

Evolution

- Evolution is the story of life on earth.
- Evolution is a process in which gradual changing in living organism or life forms occurs which leads to formation of simple to complex organism.
- It occurs due to variation generation after generation.
- Variation occurs due to crossing over, random fertilisation, use & disuse, conscious effort, environmental changing, mutation.

Origin of Universe :-

Universe Originated about 15 to 20 billion year ago.

- Origin of Universe was explained by Big Bang Theory (Given by ABdel Laemaitre).
- According to this theory universe originated by a huge thermonuclear explosion. This thermonuclear explosion is called Big Bang.
- About 4.5 billion year ago our solar system was originated by gaseous cloud called solar Nebula which start to collapse under the force of Gravitation and form our solar system.

(M, V, E, M, I, S, U, N, P) .

→ First life form originated about 4 billion year ago .

→ Initially atmosphere was absent . Various gases like water vapour, CO_2 , CH_4 , NH_3 etc release from molten mass and surrounds the earth surface ,

→ UV rays from sun broke up the water into H_2 & O_2 . Lighter H_2 escaped & O_2 reacts with CH_4 & NH_3 to form CO_2 & H_2O .

→ Initial atmosphere was reducing due to absence of O_2 & plenty availability of H_2

Ancient Theories of Origin of Life :-

Theory of special creation → Given by father Saurez .

→ A/c him life originate by the wish of god

→ A/c hindu mythology life originated by Brahma and the first man & woman was Mannu and Shradha .

→ A/c Bible life originated by god in 6 days and the first man & woman was Adam's and Eve's .

Theory of Spontaneous generation or Abiogenesis → According to this theory life originated from Non-living object like mud, rotting material, straw etc .

→ This theory was supported by Hales, Alaximander, Platu, Aristotle, Xenophane etc.

Cosmozoic Theory → Given by Richter.
→ A/c him life originated on earth due to coming of protoplasm from another planet in the form of Cosmozoa (gamete, Spore, seed etc).

Theory of Panspermia → A/c this theory life present in universe since the origin of universe and living organisms distributed from one planet to another planet in the form of spores.

→ Given by Arrhenius.

Theory of Biogenesis → A/c this theory life originated from pre existing life.
Omnis - Vivum - ex - Vivo.

→ This theory was experimentally explained by Reddy, Spallanzien & Pasteur (Swan neck experiment).

* Modern Theory Of Origin of life
or Oparin - Halden Theory
or Naturalistic Theory
or Theory of chemical evolution
or Artificial Synthesis theory :-

→ This theory was given by a Russian scientist A.I Oparin and Haldane (England born Indian Scientist).

- According to this theory first life originated in the water of Ocean by the aggregation of chemical through artificial Synthesis So, this theory is also called theory of artificial Synthesis i.e. water is necessary for Origin of life.
- There is no life on moon due to absence of water.
- Primitive atmosphere was reducing due to absence of Oxygen. So, Primitive or first life form was Anaerobic.
- Later on free Oxygen produced by photosynthesis and atmosphere converted into Oxidising.

Chemical Evolution :-

- (1) Atomic stage — Lighter element like H, N, C etc form primitive atmosphere. Among these atoms H is most abundant.
- (2) Molecular Stage or Simple Inorganic compound — First formed inorganic compound was H_2O and NH_3 . Later on lighter elements combine to form CO_2 , CO , N_2 , H_2 etc.
- (3) Early Organic compound — First formed organic compound was CH_4 . Later on HCN was formed.

→ Other organic compound like Azide, Nitride, Cyanide etc are also form.

(4) Simple Organic Compound → Earlier Organic compound react to each other to form simple organic compound like Aldehyde, ketone, Alcohol, Sugar, Amino acid, fatty acid, glycerol, Nitrogenous base, pentose sugar.

→ Energy for this chemical rxn obtain from UV rays from sun, Cosmic rays, heat of Volcanic eruption etc.

