• Function of religion

1) Social cohesion & solidarity – Durkheim
2) Psychological relief. – Malinowski
3) Social control – sins → -ve sanction] R. Brown, virtues, heaven, hell.
4) Intellectual fxn – provides answers; moral teachings
   ↳ Eg:- on life and death
5) ~~Ritual role~~. – in marriage, rituals.
   ↳ Purushartha – Kama, Moksha, artha, Dhamma.
6) ~~social change~~ – Buddhism challenged orthodoxy of Brahmanism
7) Transmission of culture to next generation
   socialisation ↳ Eg:- Bhils transmit oral history in annual religious ceremony.
8) Healing – shaman

Q.5 • Forms of religion in tribal & peasant societies

Q.5 Animism?

• Intro :- E B Tylor in his classic 'Primitive Culture' (1871) referred to animism as the earliest form of religion. It refers to a belief in dual existence of all things - a physical, visible body and a psychic, invisible soul.

• UNDERLYING CONCEPTS.

(1) Dream - Death experience of man.

1.1). ~~All people~~ Tylor believed that religion originated ~~in~~ due to people's speculation about dreams, trances and death.

1.2) Lifelike appearances in dream along with appearance of dead suggested dual existence for all things.

(2) Dual existence & belief in soul.

2.1) These experiences made early man believe that every physical body has an invisible soul associated with it.

2.2). It is the soul that leaves the body, temporarily during sleep and permanently during death, and wanders around.

(3) Tylor called this belief in soul as earliest form of religion and referred to it as animism.

④ Anthropomorphism :- Animism thus refers to belief in souls as well as anthropomorphic (having human like characteristics) supernatural beings.

⑤ Evolution of religion according to Tylor :- He said that since souls are aplenty, origin of religion should be polytheistic

Animism ⟶ Polytheism ⟶ Monotheism

- Criticism

① Tylor didn't conduct any fieldwork.

② Tylor assumed early man to be a philosopher which is too far-fetched.

③ RR Marett criticised animism for being too sophisticated and suggested animatism as the origin of religion.

④ Belief in soul is just one feature of religion. Animism doesn't talk about other features like values, morals, customs, rituals etc.

- Contemporary Relevance

① Many hunting-gathering societies have a belief in animism.
LP Vidyarthi – NMS
↓
Malen (1963)
↓
Eposain

↳ Eg:- Santhals and Bhils
↳ Korwa tribe's belief in 2 types of spirit - benevolent & evil spirit.

② Hindu concept of shraddha and attainment of 'moksha' show belief in soul.

- Conclusion

Theory of Animism laid down the founding stone ~~its~~ anthropological study of religion. It for further.
was followed by Animatism of Marrett, Totemism of Durkheim and so on.

Q.6. Animatism ?

- Intro :- R R Marett in his book 'The threshold of religion' (1909) proposed animatism to be the earliest form of religion. It refers to a belief in supernatural. ~~impersonal~~ impersonal forces. It preceded the creation of spirits according to Marett.

- Basic underlying concepts.

① Concept of Mana.

1.1) Marett adopted the word 'mana' from Melanesia. It refers to exceptional power to do things that are unusual.

1.2) Thus, mana is a kind of impersonal force that can be manifested in any person or object.

② Function of mana

2.1) Mana is a single, universal, transferable supernatural power.

2.2) Hence, it was believed that whoever possessed mana is destined to excel in performance of its ~~this~~ skills.

functions &

2.3) Eg:- Melanian chief or master craftsman possessed mana,
Inanimate objects like stone could also possess mana and when these miracle stones are kept around agricultural field, yield is more etc.

(3) However, an object (animate or inanimate) can lose this supernatural miracle-working power over time or it could be transferred.

(4) Evolution of religion according to Marett
He said that since there is a single supernatural force called mana, origin of religion should be monotheistic.

Animatism (Mana) → Monotheism → Polytheism

- Contemporary Relevance

(1) Many simple societies believe in impersonal supernatural forces.
↳ Eg:- 'Bonga' among Munda

(2) Other examples are :→ belief in power of rabbit's foot
→ supernatural power of holy water of Ganga.

- Criticism

(1) Marett in his concept of animatism doesn't talk about other aspects of religion like morals, customs, values, rituals etc.

(2) since, Mana is a contemporary concept among Melanesians. It is highly likely

that it could have been evolved out of some earlier practice and is not the ~~point of~~ origin of religion itself.

- Conclusion.

Marett's animatism was in direct contrast to Tylor's animism. However, these earlier studies laid down the foundation for emergence of detailed anthropological study of religion.

Q.7 Fetishism?

- Intro :- Charles de Brosses in his book 'Du Culte des dieux fetiches' (1760) proposed fetishism to be the earliest form of religion. It refers to worship of inanimate objects for its supernatural powers or because it is considered (fetishes) to be inhabited by a spirit.

→ ~~Also~~ Karl Marx and Augustus Comte (later) expanded the concept of fetishism ~~in later period~~. (in 'Course of positive philosophy')

- **Basic Underlying Concept**

① Fetish :- It is derived from the word fetissos which came to light during 16th century accounts of the Portuguese voyages to West Africa.

1.1) It refers to objects that are believed to have supernatural powers.

1.2) Examples of fetish objects are pieces of jewellery, wood, stone etc.

② Practice of Fetishism :-

2.1) It can be seen in Voodos of Togo and other west African tribes.

2.2) The fetish objects ~~are~~ also include blood, fur, bone, hair, claws etc.

② Function of fetish objects :- These objects (2.2) are sometimes adored or insulted depending upon whether it fulfills or not its possessor's wishes.

(2.1) People attribute inherent value or powers to material objects in fetishism

④ Evolution of religion & comte

→ Brosses has regarded fetishism to be the earliest form of religion followed by polytheism and monotheism.

Fetishism → Polytheism → Monotheism

• Contemporary Relevance

① Many simple societies worship fetish objects
↳ Eg:- Voodos, sword is a fetish object among Bondo of India.

→ Minkisi (fetish objects or idols among Bakongo of Zaire).

② Fetishism is also found in modern day religions
↳ Eg:- → Holy cross in Christianity
→ Shivalinga in Hinduism etc.

• Criticism

① According to Tylor, fetishism shifted the attention away from relationship b/w people and god to focus instead on a relationship b/w people & material objects.

(2) Doesn't talk about other aspects of religion which are non-materialistic like values, morals, customs etc.

• Conclusion

Fetishism, theoretically, is present in all religions. ~~However, in post-industrialised world, humans have managed to describe~~ In today's would, people are increasingly associating ~~that~~ scientific or economic value with material objects, separate from any religious prejudices and fears.

Q.8 Naturism ?

• Intro :- Max Muller proposed naturism to be the earliest form of religion in his ~~book~~ work 'Lectures on the origin & growth of religion' (1878). It refers to personification of natural phenomena like sun, rain, thunder etc. in form of gods due to elements of suspense, terror, marvel and miracle associated with them.

• Basic underlying concepts.

(1) Origin of naturism :- Muller argued that early man couldn't explain the regular occurrences taking place in nature with known facts

1.1) Such natural phenomena include rain, thunder, flood, oceans, forests etc.

1.2) Therefore, nature was a source of wonder, awe, terror and uncertainty for humans.

(2) As a result, humans started worshipping nature out of fear and awe.

(3) Examples of naturism :→ during floods, people worship by animal sacrifice to tame the river.

→ Eg Vedic gods of rain (Indra), sun (surya), ocean (Varuna), fire (Agni) etc.

(5) **Evolution of religion.**

→ In naturism, many phenomenons of nature are worshipped. Therefore, origin of religion should be polytheistic.

Naturism → Polytheism → Monotheism

(4) Comparison of naturism with animism

→ In naturism, people worshipped objects of nature which were beyond human control.

→ While in case of animism, objects of nature were worshipped as they were believed to have anima, or soul.

• **Contemporary relevance.**

(1) People in simple societies often worship and tributes to rain gods for good agricultural yield.

↳ Eg:- Pongal, Makar sakranti etc.

(2) 'Coronadeni' temple :- signifies worshipping of uncertain forces of nature.

- Criticism.

① All religions did not necessarily originate from naturism.

② Doesn't talk about other aspects of religion like values, morals, customs etc.

- Conclusion.

~~Nature still continues to evoke~~

Religion of simple societies is quite dynamic in nature. With increased pace of climate change, the uncertainty associated with forces of nature has also increased. However, scientific approaches in addition to religious ones have ~~also occupied the stage~~ been applied to deal with such change.

Q.9 Totemism ?

- Intro :- Durkheim proposed totemism to be the earliest form of religion in his book 'The Elementary forms of religious life' (1912).

→ It refers to granting a sacred status to a plant or animal or any other ~~symbol~~ object (Totem). Such totem is regarded as a means of group identification and is conceived to be of special ~~significance for the clan~~.

Totemism refers to a sacred relation b/w a species of plant or animal or any other object (totem) and a group of people. It is regarded as a means of group identification.

(give 'totem' definition if space)

Basic Underlying Concepts

① Totem :- It is derived from Ojibwa word 'Ototem' meaning relative, friend or kin.

1.1) Durkheim's study on Australian natives showed that each clan had its own 'totem'

He therefore quoted that -

"Totem is the flag of the clan"

1.2) Totem of a clan is the focus of its religious rituals.

② Totem and Taboo :- There is taboo against killing of totem animal as it is the saviour of clan.

2.1) This could be to promote ecological balance and inter-clan cooperation.

Pregnancy & totem

③ Durkheim's dichotomy of sacred and profane :-

He considered totem to hold high sacred & symbolic value as it evoked religious sentiments.

→ Sacredness associated with a totem is usually not a result of its exterior properties but it is attributed by the society to that totem.

④ Social cooperation & solidarity :-

→ Durkheim believed that having a totem in common promoted social integration.

→ It also resulted in inter-clan cooperation as totem of one clan is the food of other clan. Hence, when a clan prayed for increase in its totem's number, indirectly food for other clan is also increasing.

⑤. Evolution of religion :- since there are multiple totems, each for a separate clan, origin of religion should be polytheistic.

Totemism → Polytheism → Monotheism

- Contemporary Relevance

1). Many sports teams or even nation states are represented by an animal (totem)
   ↳ Eg:- Chinese dragon, American eagle etc.

2) Many simple societies continue to identify with a totem.
   ↳ Eg:- Goat clan among Gonds
   → Buffalo - Toda
   → Kaman tribe - Netam (tortoise), Wagh sori (tiger), Nag sori (snake) etc.

3) However, influence of Hinduism, Christianity, Islam, Buddhism etc. have impacted tribal religious practices.
   ↳ Eg:- Gondi Mahabharat, Bhot tribals of Ladakh following Buddhism etc.
   → Mundas influenced by 'bhakti cult' & lost faith in their own 'bonga' religion.

add this in all other answers too.

- Criticism

① All societies or groups don't have a totem (not universal)

② It neglects the psychological function performed by religion with respect to an individual.

- Conclusion

Totemism still has relevance as many groups continue to identify themselves with a common symbol. However, it has to be

viewed along with psycho-functional approach of Malinowski to establish a holistic understanding of emergence of religion.

Q.10 Compare between religion, magic and science.

- Intro :- Religion :- Durkheim defined religion in his book 'The Elementary forms of religious life' (1912) as - "a unified system of beliefs and practices relative to sacred things"

↳ Magic :- It refers to performance of certain rituals believed to compel the supernatural powers to act in particular ways.

→ Science :- It is the study of physical world through observation and experiments, and the development of theories to describe the results of such observations.

- Intro (1st line) :- Frazer in his classic work 'Golden Bough' (1890) proposed the theory of evolution of religion. He believed that primitive societies performed magic and when it didn't always succeed in producing the desired results, religion emerged. Religion further paved the way for origin of science.

