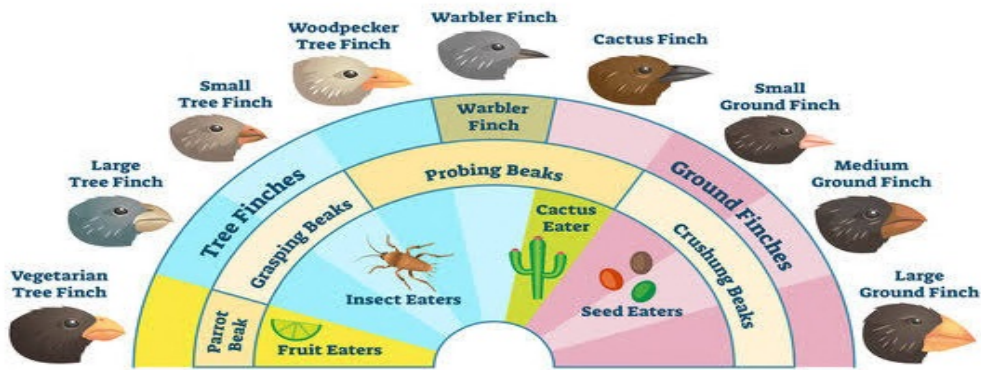
↳ origin → different
↳ function → same

Niche	Placental Mammals	Australian Marsupials
Burrower	Mole	Marsupial mole
Anteater	Lesser anteater	Numbat (anteater)
Mouse	Mouse	Marsupial mouse
Climber	Lemur	Spotted cuscus
Glider	Flying squirrel	Flying phalanger
Cat	Ocelot	Tasmanian "tiger cat"
Wolf	Wolf	Tasmanian wolf

DARWIN FINCHES



ADAPTIVE RADIATION



LAMARCKISM

Philosophic Zoologique

- theory of use & disuse

- inheritance of acquired character.

Use

↓
strengthen

Disuse

↓
degenerate

→ Giraffe

Acquired

↓
Inherit

August weismann

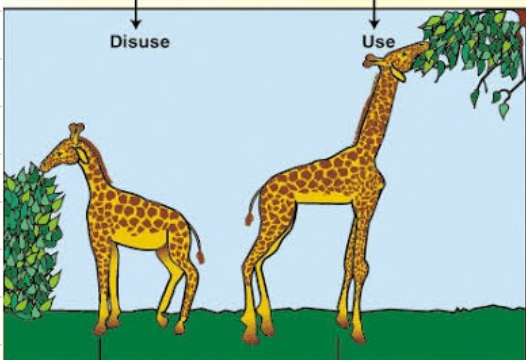
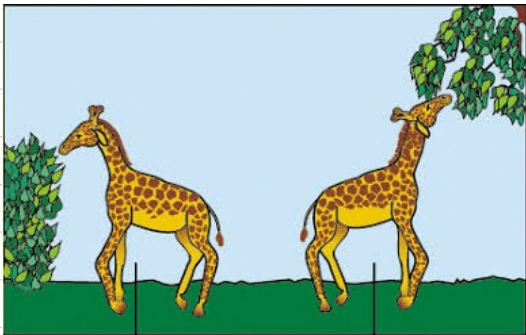
WIP rat



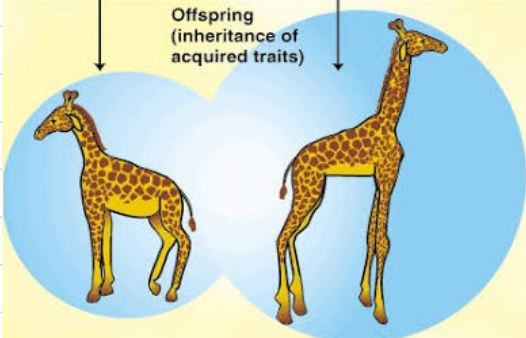
cut 21 generation of tail of mice.

theory of germ plasm

↓
Inheritable



Offspring (inheritance of acquired traits)



theory of Natural Selection

by Charles Robert Darwin

work Darwin (South America)

work Wallace (Malay Archipelago Indonesia)

Thomas Malthus (essay → population)

Population

GP → 2 - 4 - 8 - 16 - 32

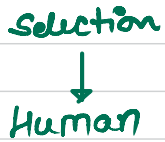
Resource

AP → 2 - 4 - 6 - 8 - 10

Natural Calamity → check population

Darwin

ARTIFICIAL SELECTION



★ Natural Selection

- ① Over-production → Reproduction in large no.
- ② Contancy of population → Resource limited.