(5) Origin of Complex Organic compound - Simple Organic compound react to each other to form complex organic compound.

ex:- Amino acids attached to each other through peptide bond to form protein

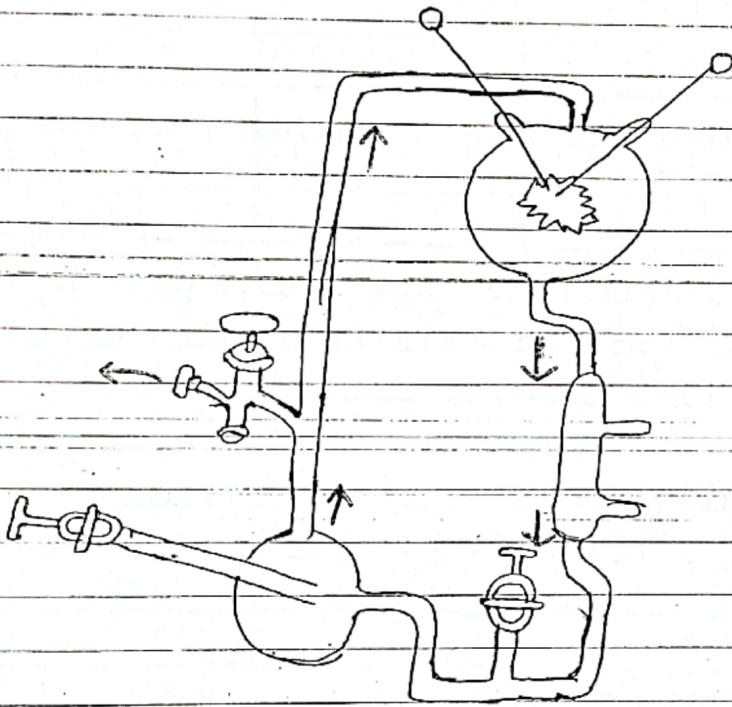
→ Sugar attach to each other through Glycosidic bond to form carbohydrate or polysaccharide.

→ Fatty acid & glycerol attach to each other through ester bond to form Lipid.

→ Nitrogenous base & pentose sugar attach to each other through N-glycosidic bond to form Nucleoside. Phosphate attach to Nucleoside through phospho ester bond to form Nucleotide. Nucleotide attach to each other through phosphodiester bond to form polynucleotide or Nucleic acid.

NOTE :- Halden called this saturated solution of Oceanic water as prebiotic Soup or dilute Soup.

* Experimental proof for chemical evolution



- Given by Stanley Miller and Harold Urey.
- Urey took a mixture of methane (CH_4), NH_3 & H_2 in the ratio of 2:1:2 ^{in large flask} and passed steam over it by boiling water.
- Electric spark was discharge at 800°C in this solution by using two tungsten electrode ~~apb~~.
- After 18 days dark red soln obtained. This mixture isolated and analysed. Then this mixture contain amino acid like glycine, Alanine and Aspartic acid.
- Similar experiment was performed by

Some other scientist and discover some other organic compound like fatty acid, glycerol, ~~etc~~ Organic acid, sugar etc.

→ From this mixture how life form appear we will study how biological evolution appear.

Atomic stage C, H, N

Molecular stage / simple inorganic compound, H_2O , NH_3 , CO , CO_2 , H_2 , N_2

Early Organic compound CH_4 , HCN , Cyanide, Azide etc.

Simple Organic compound Amino acid, sugar, N.B, P.S, F.A, Glycerol, Aldehyde, Ketone, Alcohol.

Complex Organic compound Protein, Lipid, polysaccharides, Nucleic acid etc.

Organic evolution :-

Origin of protobiont Or Coacervate → Macromolecules which were formed in primitive Ocean starts to aggregate and form a large colloidal droplet

like structure called protobiont.

→ Protobionts are made up of macromolecules (Carbohydrate, protein, fat, Nucleic acid).

→ Protobiont multiply by budding.

→ Oparin gave the term Coacervate for protobiont & also gave the statement that Coacervate are the first living molecules which gave rise to cell.

Origin of protocell or Eobiont →

Protocell was formed by the aggregation of Nucleoprotein.

→ Nucleoprotein has the ability of self duplication.

→ Protocell was the first living form which evolved into cell.

Origin of prokaryotic cell → Due to mutation protocell became more complex and able to utilise more surrounding

Nutrient and evolved into prokaryotic cell.

→ Hence, first living cell was prokaryotic cell which was originated in Oceanic water and these are chemoheterotrophic and anaerobic.

* Origin of Autotrophism → It includes chemoautotrophism & photoautotrophism.

a) Origin of Chemoautotrophism → Due to continuous withdrawal of organic nutrients from Ocean. Organic nutrient start to decrease so, some bacteria change their mode of nutrition from

Chemoheterotroph to chemoautotroph.