Frazer refused to magic as 'pseudo-science'

Magic → Religion → Science

Similarities

→ W J Goodey in his book 'Religion among Primitives' (1951) proposed similarities b/w magic & religion through his magic religious continuum.

→ Other scholars like Malinowski [Magic, Science & Religion (1948)] & Frazer have established similarities b/w magic & Science.

(1) Concept :- Both religion and magic belong to the area of sacred ~~concepts~~. They are related with non-empirical and intangible things. [B/w religion & Magic]

(2) Supernatural :- Both believe in existence of supernatural power.

(3) Function :- All three are tools of adaptation to the surrounding environment. They fulfill psychological and other material needs of individuals. [All 3]

(4) Functionaries :- All 3 are performed by a set of functionaries who are expert in their domains. Eg :- priests, shamans, scientists etc.

(5) Rituals :- Both religion & magic follow ritualistic and ~~traditional practices~~ mythological traditions. [B/w magic & religion]

(6) Objective :- All 3 emerged / developed to seek explanation about the mysteries of the world. [All 3]

⑦ Procedure :- science and magic, both are governed by a system of rules, and procedures. (principles)

Assumption :-

⑧ Both assume that certain causes create certain effects. Hence, they are oriented towards desired ends.

Magic & science.

- **Difference.**

→ Frazer, Malinowski gave following points of difference.

Area	Religion	Magic	Science (is profane & secular in nature)
Sacred & profane Nature	① It lies in sacred domain as there is belief in supernatural powers of gods etc.	① It lies in sacred domain too. However, belief is more profound in existence of variety of spirits	① It lies in ~~the area of the profane~~. It is based on reason and logic.
Area of work	② Deals with supernatural world & is ~~surrounded by~~ ~~mysticism~~ powers	② → " → Eg :- Mana among Melanesians.	② Deals with the natural world.
Methodology	③ It involves praying & asking for favours of god.	③ It involves compelling and forcing the supernatural to act in a particular way by performance of rituals	③ It involves observation, experimentation & development of theories.
Functionaries	④ Priests are usually emotionally devoted to god and occupy a lower position than god.	④ Magicians assume to have control over supernatural power. The connection is largely instrumental	④ These are trained specialists devoted to their work.

④ Priests show great devotion to god and occupy a lower posn than god.

⑤ Religion involves the entire community, it is public in nature.

⑥ Religious acts are self-contained acts performed in self-fulfillment.

⑦ Religion is mostly benevolent and social welfare oriented.

⑧ It is not open to empirical testing or questions

④ Magicians regard themselves to be superior & in control of supernatural. They can resort to manipulation or coercion.

⑤ Magical formulas are kept secret & can be accessed by only a selected few.

⑥ Magical acts are a means to an end.

Ruth benedict

⑦ It can have both positive & negative types.

④ Scientists conduct their studies within laws of nature. There is lesser role of emotions & devotion.

⑤ Though, science is individualistic. It is open to anyone who wants to learn

⑥ → ⑪

Dobu → Magic
zuni

⑦ It can be either benevolent or malevolent.

⑧ It is open to empirical testing & questions.
→ open system of thoughts & beliefs.

• Additional points for magic & religion

Durkheim → Religion is communal

(same as ⑤) ① Religious rituals are public in nature & widely known. ; shared belief

→ Magical rituals are held secretly and are not known to others. But, Known in Andaman islanders that magic too may have communal dimension.

⑦ Religion promotes social integrity & solidarity

→ Magic promotes interests of a section of society. Hence it is divisive

Eg:- Tribal Voodoo etc

bridge b/w magic & religion

- Additional points for science & magic

① Science is based on true & logical assumptions.
→ Magic is based on wrong assumptions regarding causal relations.

② Failure of science is due to inadequate knowledge and can be corrected by further research.
→ Failure of Magic is supposed to be due to some error in performance of ritual or else due to counter magic.

- Coexistence of religion, magic & science.

confluence of magic & religion
→ Eg:- Fetishism, Animatism, Totem, Animism

③ Malinowski in his book 'Magic, Science & Religion' (1948) proposed that natives are not totally unscientific in their attitudes and should be considered to possess rudimentary forms of science.

④ While they might believe in religious & magical practices. Native people also performed rational & practical activities.

⑤ Eg:- Trobianders follow scientific agricultural practices, but they also perform annual magical rites for good and healthy crops.

⑥ Scientific basis can also be developed for many modern day religious practices.
↳ Eg:- using copper utensils in rituals for their antimicrobial properties

→ health benefits of mummic.

⑤ Magico-Religious basis of many modern-day events
→ Eg:→ Horoscope in magazines
→ Coronadevi temple

• Conclusion

Relationship b/w science & religion is gradually changing from conflict & hostility to harmony & collaboration. Moreover, scientific observations can be used to discredit certain derogatory rituals, like, health risks associated with child marriage. Similarly, local religion & cultural practices can be used to give more weight to certain elements of public policies

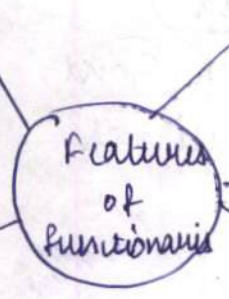
↳ Maa Danteshwari Clinic in Chhattisgarh (imp.)

Einstein :-
'science w/o religion is lame, & religion w/o science is blind'

Q.11. What are the magico-religious functionaries.

• Intro :- Magico-religious functionaries are part-time or full-time specialists who are more knowledgable than others & have acquired special training to carry out religious performances or impart religious knowledge to others.

→ Examples.



- Ritual authority
- spiritual gifts & knowledge
- traditional & elaborate attires and accessories.
- Interpret religious codes & laws
- Mediator b/w humans & supernatural power

• Types of functionaries.

I Shaman

Type of societies :- nomadic, semi nomadic - egalitarian → food collectors

① Shaman is a religious intermediary, usually part time, who is believed to have special powers and is involved with healing as well as provides assistance for other practical purposes.

② He is usually a male specialist, however female shaman is also present.

③ He acquires a high status in society; society is fairly egalitarian

④ Shamans are believed to get assistance from spirits. Dreams may also be used to provide insight or to commune with spirits.

Methodology
① ② Elaborate rituals involving dance, drum beating etc. also performed to contact spirits

⑤ Functions - a). healing and curing of illness; also called medicine man

b). Other practical matters like getting food resources, warning people about an impending disaster etc.

⑥ Eg :→ Shamans in Siberia, Tapirape Indians of Brazil, etc.
→ India :- shamans are called Dasari in Bhuia, Sunia in Maria Gond, Bhopa in Bhil etc.
Zulu of south Africa.

in Phillipines shaman perform 'spirit surgery'

II Priests

① Priests are full time specialists with very high status who are thought to be able to relate to superior gods who are beyond the ordinary person's access.

② Priests are usually male, but female priests are also found.

Format
I Sorcerer
① one line defn
② Type of soc. :-
③ status & gender
④ Training & methodology / appointment
⑤ Functions
⑥ Eg

③ Priests are either politically appointed or they inherit the office.

④ They are distinguished from other people by special clothing or hairstyle

⑤ Training :- Priests undergo rigorous & long training in the form of fasting, praying & learning the dogma & ritual of his religion.

- found more commonly in food producing than food collecting soc.
- More likely to have class stratification & political integration

⑥ Functions :- ① They are ritualistic head and carry out religious activities in lines with memorised rituals

② They impart religious knowledge to the public

③ Political fxn :- Priests often have political power

↳ Eg :- Pharaohs of Egypt.

⑦ Difference b/w priest & shaman :- If shaman repeatedly fails to effect a cure, he will probably lose his following.

→ however, if priest fails to get desired response from gods, he will still retain his position.

⑧ Eg :- Priests among Zuni of America, Brahmins in Hinduism, Kaminchu priest in Okinawa society etc.

III Sorcerers

material or tangible

→① Sorcerers are magic-religious specialists who use certain materials to invoke super-natural powers to harm people.

② They have fairly low socio-economic status

③ They are found in societies that lack procedures or judicial authorities to deal with crime & other offences. 3a) Political turmoil / unrest :- high illiteracy, distrust, poverty etc.

They are usually food producing agriculturist

④ Training & Methodology :- The act of sorcery is acquired through training and doesn't necessarily pass on to the next generation.

→ Training involves rigorous memorisation of spells and learning other rituals to establish contact with spirits

⑤ Function :- 1) Sorcerers provide an effective mechanism for social control

2) They are believed to invoke supernatural to cause illness or injury to a person.

⑥ Eg. Sorcerers are often killed for their malevolent activities.

IV Witches

① These are magico-religious specialists who can invoke supernatural malevolence and cause harm to people through emotions & thought alone, without the use of tangible objects.

② & ③ same as sorcerers.

④ Training & Methodology :- Witchcraft is often inherited and is said to be perfected through rigorous training & practice.

⑤ same as sorcerer

⑥ Witch hunts :- Many a times, people are captured & killed, ~~using them as scapegoat~~ for being witches.

→ They are often used as scapegoats in societies faced with political turmoil.

→ Eg:→ Azande of Zaire practice witchcraft.
→ witch hunt in Europe and Salem in 16th & 17th centuries.

• Difference b/w witchcraft & sorcery.

① sorcery - objects ; witch - emotions & thoughts
② " - usually male ; " - usually female
③ " - cannot be inherited, acquired art ; witchcraft - inherited.
④ sorcerer - perform magical rites to achieve evil ends ; witch - more severe destruction & death.
⑤ sorcerer - evidence can be easily found as they use materials for magic ; witch :- harder to prove. if someone is a witch as no evidence could be found; leads to witchhunt.

• Conclusion. imp.

While cultural relativism should be adopted while analysing religious practices of native cultures. It should be balanced out with respect for human rights. Practices of witchhunt should be dispelled through promoting awareness & scientific temper and by formulating appropriate policies.

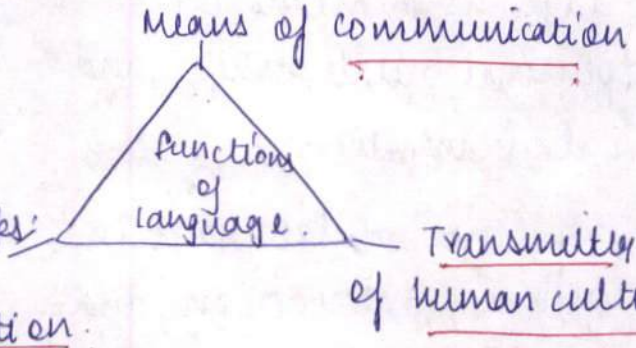
Odisha govt. has passed 'Prevention of witchhunting Act, 2013' in Odisha

Unit-7 Culture, Language & communication

Q.1 Describe the nature, origin & characteristics of language.

- Intro :- Bloch and Trager defined language in their book 'Outline of linguistics analysis' (1942) as — "It is a system of arbitrary vocal symbols by means of which a social group cooperates."

Malinowski's 'derived need'



- **Nature of language**

1) The Structural View

1.1) ~~It sees language as a system of structural elements~~ inter-related

1.1) It sees language as a structured system of interrelated elements and units ~~such as~~ phonemes, morphemes, syntax and other grammatical units.

1.2) Levi-Strauss drew inspiration from Saussure's work in structural linguistics to frame his theory of structuralism.

1.3) Grammar : Language :: underlying structure and rules : Culture

[Language is viewed as a means of communication with focus on conveying logical meanings (semantics)]

2) Communicative View

2.1) It lays more emphasis on the communicative function of language. Hence, it includes areas of semantics, sociolinguistics etc.