STRUGGLE

- Intra Specific
- Inter Specific
- Extra Specific

- ③ Variation → Small & Continuous

- ④ Survival of fittest

- ⑤ Natural Selection → Reproductive fitness.



(a)

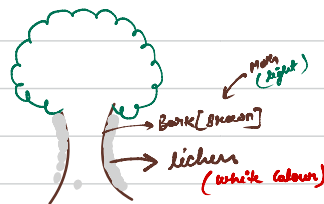
(b)

Evolution of different species in a given area starting from a point and spreading to other geographical area is known as

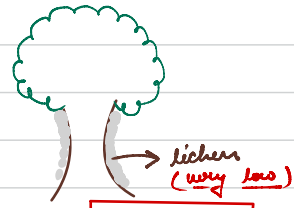
- A. Adaptive radiation
- B. Natural selection
- C. Migration
- D. Divergent evolution

before Industrialisation

Lichen
↓
white
Colour



Birds → Moth → present on tree
light dark
after Industrialisation



Bark > light

light > dark

1 - Lamarckism

- JEAN BAPTISTE de Lamarck-Proposed first theory of evolution.
- Book-philosophie zoologique
- Inheritance of acquired character OR use and disuse of organ.

Lamarck arranged his theory in the form of four postulates.

- I. Internal forces tend to increase size of the body.
- II. Formation of new organs is the result of the need or want continuously felt by organisms Doctrine of Appetency/Desires.
- III. Development and power of action of an organ is directly proportional to its use.
- IV. All changes acquired by the organism during its life are transmitted to the offsprings by the process of inheritance.

Weismann - Theory of continuity of germplasm

Reject Lamarck theory
According to Weismann

- I. Two type of matters are present in organism, somatoplasm and germplasm.
- II. Somatoplasm in somatic cells and germplasm in Germinal cell.
- III. Somatoplasm dies with the death of organism while germplasm transfers into the next generation.
- IV. If any variation develops in germplasm, it is inherited, while if variation develop in somatoplasm it is not transmitted.

Weismann cut off tails of mice generation after generation but tails neither disappeared nor shortened showing that

- A. Darwin was correct
- B. Tail is an essential organ
- C. Mutation theory is wrong
- D. Lamarckism was wrong in inheritance of acquired traits

Criticism of Lamarck

- I. Boring of pinna and nose not inherited in next generation.
- II. Wrestlers powerful muscle not inherited in next generation.
- III. Circumcision of penis not inherited in next generation.

Which of the following evidences does not favour the Lamarckian concept of inheritance of acquired characters?

- A. Lack of pigment in cave-dwelling animals
- B. Melanization in peppered moth
- C. Absence of limbs in snakes
- D. Presence of webbed toes in aquatic birds

Neo-Lamarckism

Neo Lamarckism proposes that

- I. Environment does influence an organism and change its heredity.
- II. Only those variation are passed onto offspring which affect germ cell.
- III. Internal vital force don't play role in evolution.

Differences

	Lamarckism	Neo-Lamarckism
1	It is Original theory by Lamarck.	It is modification of the original theory of Lamarck in order to make it more suitable to modern knowledge.
2	The theory lays stress on internal force, appetency and use and disuse of organs.	Neo-Lamarckism does not give any importance to these factors.
3	It believes that changes in environment bring about a conscious reaction in animals.	The theory stresses on the direct effect of changed environment on the organisms.
4	According to Lamarckism the acquired characters passes on the next generation.	Normally only those modifications are transferred to next generation which influence germ cells or where somatic cells give rise to germ cells.

Darwin Theory

- Darwin travelled by H.M.S. Beagle.
- Travelled South America, South Africa, Australia and Galapagos Island.
- Influenced by two books
- Principles of population of Malthus.
- Principles of Geology of Charis Lyell.
- BOOK - On the origin of species by means of Natural selection.

Alfred wallace

- Naturalist and working in Malay archipelago (present Indonesia).
- Similarity between the views of Darwin and Wallace.
- Darwinism or theory of natural selection jointly proposed by Darwin and Wallace.