→ These bacteria can synthesise organic food from inorganic nutrient.

b) Origin of photoautotrophism → Some bac~~teria~~ start to synthesise bacteriochlorophyll and evolve into photoautotroph.

→ These bacteria can synthesise their own food by using light energy.

* Revolution of O_2 :-

Due to photosynthesis by BGA by product O_2 produce this is called Oxygen revolution and Due to this ~~revolution~~ Oxygen following changes occur in atmosphere :-

- i) Atmosphere converted into Oxidising.
- ii) O_2 reacts with CH_4 & NH_3 to form other gases like CO_2 , N_2 , H_2 .
- iii) Formation of O_3 layer.
- iv) Evolution of Eukaryotic cell.

→ Due to O_2 revolution some bacteria evolved from anaerobic to aerobic bcoz in aerobic respiration 19 times more energy releases than anaerobic.

→ Prokaryotic cell starts to form new organells like Nucleus, mitochondria etc and evolve into eukaryotic cell.

C, H, N



CO, CO₂, H₂O, N₂, H₂

CH₄, HCN

Aldehyde, Ketone, P.S., N.B., F.A.
Alcohol, Glycerol, AAs etc.

Carbohydrate, protein, fat,
Nucleic acid,

Protobiont / Coacervates

Procell / Eobiont

Prokaryotes

Eukaryotes

Evidences of Organic evolution :-

- 1) Palaeontological evidence
- 2) Morphological and Anatomical evidence
- 3) Evidences from Vestigial Organ.
- 4) Evidences from Connective link.
- 5) Evidences from Atavism
- 6) Evidences from embryology.
- 7) Evidences from biogeographical distribution

- 1) Palaeontological evidence → Study of fossil is called palaeontology.
→ father of palaeontology - Leonardo da Vinci
→ father of Modern palaeontology - George Cuvier

→ Birbal Sahni was a famous Indian palaeontologist.

Palaeontology

→ Paleobotany
Study of plant fossil.

→ Palaeozoology
Study of Animal fossil.

→ Palaeontological evidence is one of most accepted evidence for organic evolution.

ex:- Archeopterin → fossil connecting link b/w reptiles and birds.

2) Morphological and Anatomical evidence -

a) Homologous Organ or Homology or Divergent evolution → Organs which are similar in origin & structure but differ in function are called Homologous organ.
ex:- forelimbs of Mammals.

Mammal	forelimb	function
Whale	Paddle	Swimming
Bat	Wings	Flying
Horse	fore leg	Running
Human	Hand	Holding

ex:- Vertebrate Heart & brain.

* Horn of Bougainvillea & Tendrils of cucurbits.

NOTE :- fore limb of Whale, Bat, Horse and Human consist of similar str. like Humerus, Radius, ulna, Carpels, Metacarpal, phalanges etc.

Both horn of Bougainvillea and Tendril of Cucurbits are originated from axillary bud but horn provide protection while Tendril helps in climbing.

b) Analogous Organ or Analogy or Convergent evolution $\rightarrow$ Organs which are dissimilar in Origin and structure but common in function are called Analogous Organ.
ex :- Eyes of Octopus and eyes of Mammals (Both differ in their retinal position).

* Flipper of penguin and paddle of Dolphin (Both differ in structure but perform same function Swimming).

3) Evidence from Vestigial Organ $\rightarrow$ Vestigial Organ are remnants of Organ which were functional in their ancestor.

$\rightarrow$ Human has 180 Vestigial Organ.
ex :- Nictitating membrane, Last molar, Canine, Vermiform appendix, Coccyx, Cecum, Auricular muscle (Muscle of pinna), Mammary glands in male.

4) Evidence from Atavism $\rightarrow$ Sudden reappearance of ancestral character is called Atavism.

ex :- pharyngeal fistula (Gill slits),

* post Anal Tail :

* Thick and larger body hairs

* Extra Nipples

5) Evidences from embryology → During embryonic development each organism shows their ancestral adult stage.

→ Mallet gave recapitulation theory.

→ According to this theory "Ontogeny recapitulate phylogeny" i.e each

organism repeats their ancestral adult stage during embryonic stage it means all organism evolve from common ancestor.