2.2) Language is viewed as a means of conveying logical meaning or enabling communication between different groups.

2.3) Malinowski in his functional theory described communication as a derived need for which language emerged as a cultural response.

3) The interactional view

3.1) It sees language as a means for establishing interpersonal relationships, and carrying out social transactions.

3.2) Focus is on ~~social~~ use of language in social context, such as, interaction and conversation b/w individuals.

3.3) ~~Greetz In his symbolic & interpretive~~ theory.

- **Origin of language**

→ There is widespread agreement that human language must have existed, at least 50,000 years ago due to archaeological evidence from upper Paleolithic times.

→ **Ways/Methodologies to understand origin of language**

① Development of pidgin and creole languages :-

→ Pidgin is simplified language that may expand & become more complex grammatically to form creole language.

→ There is striking grammatical similarity b/w creole languages throughout the world like use of double negatives etc

→ Hence, creole language can assist in understanding the origin of human language.

(2) Children's acquisition of language.

→ Children throughout the world express themselves in similar ways leaving out seemingly less important words.

→ Hence, it can be analysed to understand origin of language.

→ **Theories of origin of language**

(1) Divine creation hypothesis :- language is a gift of god to humans.

(2) Natural & Genetic evolution hypothesis

→ It suggests that language developed due to genetic changes in course of human evolution. Eg:- dev. of Broca's & Wernicke's area in brain.

(3) Imitation hypothesis

3.1) Ding-dong hypothesis :- language emerged ~~after~~ sounds emitted by ~~an~~ those objects. ~~in random to~~ as a result of

↳ Eg:→ names for frogs usually contain 'r' sound as frogs make such sounds.

→ words for thunder, rain etc.

3.2) Pooh pooh hypothesis :- language & speech developed as a result of primitive emotional reactions like hunger, pain, pleasure etc.

3.3) Bow-wow hypothesis :- Vocabulary developed from animal noises, ~~such as moo, bark, etc~~. ↳ Eg:- Dog - Bow-wow in English, ww-ww in Chinese etc

3.4) Gesture hypothesis :- Scholars like Darwin suggested speech ~~was ass~~ emerged to imitate hand gestures

↳ Eg :- fingers crossed, waving hand for bye

4) The Necessity hypothesis

4.1) Warning hypothesis :- Language evolved from warning signals as used by animals also.

4.2) Cooperation hypothesis :- Language developed due to need of collective effort and human cooperation.

4.3) Lying hypothesis :- It suggests that language must have evolved to fulfill selfish ends, that is for lying or deceiving as all real intentions could be communicated through gestures or sound etc.

• CHARACTERISTICS OF LANGUAGE

① Language has a structure :- It consists of phonemes, morphemes, syntax and other grammatical rules.

② Language is dynamic :- It keeps changing
Eg :- Increased use of emoji language and abbreviations in today's social media age.

③ Dialects :- Single language can have multiple regional dialects. It is result of diffusionism
↳ Eg :- Hindi : Awadhi, Braj, Bagheli etc.

(4) Socio-dialect :- language is subject to social variations in terms of speaker's social class, gender, age etc.

(5) Idolect :- language in subject to individual variations in terms of voice clarity, pitch, speech rhythm etc.

(6) language is symbolic and arbitrary. :- Brecht2 also suggested reading culture like a literary text. - thick description

(7) language can both be spoken language (through vocal tract) or sign language (hand gestures etc.).

(8) language is complex and open-ended :- new meanings can be formulated by combining already existing sounds.

• conclusion -

~~Four~~ Our planet has an enormous linguistic diversity. However, many native language are facing the threat of extinction due to colonialism and globalisation. Hence, it is required that appropriate attention is given to safeguarding the linguistic diversity. NEP 2020 is a positive step in this direction.

Q.2 Non-verbal communication.

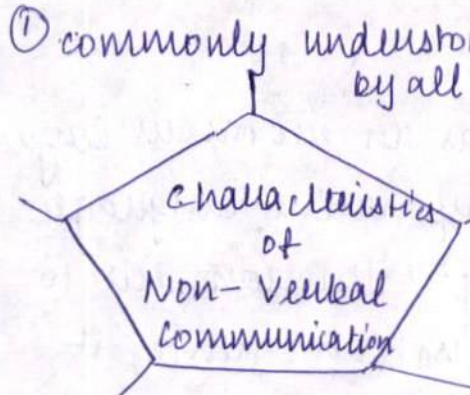
- Intro :- Language acts as a medium of communication. This is also depicted through functionalist theory of Malinowski where communication is a desired need.

There are 2 types of communication :-

Verbal / Non-Verbal.

Non-Verbal communication :- It refers to indirect communication through body language, symbolic systems or sensory channels and gestures. → without speaking

→ Charle's Darwin's book 'The expression of the emotions in Man and Animals' (1872) can be regarded as first scientific study of non-verbal communication.



(1) commonly understood by all.

(2) Not always voluntarily or consciously

(3) Universal (eg - facial expressions of happiness, fear, anger) or cultural variability (eg :- nodding up & down means 'yes' in major areas ; but 'no' in Greece.)

(4) transmission of information

(5) Reflector ~~transmitter~~ of human culture (eg :- accents can tell about person's place of origin, education etc)

- TYPES OF NON-VERBAL COMMUNICATION

Body &

① ~~Body language and~~ hand gestures → eye-gaze, head-nodding

Eg:- A firm handshake signifies interest in interaction whereas a limp handshake suggests the contrary.

② Kinesics :- Communication through facial expressions, body posture, mannerism etc.

↳ Eg:- Universal facial expressions for happiness, fear or anger throughout the world.

③ Physical environment :- This includes proximity or distance while communication according to level of acquaintance.

④ Gesture calls including whistled language :- It is more common in low density societies with great distances

↳ Eg:- Kongthong - 'whistling village' in Meghalaya

⑤ Symbolic systems :- This includes writing, algebraic equations or artistically through musical notations, art, dance etc.

⑥ Paralanguage :- These are non-verbal vocal sounds including silent pauses in speech.

↳ Eg:- Depressed person might speak very quietly in a flat tone.

⑦ Silence :- It can also reflect either companionship or unfriendliness

• **Non-verbal communication among non-humans.**

① Sound :- Birds and squirrels communicate through sounds.

(2) Odor :- Ants communicate through odor.

(3) Body movement :- Bees convey food location through body movement,
Dogs showcase their emotions through movement of their tails.

(4) Symbolic communication :- It is seen in primates as a call for warning, coopulation etc.
↳ Eg :- Gibbons sing to ~~show~~ mark their territory.

- Difference b/w human & non-human communication.

1) Human language use a larger set of symbols.] has a symbax; fitted in a proper structure

2) Human language is an open system where different sounds can be combined to produce variety of meanings.
↳ Primates have closed system.

3) Humans have unique ability to communicate about past and future events] Animals don't.

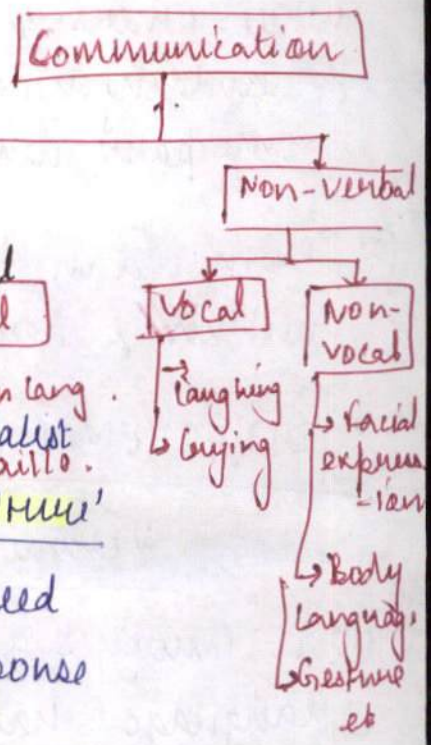
4) More complex - humans tell stories, recite poetry, give speeches.] Non-humans use sounds for more utilitarian purpose like warning, food collection etc.

→ However, attempts to ~~communicate~~ and teach apes human signs and symbols have been successful.
→ Even parrots can be trained to talk.

- Conclusion.

Non-verbal communication, thus constitutes an important part. Historically, learning ~~from point about~~ other culture's body language has helped in cross-cultural cooperation.

Therefore, it can be an essential tool for successful execution of government policies and integration of simple societies into broader network.



Q.3 Differentiate b/w verbal and non-verbal communication.

• Intro :- According to Malinowski's functionalist theory [given in 'A scientific theory of culture' (1944)], communication is a derived need and language emerged as a cultural response to it.

There are two types of communication.

Verbal

→ Transmission of information through oral means or speech.

Non-Verbal

→ Transmission of information through body gestures, sensory channels etc.

• **Similarity in Two types.**

1) Both constitute shared behaviour in a community & are commonly understood by all.

2) Both the channels of communication are transmitter of human culture

↳ Eg :- accents can tell about a person's cultural identity.

3) Both are complex and open ended

4) Some elements are universal (like common

facial expressions for happiness, anger, fear etc) while others are culturally variable (eg- nodding head up & down means 'yes' in some parts while 'no' in other parts - Greece).

(7) Means of cooperation

(5) Both aid in transmission of information within & across groups.

(6) Both are symbolic & sometimes arbitrary.

DIFFERENCE

Verbal

(1) It involves spoken language, that is, transmission through oral means.

(2) Verbal communication takes place voluntarily ~~or~~ & consciously. (involves thinking processing & articulating)

(3) It uses a single channel of communication, that is, human voice

(4) It can take place distantly too; physical presence of person is not required

(5) It is fairly easy to decode if you know the language.

(6) It is straightforward & complete in itself.

Non-Verbal

(1) It involves transmission without speaking through body & facial gestures, symbolic systems, sensory channels etc.

(2) It ~~can be~~ is not always voluntarily or consciously (can be unconscious response)

(3) It uses multiple channels of communication, sometimes at the same time. Eg:- expression, body language, tone of voice etc.

(4) It can take place only when all parties are physically present

(5) It is a little harder to decode.

(6) It can be either understood exclusively or in combination with spoken words to understand the situation better.

(6) more variability as diff. languages spoken in diff. regions

(8) more universal in nature.

• Conclusion

(7) Eg:- language like english, hindi; it can also include sign language.

(7) Eg:- kinesics, gesture calls, paralanguage, silence etc.

↳ verbal has syntax; phonetic & semantic rules/ grammar.

↳ verbal comm.

• Conclusion

Non-verbal communication is equally important and has wide cultural significance. With advent of new technologies like facetime & zoom calls, the need to be physically present for non-verbal communication has ~~also~~ reduced to a certain extent.

↳ verbal comm. types

1) formal v/s informal.

2) synchronous v/s asynch

↳ in real-time
↳ eg:- convo with friend

↳ not immediate
↳ Eg:- letter, email

3) Recorded v/s unrecorded

generally written - archived

Q.4 Examine the influence of culture on language as well as influence of language on culture.

• Intro:- Language is defined by Bloch & Trager in their book "Outline of linguistics analysis" (1942) as "A system of arbitrary vocal symbols by means of which a social group cooperates".

A L Kroeber &

→ Cognitive anthropologists like Conklin have established an interrelationship between language and culture.

↳ Conklin has proposed that structure of language through which people organise & communicate their ideas tells a lot about their culture.

Kroeber said that - "culture began in the presence of speech, then enrichment of any of them means the development of the other".

in his book 'Anthropology' (1923)

Cultural influence on language

→ On language structure

(1). Vocabulary → AL Kroeber & Lowie (1928) held that simple soc have simple vocab, and hence simpler kin terms.