Mutation Theory

- Hugo De Vries - introduce term mutation.
- Experimental Material - evening primrose (*Oenothera Lamarckiana*).

Main Point of Mutation Theory

1. Mutation or discontinuous variation are the raw material of evolution.
2. Mutation appears suddenly and produced their effect immediately.
3. Mutants are different from the parents and there are no intermediate stages between the two.
4. The same type of mutation can appear in several individuals of a species.
5. Mutation can appear in all direction and all mutations are inheritable.
6. Useful mutations are selected by nature and lethal mutations are eliminated.
7. Mutation are recurring so that the same mutant can appear again and again so chance of selection by nature are increased and new species is formed.
8. Mutation is a jerky and discontinuous process. De-vries termed single step large mutation as saltation.
9. Mutations are random and directionless while Darwinism variations are small and directional.

Against the Mutation theory

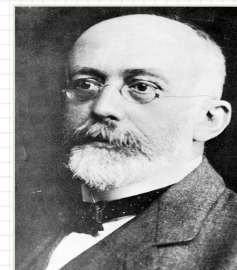
1. Natural mutation are very common as Hugo de vries thought.
2. Mutation normally recessive while characters taking evolution usually dominant.
3. *Oenothera* is not normal plant, heterozygous plant form with chromosomal aberration.

Mutation vs Variation

Mutation	Variation
Mutation is a permanent alteration in the nucleotide sequence of a gene or a part of a chromosome.	Variation is any difference between individuals or group of individuals or group of individuals of a particular species
May affect a single individual	Seen in a group of individuals
Occur due to the errors in DNA replication and exposure to UV or chemicals	Occur due to mutations, genetic recombination, gene flow, gene drift, random mating, random fertilization, and environmental factors
There are two types known as hereditary mutations and acquired mutations	There are two types known as genetic variation and environmental variation
Causes an alteration of genotype in an individual.	Caused by mutation

Hardy Weinberg Principle

- G.H. HARDY - English Mathematician
- W. Weinberg - German Physician
- Theoretical situation - population no evolutionary change.



Which one is correctly matched?

- A. Hugo de Vries : Natural selection
- B. Darwin : Theory of Pangenesis
- C. Pasteur : Theory of continuity of germplasm
- D. Mendel : Inheritance of acquired characters

Select the correct statement:

- A. Darwinian variations are small and directionless
- B. Mutations are random and directional
- C. Fitness is the end result of the ability to adapt and get selected by nature
- D. All mammals except whales and camels have seven cervical vertebrae

Modern Synthetic Theory

- Combined effect of scientists (Fisher, Haldane, Wright, Mayr, Stebbins)
- In this theory following factors are included
 - i. Gene mutation
 - ii. Change in chromosome number and structure
 - iii. Genetic recombination
 - iv. Natural selection
 - v. Reproductive isolation.

Hardy Weinberg Principle

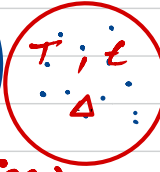
- This principle says that allele frequencies in a population are stable and is constant from generation to generation
- The gene pool (total genes and their alleles in a population) remains a constant.
- This is called genetic equilibrium.
- Sum total of all the allelic frequencies is 1

evolution

Hardy & Weinberg

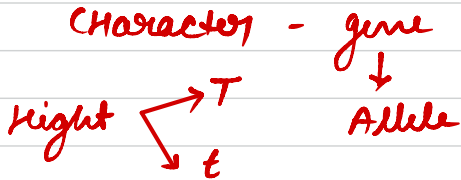
allele frequency
↓
constant

Genetic equilibrium



tall = dwarf
equilibrium

(No. evolution)



Gene pool = constant

eg. A, a

AA, aa, Aa

Homozygous

Heterozygous

Hardy - Weinberg equilibrium

frequency of Dominant allele (A) = p

frequency of Recessive allele (a) = q

$$p + q = 1$$

frequency of AA = $pp = p^2$
 " " aa = $qq = q^2$
 " " Aa = $2pq$

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

Certain Condition $(p+q)^2 = 1$

- * Big population
- * No Mutations
- * Random Mating
- * No evolution
- * No Migration



Hardy Weinberg Equilibrium

The Hardy-Weinberg Principle

frequency of homozygous dominant genotype p^2 + frequency of heterozygous genotype $2pq$ + frequency of homozygous recessive genotype $q^2 = 1$