→ Ernst Haeckel explained it and gave biogenetic law.

6) Evidences from connective link → Organism which posses characteristic of two different group One be primitive and another advance called connecting link.

ex :-

Organism	Connecting link b/w
Virus	→ Living & non-Living
Euglena	→ Plant & Animals
Proterospongia	→ Protozoa & sponge
Peripatus	→ Annelida & Arthropoda
Neopilina	→ Annelida & Mollusca
Balanoglossus	→ Chordata & non-chordata
Coelacanth	→ Bony fish & Cartilaginous fish
Urodon & platypus	→ Reptiles & Mammals
Archaeopteryx	→ Reptiles & Birds (fossils)

7) Evidence from Biogeographical distribution:-
The distribution of living Organism on different Geographical region of earth is called Biogeography.

→ All the plant species in a particular area is called flora and all the animal species in a particular area is called fauna.

→ Alfred Russel Walece divided all the world in six geographical region and explained that different Organism evolved from different geographical region.

→ Prototheria (Echidina & platypus) are found in Australia.

→ Marsupials (Kangaroo) are found in Australia.

→ Lions & Elephants are mainly found in ~~Aust~~ Africa and India.

→ Zebra, Giraffe, Hippopotamus are found in Africa.

→ Main area of Human evolution is Africa.

→ On Galapagos Island Darwin found 20 types of finches (Birds) which differ in the shape of their beak and claw due to their different feeding behaviours & habitat. It is an example of adaptive

NOTE:- Palaeontological evidence and Biogeographical evidence provide one of the strongest evidence in favour of Organic evolution.

Lamarckism :- First theory of evolution was given by Lamarck. Philosophie Zoologique.

→ Term Annelida, Invertebrate was given by Lamarck.

→ Term Biology was given by Lamarck Trvlin.

→ The famous theory of Lamarck was Theory of Inheritance of Acquired Character.

Some Concept of Lamarckism :-

(i) Internal Vital force → Every organism has an internal vital force which leads to increase in size of Organ or entire organism generation after generation.

(ii) Effect of environment & new need → Due to change in environment Organism require new need for survive. Due to new need or desire new Structure develop. Due to new Structure habit of Organism changes.

(iii) Use and Disuse of Organ → The organ which are constantly used get well develop generation after generation and Disuse of Organ leads to their degeneration.

(iv) Inheritance of Acquired character → The character which develop during life stage due to internal vital force, effect of environment & new need and use & Disuse of organ inherited from one generation to next generation and due to accumulation of this structure organism differ from their ancestor which leads to formation of new species.

ex. in support of Lemarkism :-

- * Neck ^{& forelimb} of Giraffee ~~do~~
- * Due [^] to stretching in toes wave develop in aquatic bird.
- * Snake leg disappeared due to their disuse.

Criticism from Lemarkism :-

- 1) According to internal Vital force theory ^{cou} size of Organ of Organism ↑ses in ~~force~~ of evolution but it is not universal bco in plant Herbs, Shrubs & Grasses evolved from trees and in course of evolution their size get reduced.
- 2) We cannot sprout our wings wishing to fly.
- 3) Eyes of students & readers do not ↑ses i size and power Generation after generation.
→ Size of Heart remains same generation after generation even though it constantly beat throughout the life.

4) 4th concept are completely wrong bcoz
Aquired character are non-inheritable.

This was explained by :- for

(a) Weismann → He cut tail of rat²²
generation and observed that tail
appear in each generation. From this
concept weismann gave "theory of
continuity of germplasm".

Protoplasm

↓
Somatoplasm

→ Found in somatic
cell.

→ It dies with the
death of organism

→ It is non-
-inheritable.

↓
Germplasm

→ Found in
germinal cell

→ It transfer from
one to next generation

→ It is inheritable

(b) Pyne reared Drosophilla in dark for 64
generation and observed that size and
power of eye remain constant in each
generation.

(c) Boring of pinna & Nose in Indian.

(d) Iron shoes in chinese.

Neo Lemarkism → Some scientists
modified theory of Lemark and such
scientist are called Neo Lemarkian.

→ According to them - Due to change in
environment some physical and chemical
changes occur in organism and due to

this changes germ plasm affected and affected germ plasm inherited from one generation to other.

Darwinism → Darwin was born in England.