1.1) More complex societies tend to have larger vocabularies than simple societies (1973)

↳ Eg:- Berlin & Kay suggest, that number of basic color terms increases with technological specialisation in a society. in his "India: An anthropological perspective"

↳ Typical eg of Koya & American

1.2) societies develop rich vocabulary for events or natural phenomena that are of particular importance to them.

↳ Eg:- Conklin in his article "Hanunoo color categories" (1955) depicted effect of moisture on color palette segmentation among Hanunoo of Philippines.

~~Xenon~~ Britishers used a common term 'Masala' to refer to all spices when they first accounted them, but Indians had separate terms for each.

(2) Acculturation & semantics :- Blending of two or more cultures can lead to assimilation of certain words and terms in daily use.

↳ Eg:- Hinglish

(3) Grammar :- Verb usage and categories differ in various cultures. separate

↳ Eg:- Hoijer studies Navajo's verb categories for objects in motion & at rest. It reflects their nomadic experience.

↳ Societies that ~~have~~ contain a system of private property may develop the verb 'have'

↳ Usage of 'Hum' & 'main' in parts of Bihar, Jharkhand & Delhi, Haryana respectively.

→ On language content

④ Use of numbers & other quantity related terms :- Possible that money dependent economies use more numbers in their language.

① Social status :- The language used differs with variance in class, caste, etc. (sociolect, slang)

↳ Eg:- Clifford Geertz study of Javanese indicate difference in vocabulary among peasants, townspeople & aristocrats.

② Gender difference :- Many societies have different ~~use~~ ~~speech~~ vocabulary and speaking styles for men & women.

↳ Eg:- In Japanese, male word for chopsticks is hasi and female word for same is ohasi

③ Regional variation :- Dialect differentiation occurs due to both physical as well as social distance.

↳ Eg:- Different dialects of Hindi - Awadhi, Braj, Rajasthani etc.

④ Influence of taboo :- In many cultures, usage of certain words is forbidden.

↳ Eg:- In victorian England, terms linked to sexuality were tabooed in polite conversation.

• Linguistic influence on culture

→ Sapir and whorf gave the linguistic relativity hypothesis, properly known as Sapir - whorf hypothesis.

→ It stressed on the influence of language.

on culture.

→ whorf famously quoted "speech is the best show man puts on... language helps man in his thinking"

① Impact of language on gender identity :-
languages which make more gender differences than others are more likely to have children that acquire the concept of stable gender identity earlier.

↳ Eg:- Hebrew English Finnish.

most → least
gender differentiation in speech.

time of acquiring gender identity: earliest mid-time latest

of people is also a result of their language.

② world view :- whorf proposed that Hopi & English speakers see the world differently due to latter's more emphasis on discreet time & space concepts.

③ Influence of language on stereotypes :- Certain elements of language which otherwise may seem ~~to~~ harmless may perpetuate sexist or casteist stereotypes

↳ Eg:- Boys are usage of terms like policeman, chairman to depict these offices.
male

④ Social status and identity :- Change in language can be linked to change in social identity.

↳ Eg:- M N Srinivas proposed that sanskritisation & westernisation began with the change in language.

(5) Globalisation :- with advent of globalisation and spread of Western languages, many native languages are now on the verge of extinction. with those languages, their culture are also facing a threat.

(6) Use of machine language :- Machine learning and AI ~~have brought to the fore front~~ require use of programming language.

↳ such use has enabled emergence of ~~high~~ technologically advanced culture.

contemporary relevance

• ~~Conclusion~~

(7) Modern language of emoticons and abbreviations :- It is giving rise to a social media, culture. It represents. & digital. the fast paced environment we are living in.

(8) Fictional languages :- Many cinematic worlds have developed their own fictional languages to better represent the fictional culture

↳ Eg :→ Klingon - star trek series
→ Dothraki - Game of Thrones etc.

• Conclusion

Thus, language acts as a tool to both express and reinforce culture. Need of the hour is to safeguard native languages.

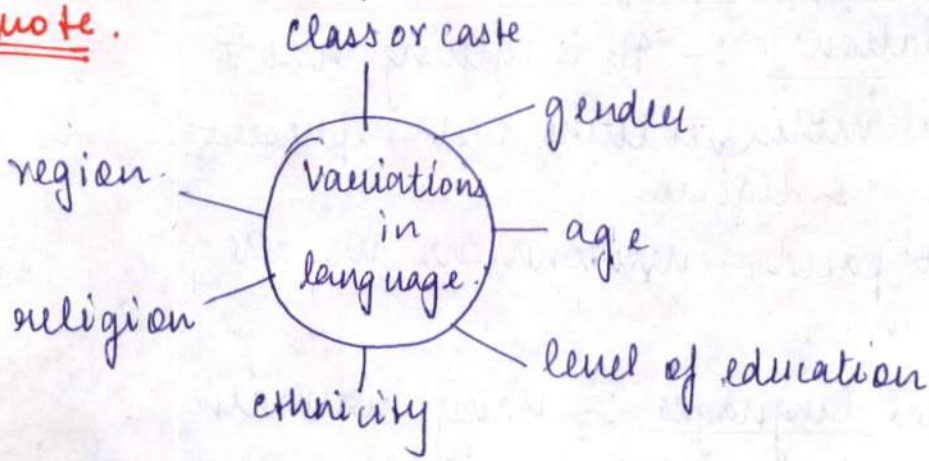
to sustain their unique culture. Three language policy and NEP 2020 are a positive step in this direction.

Q.5. Social context of language use / Explain how variations in language usage is related to social inequality.

- Intro :- The effect of any ~~and or all~~ aspects of society, including cultural norms, social context and social inequalities on language can be studied under the head of sociolinguistics

→ Thus, there are certain sociolects according to which language usage varies.

Whorf's quote.



- Types of inequality based on language use

(1) Subjective inequality :- There is a common prejudice that certain way of speaking is the right way. Therefore, others who don't subscribe to this way face unequal treatment

(2) Linguistic inequality :- People having rich technical vocabulary often enjoy higher prestige.

(5) Communicative inequality :- It represents barriers to communicating their ideas successfully by certain groups of people. It can be due to language or cultural barriers or social inequality.

Social factors influencing language usage.

(1) Social status or caste / class :- ~~Many societies~~

Many societies have different vocabulary or dialects for people belonging to different social class / castes.

↳ Eg :- i) ~~Brown~~ stated that in Java, peasants, townspeople & aristocrats used separate terms for the same concept.

ii) ↳ In Ancient India, sanskrit was the language of upper class (Brahmins) & Prakrit was of common people. — such belief also gave rise to sanskritisation movement.

(2) Gender :- In many societies, difference in men's and women's speech showcase unequal prestige and power.

↳ Eg :- women may try to use more polite and standard speech to fit into society's framework

(i) → Japan :- female add polite prefix 'O' like 'ohasi' for chopsticks., while male use simply hasi

→ (ii) use of male terms for certain jobs like policeman, chairman etc.

(3) Economic inequality :- Studies like that of William Labov (1960s) demonstrated that people in the process of wishing themselves to be associated with a certain socio-economic class

(3) Level of education :- Modern education has resulted in linguistic inequality among the masses.

↳ Eg:- Dominance of english language in formal conversions and urban areas.

(4) Economic inequality :- People tend to acquire language which they associate with higher economic status

↳ Eg:- ~~✓~~ Westernisation ~~and sanskritisation~~ has led to extinction of native languages in many parts of the world.

MN Srinivas

(5) Ethnicity and region :- Certain accents and styles of speaking are attributed greater prestige than others.

↳ Eg:- use of heterogeneous speech or double negatives among African Americans has given rise to differential prejudice among them.

(6) Religion :- Certain languages are associated with particular religions. ~~and can be a cause of social disorder~~ It can form the basis of inequality on religious grounds and can even lead to violence & social disorder

↳ Eg:- → Arabic and Urdu are associated with Islam ~~etc~~.

→ Attack on non-english speakers in western countries, etc.

• Contemporary relevance. - Balance b/w monolingualism & linguistic diversity

→ There have been efforts to bridge the social gap through special focus on local languages.

II

① Three language policy and engineering courses in 14 Indian languages under NEP 2020.

② Rejuvenation of native languages through school programs among Maori of New Zealand, Hawaiians of US etc.

→ Digital inequality transcending into linguistic inequality :- Increased social media culture has led to rise in use of emoticons & abbreviations etc. This is giving rise to a new type of language. However, the digital bayrun among certain sections has caused them to be isolated

not required

I → Globalisation & modernisation :- It has led to the emergence of a uniform standardised language. Since modern tasks require the use of this language, those who don't know it end up feeling isolated.

• Conclusion

There is a need to promote cooperation and mutual respect and tolerance for different languages. This can aid in bridging the social gap.

The ~~gap~~ focus should be shifted from 'English v/s Mother tongue' to 'English and mother tongue' for a more healthy balance.

Q.6 Sapir - whorf hypothesis ?

• Intro :- sapir - whorf hypothesis was first presented in Sapir's Essay 'The Status of Linguistics as a Science' in 1929.

It states that ~~particular~~ language spoken by a person ~~of a speaker~~ influences his conceptions of the world around him.

→ whorf famously quoted " speech is the best show man puts on ... language helps man in his thinking "

• Cross - cultural study by Sapir & whorf

1). They compared English language with hopi and deduced the following :-

2) English language has discreet categories with regard to time & space. For instance, usage of past, present & future tense.

3) Whereas, hopi language lacks such differentiation based on time.

4) According to whorf such difference has led English and Hopi speakers to view the world differently. → ~~No words or expressions for time~~ ~~no notion of time among~~ among Hopis. ~~but~~ → ~~However~~, hopis focus more on mythical events, ~~as depicted by their language~~.

• Basic Underlying concepts

① It shows influence of language over culture. Eg:- Language/ terms like policeman -chairman & ongoing processes propagate gender stereotypes.

② ~~Manga~~ People tend to have

more elaborate vocabulary for events that are of particular interest to them.

↳ Eg:- Eskimos have more than twenty words for snow; while Hindi speakers have only one - 'barf'.

(3) Thus, language helps in developing a particular thought process and rationality among humans. This is the basis of cognitive anthropology.

↳ Eg:- chemical formulaes and algebraic equations represent complex thought process of humans.

(4) This has also been emphasised by cognitive anthropologists like conklin ('Hanunoo color categories' (1955) based on moisture). Conklin, has also supported the hypothesis through his language-culture interrelationship.

↳ structure of language tell us a lot about how people perceive things and hence is a reflection of their culture.

u(a)

Criticism

(1) It is difficult to segregate the effects of other aspects from the effect of language on culture.

(2) ~~Many~~ studies have shown that people can think about things even if they don't have word for it in their language.

(3) Malotki, a linguist in his book 'Hopi time' has shown that Hopis talk about time using noun phrases.

• Conclusion

Despite its criticism, ~~the~~ sapir-whorf hypothesis ~~laid the foun~~ provided a new direction to linguistic studies. It also laid the foundation for cognitive anthropology providing a fresh impetus to cultural studies from the native's point of view.

→ Basic underlying concept

1) Effect of language on culture.
   ↳ 1.1) on world view - Hopi & English as mentioned above
   1.2) Gender identity and stereotypes.
   1.3) social status. - MN srinivas - sanskritisation.

2) Language as reflector of individual's thought process and culture
   ↳ 2.1) elaborate vocab. for events of particular significance.
   2.2) Different vocab. for people belonging to different caste, gender, region, ethnicity.

3) Linguistics and cognitive anthro
   ↳ Sapir-whorf hypothesis inspired Conklin to devise interrelationship b/w language & culture.

Language : speech & ideas ! ! culture : human behaviour

Chapter-8

Q.1 Discuss the fieldwork tradition in anthropology.