Hybrid

p^2 - TT - tall
 $2pq$ - Tt - Hybrid
 q^2 - tt - dwarf

Factors Affecting Hardy Weinberg Equation

- 1 Migration
- 2 Genetic drift
- 3 Mutation
- 4 Genetic recombination
- 5 Natural selection

1. Migration
 In → India → out
 Gain / Loss of allele

2. Mutation → evolution

3. Recombination → Crossing over

4. Natural Selection → Variation

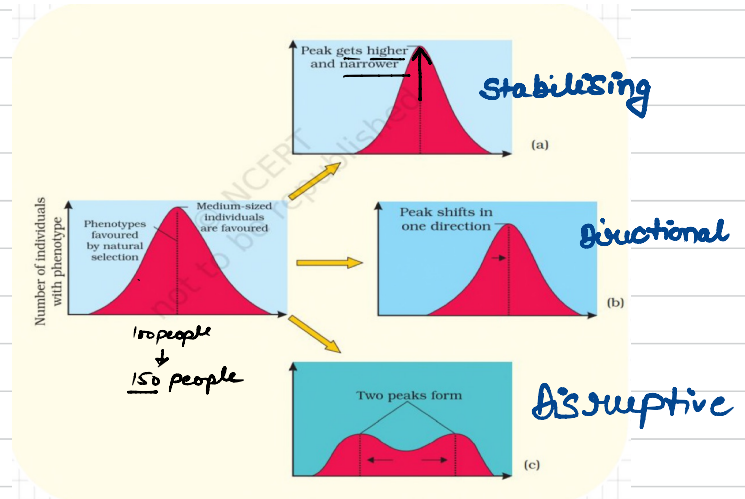
5. Small population

6. Random Mating

7. Genetic drift

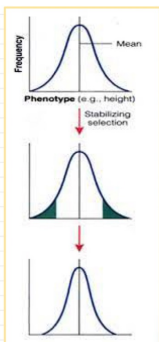
Natural Selection

- Nature select those variation which are heritable and make survival more better.
- Lead to change in allelic frequency.
- 3 types
 - A. Directional
 - B. Stabilising
 - C. Disruptive



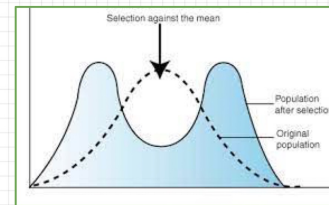
2. Stabilizing Selection

- Both ends of frequency distribution eliminated.
- Operate in constant environment.
- Introduces homozygosity.
- Population genetically constant.



3 - Disruptive selection

- Extreme ends favoured at the expense of intermediate.
- Opposite to stabilizing selection.
- Population breakup into adaptive forms.



Q. Natural Selection

child height

0.1m 0.5m 0.9m

 Range

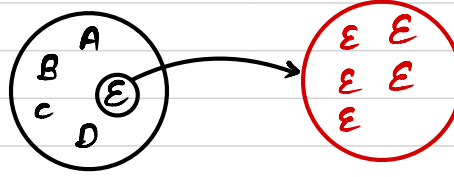
• More No. of children with 0.5m Height.