Boat → HMS Beagle.

→ He travelled to South Africa, South America, Australia & Galapagos Island.

→ Darwin was influenced by two books —
'Principle of population' → By Malthus.

'Principle of Geology' → By Charles Lyell.

→ Concept of Natural selection was struck in the mind of Alfred Russel Wallace & He wrote an essay and send to Darwin.

→ There was striking similarity between concept of Natural selection of Darwin & Wallace.

→ Theory of Natural selection was proposed by Charles Darwin & A.R Wallace.

→ Later on Darwin explained it in his book "On the origin of species by the means of natural selection".

Concepts of Darwinism :-

- (i) Over production.
- (ii) Struggle for existence.
- (iii) Heredity and Variation.
- (iv) Natural selection.
- (v) Origin of New species.

(i) Over production → Every organism has capacity to produce large no. of offspring under favourable condition.

→ Every organism reproduce in Geometric manner.

(ii) Struggle for existence → Every organism compete with other organism for food, Shelter, mating etc. These organism may be of same species or diff. species.

→ Competition is of 3 types :-
Intra Specific competition — b/w same species for food, shelter & mating
It is an acute type of struggle / competition
Inter specific competition — b/w different species for food, shelter.

Environmental struggle — Organism also struggle with their surrounding
Each organism struggle with cold, heat, desiccation, flood etc

(iii) Heredity & Variation → A/c Darwin Variation is continuous & those variation which are useful in struggle for existence would be passed from one to next generation and other will disappear.

(iv) Survival of the fittest & Natural Selection → The actual idea of survival of the fittest was proposed by Herward Spenser. According to Darwin, only those organism survive which possess useful variation and which are helpful in struggle for existence.

↓
Natural selection

↓
Sexual selection

→ Nature select only fit individual i.e. having useful variation which is helpful in Struggle for existence Called Natural (adaptation) Selection. → According to Sexual Selection Darwin explained that only female can select male for mating.

(v) Origin of new species → According to Darwin variation which arises due to environmental changing inherited to next generation & natural selection repeat it generation after generation & due to accumulation of this variation after several generation origin of new species occur.

Criticism of Darwinism :-

- 1). In Darwinism there is no any concept about Vestigial Organ.
- 2). In Darwinism there is no satisfactory explanation about cause, origin & inheritance of Variation.
- 3). Criticism of Darwinism was based on Sexual Selection = Why ~~select~~ female select male for male Why not vice versa.
- 4). Darwin has no idea about Somatoplasm & germplasm.
- 5). Darwin only explained survival of the fittest not arrival of the fittest.

6) The main drawback of Darwinism was lack of knowledge of heredity.

Neo Darwinism — It is a modified form of Darwinism which includes recent studies and researches of Hugo de Vries, Weismann, Mendel, Huxley etc.

Features of Neo Darwinism :-

- (i) Rapid multiplication or Random mating.
- (ii) Limited resource (Food & Space)
- (iii) Struggle for existence (Inter specific, Intra specific or environmental struggle)
- (iv) Genetic variation → Genetic variation is inheritable which arises due to—

a) Mutation — Sudden inheritable change in genotype which change the phenotype.

b) Genetic recombination :- It arises due to crossing over.

c) Hybridisation or Gene migration :-

d) Genetic Drift :- It is elimination or addition of a gene of certain character when an animal Emigrate or Immigrate or dies from a population.

→ Due to genetic drift gene frequency of remaining population changes.

→ Genetic Drift operates in small population.

→ Genetic Drift is change in gene

frequency of a gene pool by chance.

Sum of the total gene of a population is called gene pool.

* Founder effect — Due to genetic drift phenotype of a small population rapidly changes and becomes different from parental population & sometime form a new species such an effect is called founder effect.

(v) Natural Selection

(vi) Isolation → It is segregation of a population by some barrier to prevent interbreeding. It leads to origin of new species.

vii) Origin of new species → Due to Isolation

Examples Of Natural Selection :-

Before

i) Industrial melanation — ~~Before~~ Industrial revolution dull grey (white) coloured peppered moth (Biston betularia) were dominant while Carbonaria form (Black peppered moth) was there bcoz white peppered moth were flourished on tree trunk while black peppered moth exposed and killed by birds.