• Intro :- Fieldwork refers to first hand study of people through personal observation, interview & interaction that involves prolonged residence among the people being studied.

→ Malinowski pioneered the modern fieldwork tradition through his ethnographic study of Trobriand Islanders as mentioned in his book 'Argonauts of the Western Pacific' (1922)

• **EVOLUTION OF FIELDWORK.**

1) Classical evolutionists mostly relied on second hand information except Morgan who stayed among Iroquois Indians and collected data.
   ↳ 'League of the Iroquois' (1851)

2) A.C. Haden was among the first to organise fieldwork expedition to Torres Strait in 1898.

3) Franz Boas emphasised on the importance of data collection & fieldwork.
   ↳ He conducted fieldwork among Inuit of Baffin Island ['The Central Eskimo (1888)] and Kwakiutl Indians.

4) Functionalists like Malinowski and RC Brown promoted participant observation.
   ↳ Brown conducted Andaman Islanders as fieldwork among

mentioned in his ethnographic study 'The Andaman Islanders' (1922)

5) Structuralists like Levi-Strauss and Edmund Leach carried out fieldwork in Amazonian forests and Highland Burma.

6) Culture and personality school scholars like Margaret Mead is known for new ethnographic studies - 'Coming of Age in Samoa' (1928) etc.

7) Further, field work was done by symbolic and interpretive anthropologists like Geertz in Java.

8) Cognitive anthropologists like Conklin (1960s) stressed upon emic perspective while conducting fieldwork.

combine it less space.

9) In 1961, Human Relations Area Files (HRAF) was set up containing information about 85 societies.

CHARACTERISTICS OF FIELDWORK.

Ethnography :-

1) It involves first hand recording, reporting & documenting the culture and society of people.
↳ Eg:- 1) Andaman 2) Levi-Strauss etc.

Methods :-

2) Fieldwork involves participant observation as well as other methods like ~~conducting~~ a ~~census or a~~ survey, questionnaire etc.

3) It requires minimum one year of stay with the locals.

4) It involves learning the local language

5) Participate in the life of people and group activities.

6) Recording statements and interviews of local informants.
↳ Eg:- Malinowski got to know Trobriandens view point on incest taboo through this.

10) HRAF was expanded and called Ethnographic Atlas (800 societies) in 1967.

11) Now, it is called 'World Ethnographic Atlas' (more than 1500 soc.).

2) Observing and taking note of the non-verbal behaviours.

b) Testing of responses through paraphrasing or by reference to hypothetical situations.

• ADVANTAGE OF FIELDWORK.

1) Enables in-depth study of native culture & society.

2) Allows incorporation of native's point of view ~~about his society~~ free from all prejudices - emic perspective

3) Ethnographies thus formed serve as valuable source of information for later studies. It saves time and resources for future studies.

4) It helps in cross-cultural comparisons and formulating ~~generalised~~ theories.

5) Collects info which can't be accessed by other methods.

6) Identify real problems of the native people & help in framing administrative policies.

• CHALLENGES IN FIELDWORK.

(1) whom should the anthropologist interact with as society contains people from variable backgrounds each having different perspectives.

(2) Methodological challenge regarding choice of the field.

(3) Ethical challenge - Anthropologist could unconsciously ~~induce introduction of~~ introduce modern utilities or ideas in the field, thus changing their native culture.

(4) Moral challenge :- convincing the informants & natives that his field work brings social action

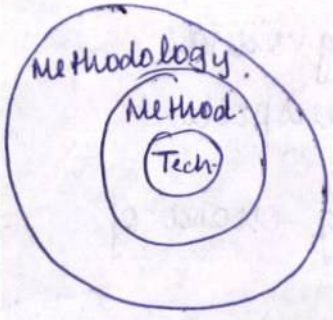
- Conclusion

Field study, ~~xxxxx~~ is in concurrence with Gandhi's idea that " to help the poor, one must think like the poor". The most important task in field study is to keep away personal biases and strike a balance b/w subjectivity and objectivity.

Q.2 Distinguish b/w technique, method & methodology.

- Intro :- Anthropological research includes scientific & systemic collection of data, formulation of hypothesis and model building in search for pertinent knowledge on specific ~~field~~ topic.

→ In this content, one comes across three distinct yet inter dependent terms namely — Technique, Method and Methodology.



I Technique

(1) It refers to specific tools or instruments used for data collection & analyses.

(2) Though, technique and method are used

→ It is closely linked to skill and proficiency in the concerned procedure.

interchangeably, the scope of method is more than technique.

(3) Example :- Types of technique → Observation, Interview, Questionaire, Case study, Genealogy, Life history etc.

II Method

(1) Method is a plan of action adopted to execute a given research project. system or

(2) The purposes of a method are :-
- classification & organisation of data
- achievement of scientific & academic values etc.

(3) Types of Method :→ Historical method :- by Boas, Evans Pritchard.
→ Comparative method :- used by classical evolutionists
→ functional method
→ structural method.

(4) Eg :- In method of participant observation, various techniques can be used like interactional recording, questionnaire, photographic technique etc.

III Methodology

(1) It refers to the overall strategy along with principles and rules underlying a scientific enquiry. It ~~also~~ deals with ~~logic behind~~ analysis and determining appropriateness of employed rules & procedures ~~those rules~~.

(2) Methodology has many dimensions of which research method is one part.

③ The objective of methodology is to convert raw material in the form of data to abstract, theories generalised

④ Types of methodology

↳ Classical methodology :- It focuses on cultures evolution due to interaction with environment & other cultures.

↳ Modern methodology :- It includes schools of functionalism, structuralism etc.

↳ Post-modernist methodology :-

Broad field of work ↑ "

Intermediate field of work :- ↑ finding research soln by focussing on one task at a time

narrow field of work ↑

Methodology	Method	Technique
① Objective is to determine appropriateness of the methods for the problem at hand.	① Objective is to find solution to the research problem by adopting certain ~~methods~~ techniques.	① Objective is to collect & analyse relevant data
② It involves analysis of all methods & procedures	② It refers to behaviour or instrument to carry out a research task.	② It involves specific tools. can be linked to proficiency & skill
③ Applied during the initial stage itself.	③ Applied during later stage once methodology is finalised.	③ later stage
④ has many dimensions of which method is one part.	④ comprises different techniques. ↳ Eg:- participant observation	④ occupies the fundamental & most basic part
⑤ Eg:-	⑤ Eg:-	⑤ Eg:-

• Conclusion

Thus, technique is far more specific than method and method is more specific than methodology. However, when ~~they are~~ taken together, they form the backbone of scientific research.

* Format :- I intro + (diagram)

II
① Technique - defn + eg./Types.
② Method - defn + types
③ Methodology - defn + types.

III Tabular difference.

IV Conclusion.

Q.3 Observation as a tool of data collection.

• Intro :- Observation is the act of noticing ~~the~~ things and events as they exist and occur respectively. It is a scientific technique used in anthropology for data collection.

→ The most important type of observation is participant observation. It was popularised by Malinowski's work among Trobriand islanders as depicted in 'Argonauts of the Western Pacific' (1922)

• Types of observation

I) Controlled and Uncontrolled observation

1). Controlled observation involves creation of an artificial environment for experimental study.
↳ There is minimum participation of the observer.

2) Uncontrolled observation refers to conducting research in the natural environment.
↳ Observer conducts his research as the member of society.

II Structured and Unstructured Observation

1) Structured observation is characterised by careful definition and setting standards for what needs to be observed and in what manner.

2) Unstructured observation doesn't involve ~~any~~ such standardisation.

III Participant & Non-participant observation

① Participant :- Studying a particular society by directly participating in the social and cultural activities of that society as its member.

② Non-participant :- Anthropologist studies a particular society but doesn't participate in group activities himself.
↳ Eg:- interviews, questionnaires, case studies etc.

• **CHARACTERISTICS OF OBSERVATION**

1). It involves first hand recording, reporting and documenting the culture & society of people.

2). It requires prolonged stay with the native people.

3). Learning the local language is desirable.

4) Observing and taking note of non-verbal behaviours.

5) It can involve both participation of anthropologist in group activities or observing from a distant.

• **MERITS**

① Enables in-depth study of native culture in their natural environment.

② Provides access to authentic & intensive information that couldn't be collected through other methods. ↳ Eg:- family crisis, sexual behaviours etc

③ Ethnographies so created can serve as valuable source of information for future cross-cultural studies, thus saving time & resources.

④ Helps in knowing the emic or native's point of view for better understanding of context.

• **Limitations**

→ Point ①, ③ & ④ from challenges part of Q.1.

• Conclusion

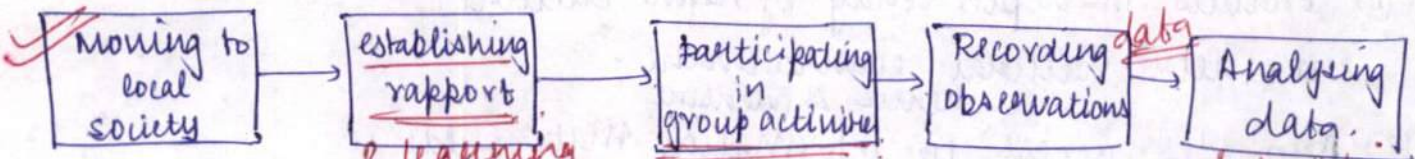
--- on same lines as Q.1 - - - -

Q.4 Evaluate participant observation.

- Intro :- Participant observation refers to ~~the act of data collection and~~ studying a particular society by directly participating in the social & cultural activities of that society as its member. It helps in data collection and is a major part of fieldwork.

→ Malinowski pioneered participant observation through his work among Trobriand _ _ _ _ 'Argonauts _ _ _ ' (1922)

- **Phases of Participant observation**



- **Characteristics**

Preparing

1) Ethnography :- involves first hand recording ↑ reporting and documenting the culture & society of people
   - Eg:- RC Brown's ethnography ('The Andaman Islanders' (1922)) tells about culture of Andamanese
   - & village study by MN Srinivas among 'Coorgs'

2) Period of stay should be at least one year as suggested by Malinowski.

Balance b/w Emic & etic view

3) The observer and observed are on the same side by making the observer a member of the group.

4). The observer participates in group activities so that he can experience what they experience. → Malinowski says there is observable difference b/w what people say they do & what they actually do. based on his analysis of kula exchange.

5) Learning the local language is desirable
↳ Eg:- Margaret Mead learnt the language of Samoa during her time there (1928).

6). Selecting informants from among the society who help the observer interpret certain aspects of culture.
↳ Eg:- Malinowski interpreted Trobianders view point on incest taboo through this way.

7). Observing & taking note of non-verbal behaviours.
↳ Eg:- This helped Evans Pritchard collect information about witchcraft among Azande.

- **MERITS.**

(1), (2), (3) & (4) as Q. 3.

~~(5)~~ (5). → same as (5) of Q. 1.
↳ Eg:- Clifford Geertz study of Balinese cockfight was instrumental in lifting ban on the governmental ↓ Practic

- **Limitations.**

→ same as Q. 1 challenges (1) - (4).

(5) Emotional involvement of observer can be detrimental to the objectivity.
↳ Post-modernists

- **Case studies**

1) ~~Alyssa~~ Alyssa Crittenden study of Hadza women (2014).

↳ she studies dietary practice of Hadza women of Tanzania in relation with their reproductive capacity & health.

2). Emic approach of cognitive anthropologists like Conklin - research among Hanunoo of Philippines (1960s).

3) India :→ Village studies by M N Srinivas
Eg :- among Coorgs etc.
→ D N Majumdar's study of Khasa

- Conclusion

--- same as Q.1 ---

Q.5 Describe 'Interview'.