GENETIC DRIFT

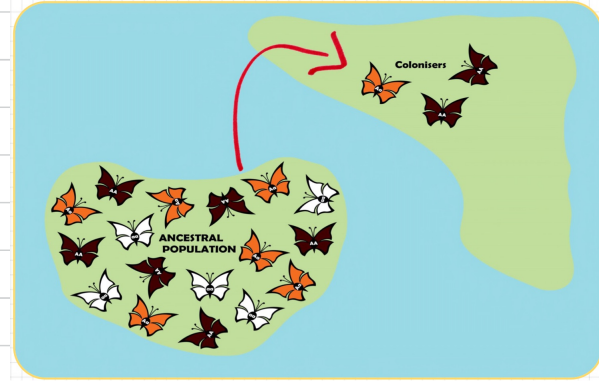
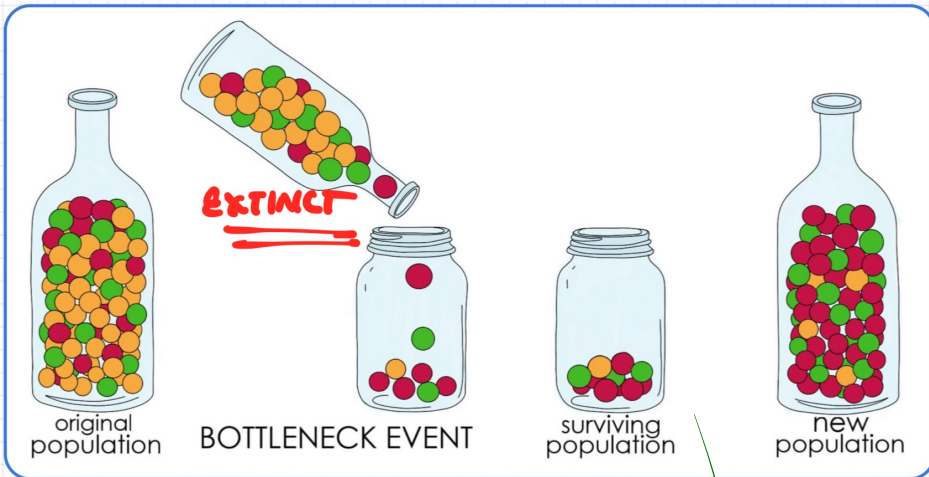
Random Drift

- By chance
- x Survival advantage
- Accidental change
- Small population.

Founder's effect



Bottle Neck effect



In Hardy-Weinberg equation, the frequency of heterozygous individual is represented by

- A. p^2
- B. $2pq$
- C. pq
- D. q^2

Q. Industrial Melanism.

? Natural Selection

Ans.

Before

after

light > dark

dark > light

Directional

Q. Sickle Cell Anemia?

Ans.

$Hb^A Hb^A$ $Hb^S Hb^S$

$Hb^A Hb^S$

Mean value

Balancing /
Stabilising

Salutation means

- A. Single step small mutation
- B. Single step small variation
- C. Single step large mutation
- D. Single step large variation

If nature selects both of the peripheral traits of a character then which kind of natural selection is said to be operating?

- A. Stabilising
- B. Disruptive
- C. Directional
- D. Rotating

At a particular locus, frequency of A allele is 0.6 and that of a is 0.4. What would be the frequency of heterozygotes in a random mating population of equilibrium?

- A. 0.36
- B. 0.16
- C. 0.24
- D. 0.48

Q. population = 100 people
Non Rollers = 16/100

find frequency of Rollers

tongue Rollers
 (Dominant)

Homozygous

Heterozygous

Ans tongue Non-Rollers (q^2) = $\frac{16}{100}$

$$q = \sqrt{\frac{16}{100}} = \left(\frac{4}{10}\right) = \frac{4}{10} = 0.4$$

$$q = 0.4$$

① Homozygous Roller

$$p + q = 1$$

$$p = 1 - q$$

$$= 1 - 0.4$$

$$p = 0.6$$

↓
 p^2

$$= (0.6)^2$$

$$= 0.36$$

② Heterozygous

$$2pq$$

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

$$= 0.48$$

frequency of A = p

AA

Q. total 100 AA = 20
 aa = 50
 Aa = 30

Genetic drift operates in

- A. Small isolated population
- B. Large isolated population
- C. Non-reproductive population
- D. Slow reproductive population

A population will not exist in Hardy-Weinberg equilibrium if

- A. There is no migration
- B. The population is large
- C. Individuals mate selectively
- D. There are no mutations

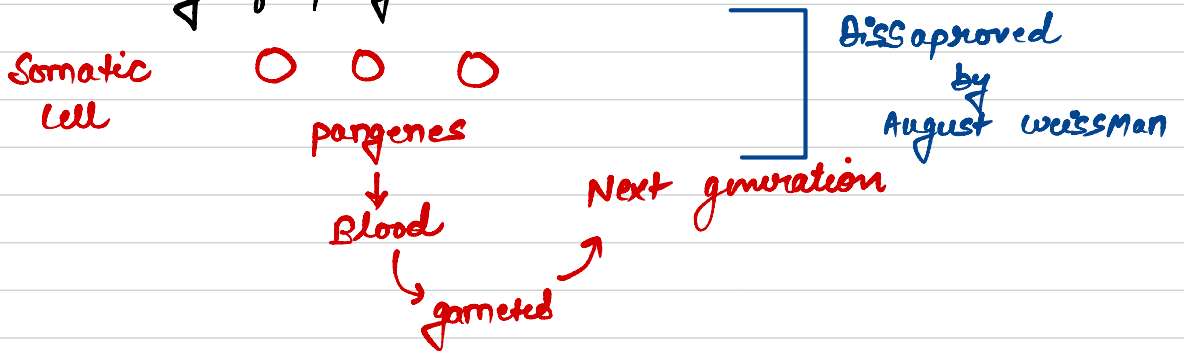
In a population of 1000 individuals 360 belong to genotype AA, 480 to Aa and the remaining 160 to aa. Based on this data, the frequency of allele A in the population is