After Industrial

revolution smog got deposited on trunk due to which trunk of tree turn black so black peppered moth flourished while white peppered moth exposed. Hence, Black peppered moth became dominant.

ii) Drug resistant → Drugs which are used to kill the pathogen becomes ineffective in course of time bcoz pathogen becomes tolerant from these drugs and produces tolerant progeny which becomes resistant from that drug. It is an example of Anthropogenic evolution (Man made evolution).

iii) Sickle cell anaemia and Malaria → Sickle cell anaemic patient are resistant from malaria.

iv) G-6 PD Deficiency & Malaria → Glucose 6-phosphate Dehydrogenase deficiency affect the RBC production hence Such patient become resistant from malaria.

Comparison of Variation Hugo devrie Vs Darwin :-

Darwin Concept

Devrie's Concept

→ Variation occur due to gene combination	→ Due to mutation
→ Variation is directional & gradual	→ Variation is directionless & random
→ Successive	→ Single step large variation called saltation.

Hardy' Weinber principle :-

According to this principle Gene frequency

of a population is stable and constant from one generation to next generation.

→ Gene pool remain constant called Genetic eqb.

→ Sum total of all allelic frequency is

$$\text{Allele} \quad A + a = 1$$

$$(A + a)^2 = 1^2$$

$$A^2 + 2Aa + a^2 = 1$$

$$\text{Gene} \quad AA + 2Aa + aa = 1$$

$$\begin{aligned} 16\% &= 0.16 \\ 0.16 &= 0.4^2 \\ a &= 0.4 \\ A &= 0.6 \end{aligned}$$

→ Change in genetic equilibrium or Hardy Weinber eqb. or Allele frequency leads to evolution.

→ Five factors are responsible for this change.

- (i) Gene migration or Gene flow.
- (ii) Genetic Drift.
- (iii) Gene recombination.
- (iv) Mutation.
- (v) Natural Selection.

Q) If %age of recessive character in a population is 25% then % age of other character will be.

$$\% \text{ of recessive character} = 25\%$$

$$\text{frequency} = 0.25$$

$$a^2 = 0.25$$

$$a = 0.5$$

$$A = 0.5$$

$$A^2 = 0.5 \times 0.5 = 0.25$$

$$= 25\%$$

$$2Aa = 2 \times 0.5 \times 0.5 = 50\%$$

$$\% \text{ of dominant character} = 25\% + 50\%$$

B) If frequency of dominant allele is 0.6 then % of homozygous dominant heterozygous dominant & recessive character will be.

$$A = 0.6$$

$$a = 0.4$$

$$A^2 = 0.6 \times 0.6$$

$$= 0.36$$

$$= 36\%$$

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

$$= 48\%$$

$$aa = 0.4 \times 0.4$$

$$= 0.16$$

$$= 16\%$$

Types of Natural Selection:-

On the basis of relation b/w Organism and environment Natural Selection is of three types:-

1) Stabilizing Selection - It operates when phenotypic character coincides with optimum environmental condition and competition is not present.

→ It gives a population genetically constant.

→ Here, more individual acquire mean character so, bell shaped curve obtain.

ex - Mortality in baby

2) Directional Selection / progressive selection - It produces a regular change in population with respect

to certain trait.

→ It operates in response to gradual change in environmental condⁿ (environment is changing in one direction).

→ Here, more individual acquire value other than mean character value.

ex:- Boston Betularia.

Resistance of Insect to DDT

3) Disruptive Selection (Rare) --- Due to facultative environmental condition (Season, Climate etc) more than one phenotype in a population may appear.

→ This can split a population into a sub-population.

→ Gene flow b/w sub-population is prevented so, each population give rise to a new species.

ex:- Shell patterns limpets

↓
(An aquatic Mollusca).

Evolution of man:-

Kingdom → Animalia

Phylum → Chordata

Sub Phylum → Vertebrata

Class → Mammalia

Sub Class → Eutheria

Order → Primata

Family → Hominidae

Genus → Homo

Species → Sapiens.

Evolution of Apes :-

Propliopithecus



Aegyptopithecus



Proconsul



Dryopithecus



Ramapithecus



Shivapithecus



Kenyapithecus



Australopithecus

EVOLUTION OF MAN :-

Homo habilis



Homo erectus



a) Java man



b) Peeking man

c) Heidelberg man



Homo sapien



d) Cromagnon man



h) Neanderthal man