- Intro :- Interview is an effective, informal or formal, conversation initiated for specific two-way purposes and focussed on certain planned content areas. It is an important tool of data collection in anthropology.

- **Objective of interview**

1). Exchange of ideas and experience between the interviewer & interviewee.

2) Acquire information pertaining to a wide range of topics to ~~under~~ gain a better understanding of native customs & culture

3). Helps in understanding individual behaviour ~~and motivation~~ on the basis of psychological & social factors.

↳ Mead conducted interview among samoans to understand their adolescent behaviour.

• Types of Interview

1) On the basis of number of people

Group interview — individual interview

2). On the basis of approach

2.1) Directive / structured interview :- Interview is based on predetermined list of questions with little flexibility.

↳ The entire process is based on standardised procedure; helps in comparative study.

2.2). Non-directive / unstructured interview :-

→ Questions are asked randomly as per situation; there is greater flexibility.

→ It is more efficient in unraveling the hidden aspect of social structure. helpful

→ However, it is not ~~relevant~~ for comparative study and may generate non-relevant data.

3) On the basis of objective.

3.1) Focussed interview :- Special emphasis is given on ~~to~~ extracting information about a particular event or experience. Eg :- Natural calamity

3.2) Depth interview :- It focuses on extracting

hidden details of social structure as well as deeper aspects of human mind.

3.3) Repeated interview :- It involves conducting interview after a specific time interval to analyse changes in responses of people in the given time period.

- **Features / Principles of Interview**

1) Interviewer should have open-mind and no personal biases – emic perspective.
2). Establishing rapport with locals. Interviewer should be warm, sympathetic, respectful and a patient listener.
3) focus should be on both verbal and non-verbal behaviour
4). Interviewer should ask relevant questions. They can be based on interview guide.
5). Interviewer should focus on creating an informal atmosphere to eradicate hesitancy among respondents.

- **ADVANTAGES.**

1). It is more flexible allowing free flow of information.
2) It is direct, trustworthy & reliable tool of research
3) Less time consuming

4) Useful for collecting rare kinds of data which might not be otherwise available.
   ↳ Eg:- views on incest, adultery etc.

5) Incorporates emic or native's point of view.

• **DISADVANTAGES**

1). Respondents might suffer from lack of memory, insight or inability to articulate.

2) It can be biased due to greater subjectivity

3). People might intentionally provide wrong or fake information.

4). Improper interpretation of responses by the interviewer.

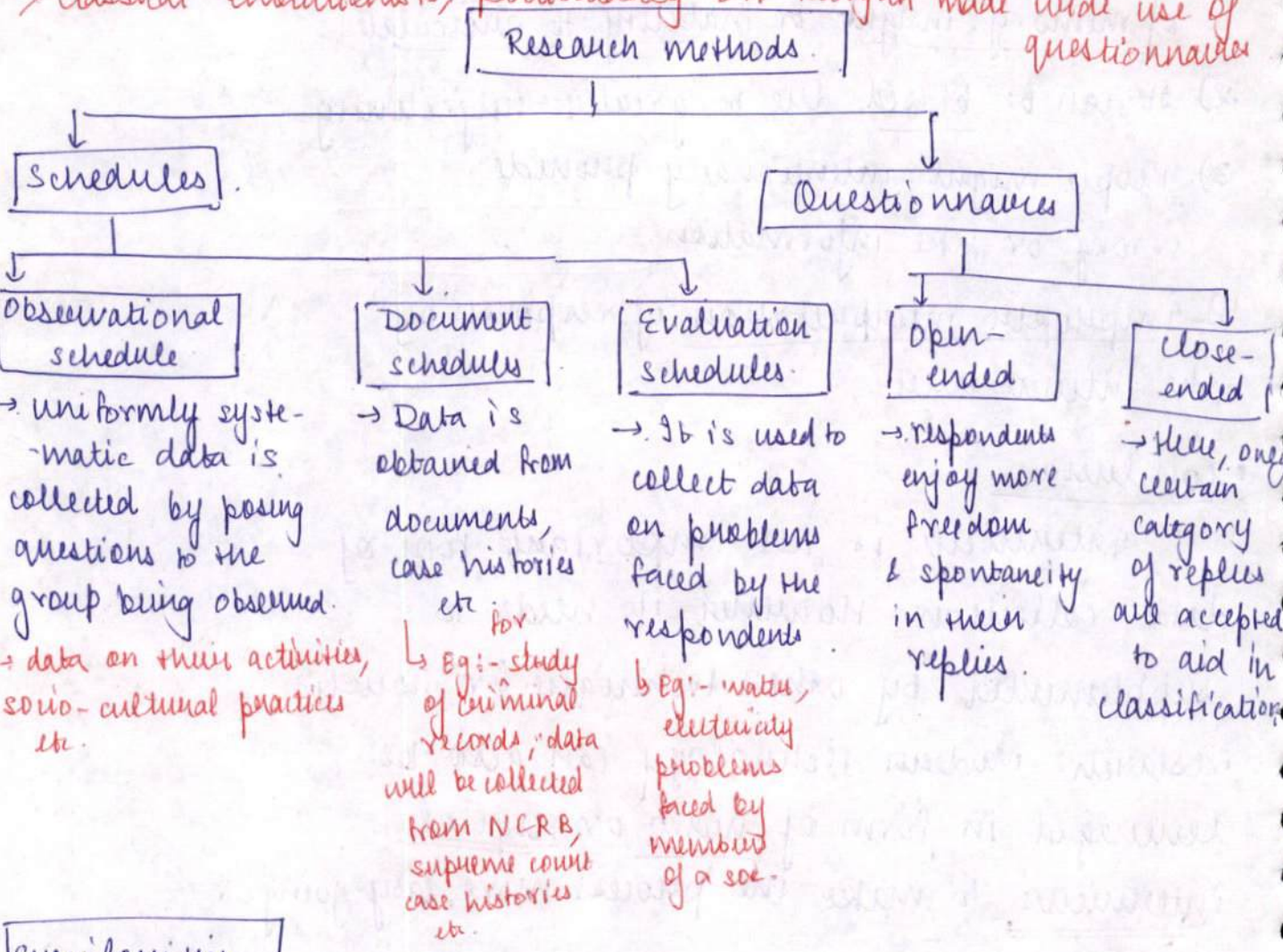
• Conclusion.

Interview is an important tool of data collection. However, it needs to supplemented by other technique for holistic research. Modern technology can also be leveraged in form of video or digital interviews to make the process more easy-going.

Q.6 Compare and contrast schedule & questionnaire

• Intro :- Schedule and questionnaire are used as subsidiary research tool for collecting data. Schedule refers to a structured set of questions asked to the respondents by the investigator himself. While Questionnaires, though have the same format, are filled by the respondents themselves without the interference of the investigator.

→ Classical evolutionists, particularly LH Morgan made wide use of questionnaires



• Similarities

1). Both focus on problem-oriented approach and standardising the data collected.

2). They are used to supplement other research methods such as interview

3) Both ensure large no. of respondents are covered for greater accuracy.

4) Both have the same structure and involve a similar question-answer pattern.

- **Differences**

	Questionnaire (only verbal / written behaviour)	Schedule (both non-verbal & verbal behav. for detailed analysis)
1)	They are sent out through mail and respondents fill the data by themselves.	It is filled out by investigator himself by asking questions to the respondents.
2)	It is more cheaper.	It is relatively expensive as money is spent on appointing and training research workers
3)	Non-responsiveness is higher.	Majority of people respond & non-response is low.
4)	Greater degree of anonymity as identity of the respondent is always not known.	Investigator usually knows the identity of the respondent. This also helps him (enables him to study expressions & reactions of respondents) more accurate interpretation of data.
5)	It is likely to be a slower process as people don't send out responses even after several reminders	It is a relatively faster process. However, it can be more time & energy consuming too.
6)	It requires respondents to be literate and cooperative.	It is useful in data collection even when people are illiterate.
7)	Risk of collecting incomplete or wrong info is more	Info is usually complete and correct.
8)	Researchers cannot effectively aid the respondents in understanding the question correctly.	Researchers can make people understand the questions and extract more relevant & accurate information.

9) It is less flexible in terms of additional questions cannot be added.

9) It is more flexible, any extra data could be collected

- **Advantages**

1). Objective method - data collected through simple question-answer process

2). Provides privacy especially in case of questionnaires.

3) large no. of people are covered at a greater speed and less cost.

4) standardised data is obtained that is useful in comparative studies

- **Limitations**

1) Difficulty in understanding the language of questions

2). Respondents might suffer from lack of memory insight or inability to articulate.

3) Uniform questions do not always fit while studying varied groups.

4) Ambiguity in interpretation of data by researcher.

5) Possibility of wrong or incomplete info.

- **Conclusion**

Despite its limitations, questionnaire & schedules are effective tool in data collection. Focus should be on making the entire process more simpler and respondent-friendly.

Q.7. Case study?

- Intro :- Case study refers to a fairly exhaustive and comprehensive study of a social unit in their ecological setting. It aims at obtaining the complete in-depth account of that social unit.

- **Evolution of case studies**

1). Friedrich Le Play (1885) is considered the founder of case study method.

2). Herbert spencer was first to use it in his ethnographic studies.

3) Other notable works including case study are :-

3.1) Cora Du Bois' - 'The people of Alor' (1944) :- she gained in-depth qualitative knowledge of inhabitants of Alor by collecting ethnographic data, life histories, biographies & even childrens drawings.

3.2). Robert Redfield's - 'Tepoztlan - A Mexican Village' (1930)

- **Characteristics**

1) Social unit :- Researchers consider a social unit for study. It can be a person, a group, a district or even a situation.

2) Deep and comprehensive study of all aspects.

3) Qualitative study rather than quantitative - It therefore gives deeper insight to the researchers.

4). Combines objective and subjective data -
The data is useful in formulation of hypothesis as well as ~~preparation of questionnaire for further research~~. testing it through future studies.

5). Focus on tracing the natural history of the unit and unravelling its relationship with its surroundings.

- **Advantages -**

1). Provides a more real and holistic record of personal experiences which might not be possible through other methods like schedules etc.

2). It deepens the understanding of the researcher about his subjects.

3) Helps in understanding the past as well as reveals new research problems for future.

4) Clear understanding of the dynamics of social change.

- **Limitations**

1). The process is time-consuming & expensive

2). Subjectivity due to personal bias of researcher.

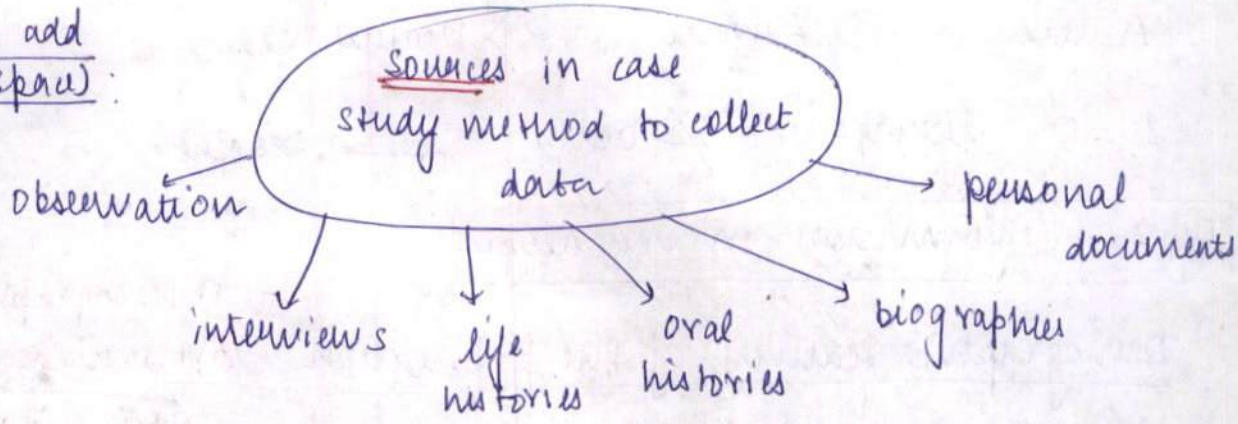
3). Faulty selection of case at times & inaccurate observations.