- A. 0.4
- B. 0.5
- C. 0.6
- D. 0.7

$$A = \frac{640}{1070} = 0.6$$

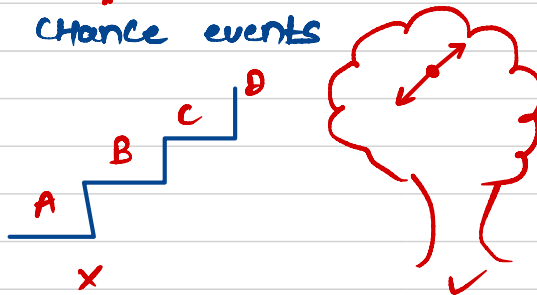
Darwin

- Natural Selection
- theory of pangenesis



★ evolution

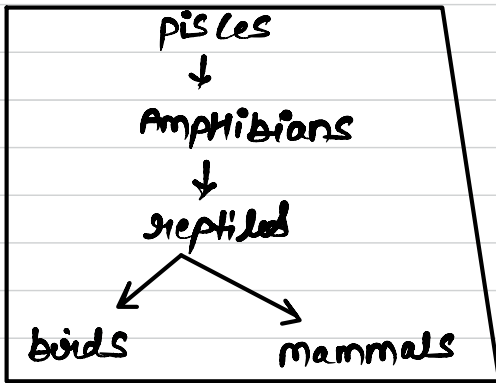
↓
Stochastic
↓
Chance events



Simple → Complex

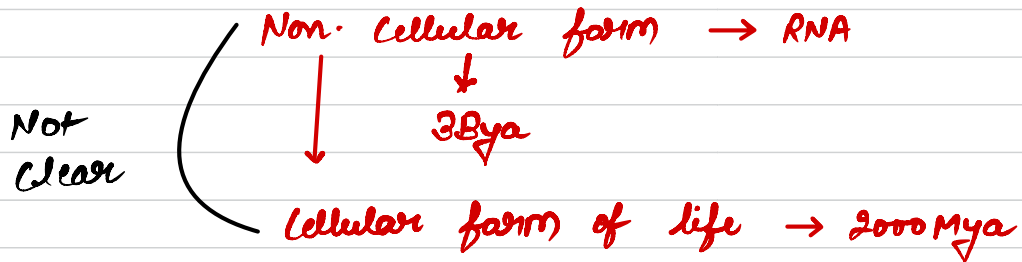
↑ Retrogressive

↓ progressive



BRIEF ACCOUNT OF EVOLUTION

universe → 20 Bya
 Earth → 4.5 Bya
 Life → 4 Bya



Cells → Photosynthesis

↓

Release O₂

(Splitting of H₂O)

unicellular → Cellular

Invertebrate → 500 Mya
Jawless fish → 350 Mya
(Agnatha)