4) Risk of false generalisation due to no uniform way of collecting data.

- **Conclusion**

Case study method is often called the 'social microscope' due to its advantages. Its limitations can be reduced by concerted effort on part of the researchers.

→ can add (if space):



Q.8 Genealogy / Genealogical method?

- Intro :- Genealogical method is concerned with written record of ancestry of a group of persons prepared by the investigator. for analytical purpose.

→ It consis of both consanguineal & affinal relations.

- Background.

1) L H Morgan was the first to use genealogical method in his study of the Iroquois - this enabled him to gain valuable data on their kinship system. → ('League of the Iroquois' (1851))

2) W H R Rivers popularised the method through his work on Toda - 'Genealogical Method in Anthropological Enquiry' (1910).

- Methodology

1) Information is gathered through the ego
2) That is, all kinship relations are traced from him.
3) following symbols are used while preparing genealogy :-

△ Male ○ Female ◇ Neutral sex.

△=○ Marriage ⚠ Death ⊥ Descent.

Types of information in genealogy

1) Demographic features of the population :- sex ratio, age structure, family size etc.
2). Patterns of marriage, fertility, mortality & migration.
3) Interpersonal behaviour b/w relatives.
4). ~~Marriage rules~~, Rules concerning inheritance of property, succession to chieftainship etc.
5). Kinship terms., rules of residence etc.
6). Rites de passage – ceremonies associated with birth, marriage, death.

(1) Demography
(2) Marriage – types and rules of marriage (polygyny, monogamy) etc
↳ fertility, mortality
(3) family & Kinship
↳ Pt. (2) & (3)
↳ clan & lineage (matrilineal, patrilineal)
(4) Political structure
↳ Pt. (4)
(5) Rites de Passage

Advantages.

1) It is useful even in non-literate societies.
2) It acts as an analytical tool and helpful in sociological work.
3). Incorporating emic point of view.
4) Also useful in identifying genetic disorders within a society.

limitations

1) Choice of ego is a crucial one.
2) Informants might not provide complete info fearing that it can be used against them.
3) Misinterpretation of information by the researcher.

Conclusion

Hence, genealogical method has added a

district & new dimension ~~in research work~~.
in anthropological studies. due to its relevance
in both socio-cultural & physical anthropology.

Q.9 Life history?

- Intro :- It is defined as sequentially laid out account of an individual's life experiences covering all the dimensions that make up the identity and perceptivity of a life.

→ Clifford Geertz famously made use of this technique in his studies in Java, Bali & Morocco.
↳ Cora Du Bois

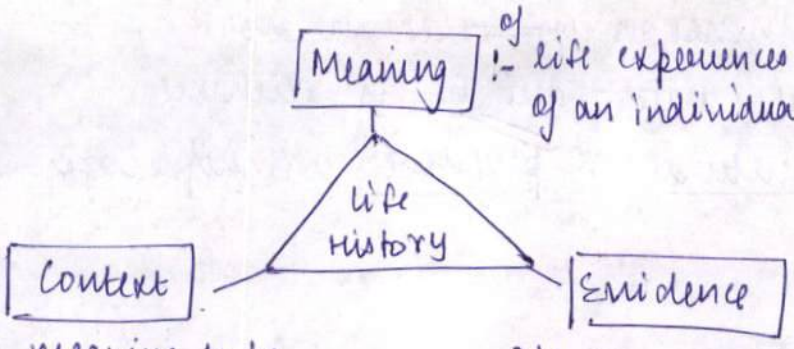
- sources of data for Life History
  - interviews and surveys.
  - biographies, autobiographies
  - diaries
  - personal letters & documents.
  - photographs.
  - folklore.

- Characteristics → recording & analysing imp. events of his life including socialisation process
  ↳ rites de passage
  → Marriage
  ↳ subsistence method etc

1) socio-cultural context - It focuses on crucial aspects of an individual's life and his decision making in such scenario in his socio-cultural setting.

2) The subject is viewed as a member of a cultural group or community.

3) It is amalgamation of meaning, context and evidence.



:- of life experiences of an individual.

Such meaning to be understood in his socio-cultural context

All the records are based on evidence.

4) Life history covers all the experiences from childhood to adulthood.

5) It also provides an insight into his thought process, cognition and future plans.

- **Advantage.**

1). Understanding an individual's life from his own perspective - emic view.

- understand an individual's experiences in larger context of entire society.

2) Deeper insight into processes of enculturation, socialisation, rites de passage etc. prevalent in a society.

3) Helps in recording any major event and understanding its impact on society and individual.

4) Helps the researcher to formulate 'thick description' study based on cont-ext.

- **Limitations.**

1) Socio-cultural conditions may change with time, & so does the context.

2) Biasedness of the researcher.

3) Individual might suffer from 'lack of memory' and can provide incomplete info.

• **Conclusion**

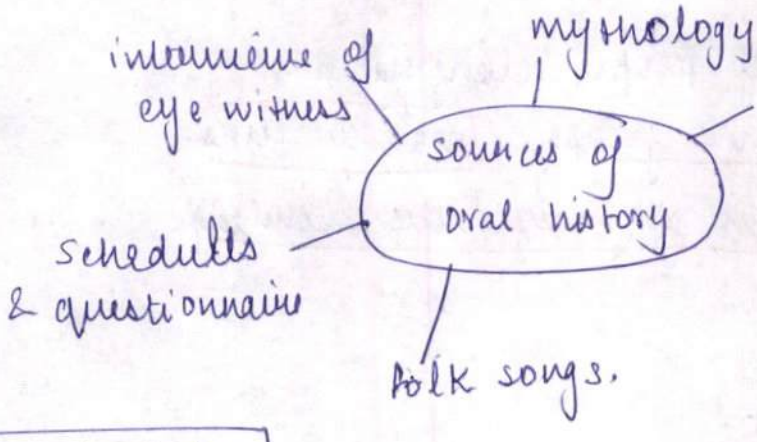
Hence, life histories are important tool in understanding the state of mind of an individual as well as the social context in which he is operating.

Q.10 Oral history?

• **Intro** :- Oral history can be defined as the recording, preservation and interpretation of historical information, based on the personal experiences and opinions of the respondents.

→ It refers to the knowledge, both sacred & secular transmitted from generation to generation through word of mouth.

↳ Eg :- Bhills of Mangarh hills (Gujarat) organise an annual fair in which they tell their oral history (conflict with britishers etc) in form of songs.



• **Characteristics**

1). Oral history represents collective experience and wisdom that has accumulated over years.

2) It is largely anonymous

3). While oral history gets transmitted from one generation to the next, it experiences certain changes (additions & deletions) which are inevitable.

4) Its survival largely depends on ~~its~~ the inhabitants since there is no written record.

↳ Eg:- Tribal history of India is by and large oral in nature. It could die out with time if adequate efforts are not made.

- It can be both true/reality or mythical in nature.
- Knowledge of local language and brief socio-cultural history for better understanding

- **Advantages**

1) Useful in reconstruction of history especially when no written records are available.

2) Emic perspective - It helps in collecting the various details while keeping in mind the socio-cultural context.

3) Reveals facts that are otherwise not available in public domain.

4) Records experiences of people belonging to varied socio-economic groups & not few elites.

5) Helps in preservation of indigenous knowledge and culture.

- **Limitations**

1) Data provided could be repetitive or irrelevant.

2) Question of reliability of various mythological stories and folk tales.

3) Concern regarding biasedness or ethnocentrism of researcher.

- **Conclusion**

Oral histories thus require adequate attention for their safeguard. The inauguration

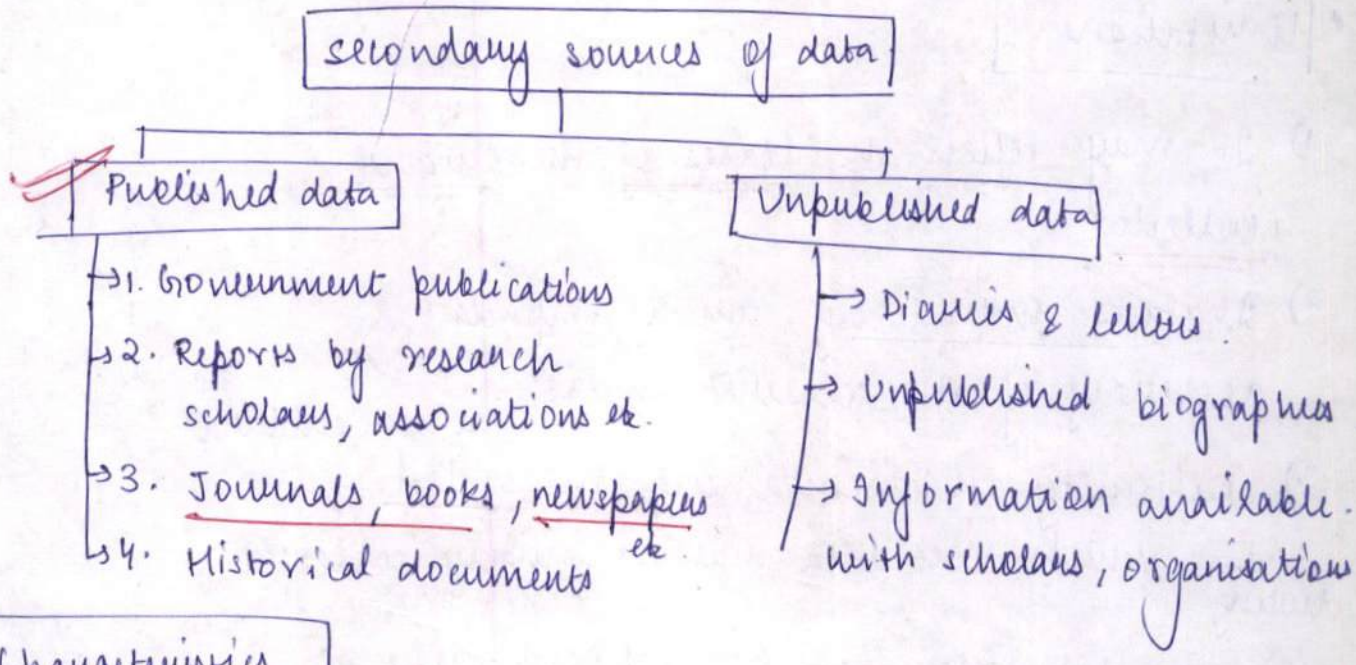
of 'Janjatiya Gaurav Diwas (15 Nov) to provide recognition to tribal role in freedom struggle is a good step in this direction.

Q.11 What are the secondary sources of information?

• Ans:- Secondary sources of information refer to the data that have already been collected & analysed by someone else.

→ Classical evolutionists mainly relied on secondary data for their studies.

↳ Eg:- 'Golden Bough' (1890) by Frazer is based on secondary data from various sources.



• Characteristics

1) It is readymade & readily available.
2) Researcher has no original control over collection & classification of data.
3) It is not limited in time & space.
4) Criteria for determining usefulness of 2° data :—

It should be — reliable, suitable & adequate.

Advantages.

1) It is not time-consuming and not expensive.

2) The data can be used as a source of reference for future research projects

3) It can be used in comparative studies, that is, it can be treated as a benchmark against which current results are tested.