few plants → 320 Mya

↳ Lands

350 Mya → fishes left H₂O and enter Land.

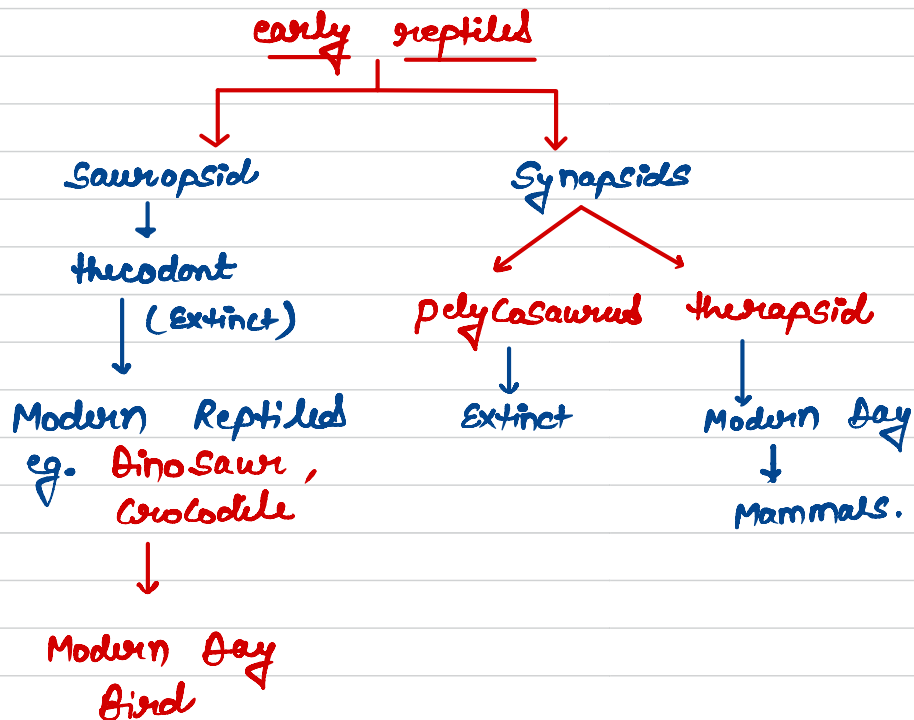
1938 - South Africa

Coelocanth → Ancestors of Amphibians

* evolution of Reptiles → first true Land vertebrate.

200 Mya → Reptiles dominated
eggs → thick walled

↓
prevent Desiccation



* H₂O dwelling Reptile → Ichthyosaurus.

tyrannosaurus Reptile → Carnivore
- 20ft in Hg
- Dogger like teeth.

Dinosaur disappeared 65 Mya

Climate evolved to birds

evolution of Mammals

early Mammals - shrews

Viviparous

Aquatic - seals, sea lion, whale, dolphin.

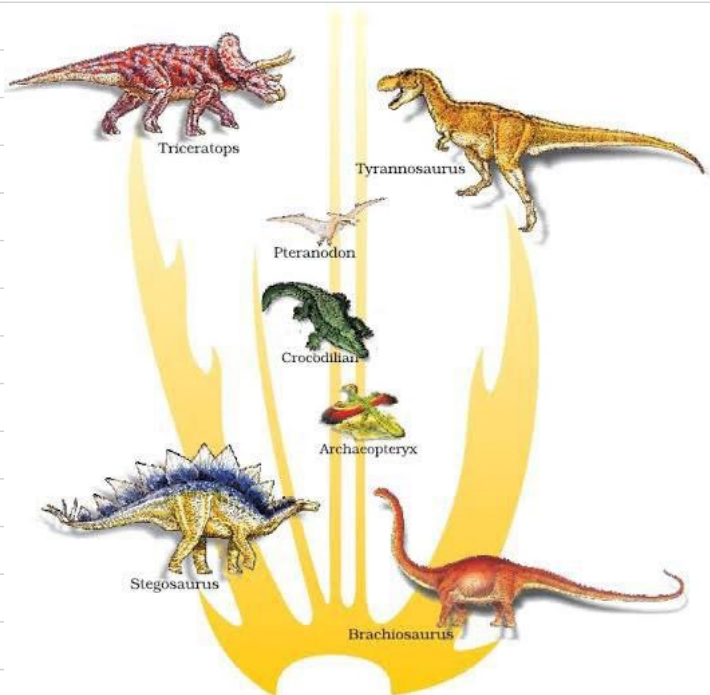
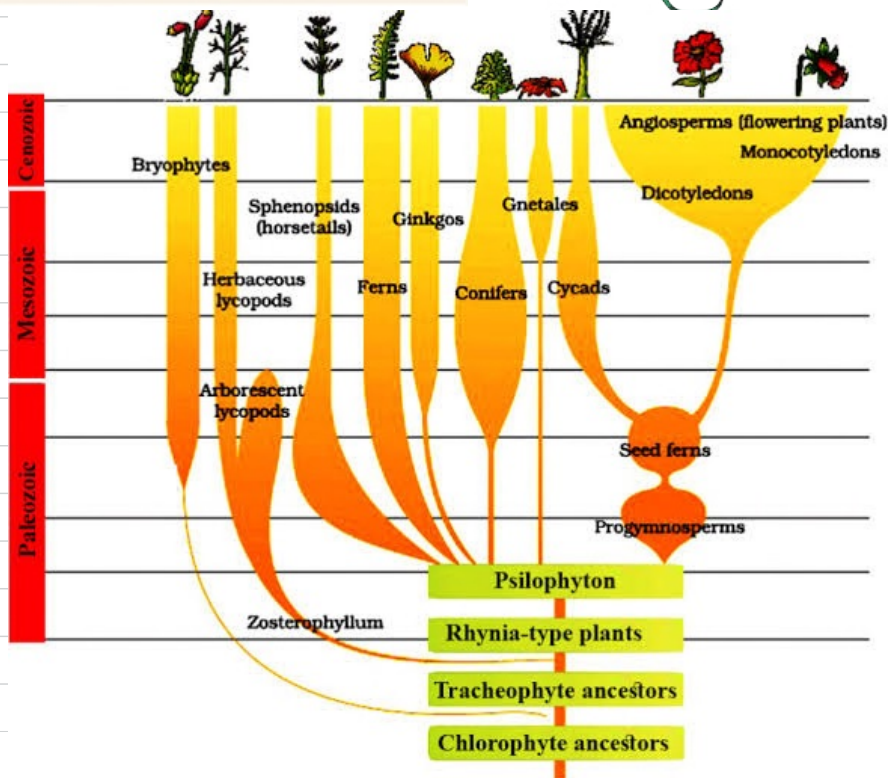
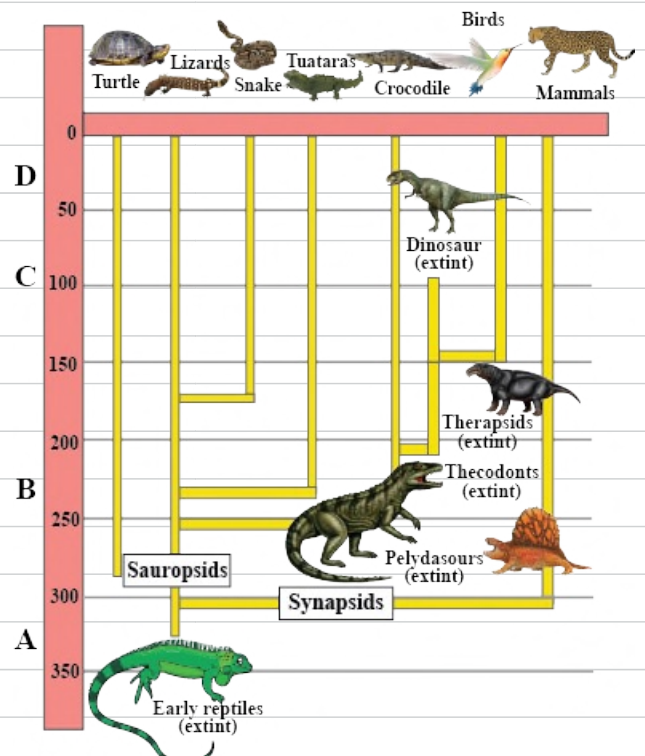


Figure 7.2 A family tree of dinosaurs and their living modern day counterpart organisms like crocodiles and birds



Human evolution

Lineage	time period	Cranial Capacity	Archaeological evidence and food Habits.
Dryopithecus/ Ramapithecus	15 MYA	Incomplete fossil	- Quadrupedal, fruit eating, Arboreal. - fossils - Europe, Africa Ramapithecus - Sivatic hills.
Australopithecus	4-2 Mya	450 - 600	Bipedal, Vegetarian, used stones as tools.
Homo Habilis (Handy Man)	2 Mya	650 - 800	- Vegetarian - fashioned stones - fossils - east africa - first human like to Hominid. (first tools maker).
Homo erectus	1.5 Mya	900	Ate Meat, tools Making - fossils - china, Java, Europe, Africa. (use fire).
Neanderthal Man	40,000 - 10,000 yr ago	1400	- Burial custom - Religious - Ate Meat - tool Making - Hunter + predator
Homo Sapiens Sapiens	75,000 yr ago	1400 - 1450	Beginning of Agriculture (10,000 yr ago) - Cave paintings (18,000 yr ago)