Limitations.

1) It may reflect the biases of the original collector.

2) It lacks authenticity which impacts accuracy of the research work.

3) Difficulty in ascertaining the socio-cultural context during which the data was originally collected.

4) The data may not be representative of the wider population.

Conclusion

2° data is quite useful in conducting research work in present time and saves a lot of efforts and time. The only concern is regarding its reliability, suitability & adequacy.

Q. 12 Rapid rural appraisal ?

- Intro :- RRA is a systematic study designed to draw inferences, assessments or hypothesis of the local situation through the aquisition of new information in a limited time period. It is carried out by a multidisciplinary team of professionals.

- Background

→ During the post WW II period (after 1970s), focus was on rural development

→ However, ~~they~~ experts faced several problems in this area :-

  - Top-down approach - often fails due to lack of knowledge of grassroot situation.
  - Neglect of socio-cultural setting of people
  - Materialistic growth was incompatible with rural areas.

→ To overcome these issues, Robert Chambers and Gordon Conway in 1978-80 devised the method of RRA.

- Basic principles of RRA

1). Bottom-up approach :- A reversal of learning, to learn from the local people directly on site.

2). Effective communication ~~the~~ b/w experts and locals.

3). Collecting necessary data in short interval of time

4). Triangulation - cross checking & progressive learning through plural investigation.

↳ That is, comparing findings from several methods to increase accuracy.

5) Offsetting biases of rural development professionals so that they can more effectively understand the concerns & priorities of local people.

- **Methodology**

1) Site selection and approval from the administration.

2) Preliminary visits to the site and building rapport with the locals.

3) Sampling of respondents and data collection.

4) Analysis and interpretation of responses.

5) Identifying opportunities & ranking them.

6) Formulating the Village Resource Management Plan.

7) Implementation of the plan with continuous evaluation, monitoring & corrections.

- **Advantages**

1) Integrates traditional knowledge and technical skills in the development process.

2) ~~Brings together community, technocrats, sponsors and administrations.~~

3) It involves the local community in planning and decision making.

3) Judicious resource mobilisation and management

4) Promotion of multi-sectoral & multi-institutional coordination.

5). Aids in policy formulation on the basis of real-time developmental needs and goals of the local community

→ **Case study** :- Kamble, 2014 :- PRA in Mahale village of MH led to organisation of women village assembly to tackle problems faced by women, esp. alcoholism. Resulted in village passing a contract banning liquor altogether.

(see Akshat Jain or search).

- **Criticism**

1). The rapid nature can cause overlooking of some key aspects.

2). Biased conclusion due to personal bias of or wrong researchs, lack of rapport or understanding of local language etc.

3). RRA doesn't involve locals in data collection.

4) Standardisation often doesn't suit the demands of different socio-cultural settings.

- **Conclusion**

Despite its limitations, RRA has been instrumental in rural development. Its modified version, participatory rural appraisal has used participation by locals. RRA should be implemented with aid of local Panchayati Raj Institutions for greater impact.

Q.13 Participatory Rural appraisal ?

- Gyan :- PRA is a method by which outside experts empower local people to collect data about their own village and use it to formulate a plan for development of their own village community

→ It is an extension of RRA. Only difference being that in PRA local community instead of multidisciplinary team of professionals is engaged in data collection and planning.

- **Background**

→ Robert Chambers & Gordon Conway devised the RRA technique in 1978-80 for rural development

→ However, RRA technique was often associated with researcher biases, lack of local context, difficulty in understanding the local language etc.

→ To overcome these issues, PRA emerged as an extension to RRA.

- **Principles**

1) People-centric - People aided by experts determine their own priorities, prepare a village resource management plan, mobilise their own resources and implement it by themselves.

2) ~~Bottom~~ Multisectoral (agriculture, water, electricity) and multiinstitutional (Govt, NGO, corporate, locals etc) coordination

3) Rapid and progressive learning - collection of necessary data in short interval of time.

4) Triangulation - cross checking and comparing findings from various sources for plural investigation.

5) Offsetting bias by ~~minimising~~ limiting the role of external experts to advising in rural development.

- **Methodology**

1) --- same as Q.12 ---
2) Preliminary visits to the site and introducing PRA to the locals.
3) Data collection and synthesis by local.
4) Analysis & interpretation of data.

-- (5), (6), (7) -- same as Q.12.

- **Advantages**

-- (1), (2), (3), (5). -- same as Q.12.

- **Disadvantage**

1) Time-consuming and need adequate rapport with locals.
2) Difficulty for experts to make locals aware about PRA tools and their application.
3) Standardised method might not be suitable for different settings.

- **Conclusion**

PRA is an effective tool in rural development especially after it overcomes the short-comings of RRA. To ensure better implementation, local Panchayati Raj Institutions should also be involved.

filtering + categorisation + organising data around certain themes

Q.14 Data analysis, interpretation & presentation.

• **Data analysis** :- It is a research technique for the systematic, objective and quantitative description of the data procured through different tools of data collection. → drawing conclusion out of it. & organisation

→ As per Alfred Marshall, facts and figures do not make much scientific sense on their own. True meaning can only be deciphered when :-

- facts & figures are organised, and
- viewed in the correct context.

using both collected data + extraneous facts + consultation with experts.

• **Principles / Techniques of data analysis**.

1) Data analysis actually starts during the process of data collection itself.

↳ It guides the researcher about

- what data to collect
- what techniques to use
- what hypothesis is to be tested.

2). Next step involves reducing the data by extracting relevant details through data manipulation.

↳ This involves manipulating, transforming & coding the data.

3) Organising and assembling the data

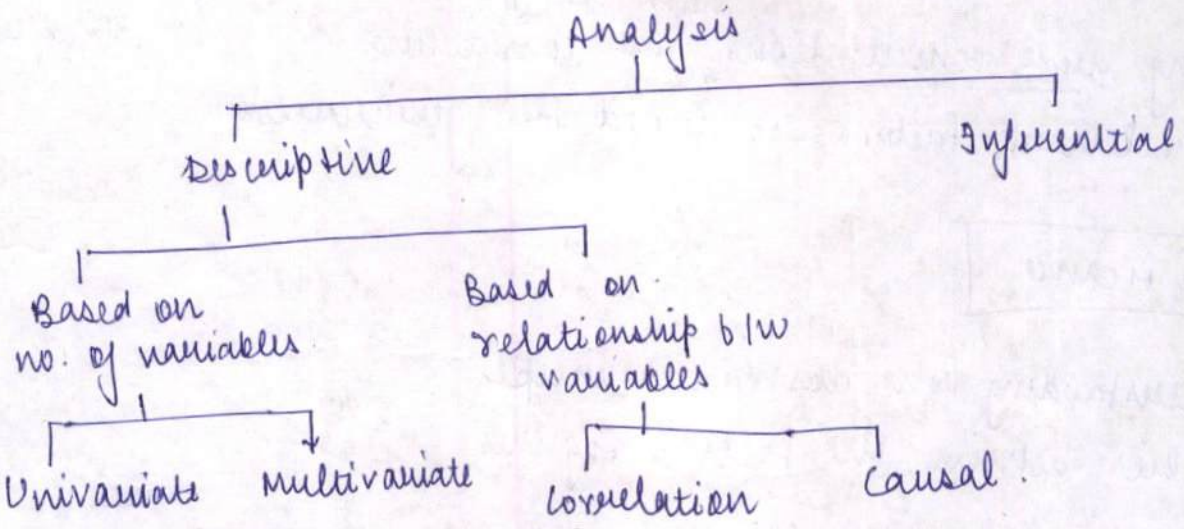
around certain themes and points.

4). Identifying a pattern of data and using it for extrapolating trends.

- **Types of data analysis**

1) Descriptive analysis :- study of how one or more variables are distributed, their interrelationships etc.

2) Inferential analysis :- It is concerned with ~~testing~~ determining the significance of data collected in testing a hypothesis the.



- **Significance**

1) Guides the data collection process.
2) Helps in drawing up generalisation.
3) Helps in ~~testing~~ determining the validity of data collected in testing a certain hypothesis at the early stage itself.

Is This same time, cost & efforts.

II Data interpretation :- It refers to the task of drawing inferences from the collected facts after an analytical & experimental study.

• Techniques of interpretation

→ It requires great skill & dexterity on the part of researcher.

1). ~~The~~ Identifying uniformity underlying the diverse research findings

2) Considering both collected facts & extraneous information while interpreting with specialism to identify omissions and errors.

3) Holding wide consultations ~~and~~ considering all relevant factors to avoid false generalisation

• Significance

① Understanding the abstract principle that lies behind the facts & figures.

② Establishes connectivity in research. by linking the results of a given study with those of another.

③ Provides explanatory concepts that can serve as a guide for future research studies.

• Conclusion

Wrong interpretation can lead to inaccurate conclusions even if the data collected is correct. Therefore, the researcher should be

patient, bias-free, and cautious while making interpretations.

III Data presentation

→ It refers to writing of the report consisting of research findings, inferences and result in an engaging manner.

→ It is the last step in a research study and holds great value because all the findings are of little value unless effectively communicated to others.

- **Steps**

1) Logical analysis of the subject matter.
2) Preparation of the final outline.
3) " " " rough draft.
4) Rewriting & polishing
5) Preparation of the final bibliography.
6) writing the final draft.

- **Types of Reports**

1) Technical reports ..

Tools in data presentation.

1) Distribution curves
:- It provides visual representation of various findings.
↳ Eg:- Frequency distribution, % distribution, cumulative distribution.

2) Tables, diagrams and flowcharts.
3) Graphs such as Histograms, pie chart, line graps etc.

• Significance

1) Aids in effective communication of the research findings with the outside world.
2) widen public reach of the research work.
3) employing a simplistic manner to make people understand the efficacy or significance of the work.
4) Enabling future researchers to quote their findings while carrying out future studies.
   ↳ Thus, saving their effort & time

• Conclusion

A good report should be ① simple to read, (avoid technical jargons) ② grammatically correct, ③ shows originality, ends with a forecast on the future scope ④ of study.

⑤ Tools of data presentation employs engaging (mentioned in pvs page).

Combine these 5 points under headline 'Principles of data presentation'

~~Futu~~ Further aves - ethnography, sampling.

Unit 1.4 Human Evolution and Emergence of man.

Q.1 Discuss Pre-Darwinian / Lamarckian theory?

- **Intro** :- Lamarck, a French evolutionist explained organic evolution prior to Darwin (1859; (Pre-Darwinian). in his book 'Philosophic Zoology' (1809).

→ It suggests that changes in environment bring about bodily changes in individuals. driven ~~energised~~ by their inner urge. Such acquired characters are developed by use and disuse and passed on to the next generation.

- **Basic Postulates**

(1) **Theory of Growth or 'Elan Vital'** :-
Internal forces of life tend to increase the size of an organism by growth in organs and systems.
↳ Eg :- seed → Tree ; Zygote → adult organism

(2) **Theory of environmental Pressure and spontaneous formation of organs** :-
Change in Environment → initiation of need of particular trait in organism → (internal force) → spontaneous acquisition of new characters

(3) **Theory of use and disuse** :-
Continuous use of an organ strengthens it while disuse has reverse effect.

↳ Eg :- 1) Use → Lengthening of giraffe neck.
→ Strong leg-bones and thickened enamel in teeth in horses

2) Disuse :→ Vestigial organs in humans like Pinna, vermiform appendix
→ Elongated body and loss of limbs in snakes.

(4) Theory of inheritance of acquired characters

↳ All changes are transmitted to next generation.

- **Supporters of Lamarckism**

1) Summer's Experiment :- Rats reared at 20°-30°C while developed longer bodies, long tail and transmitted these acquired characters.

↳ Critic :- High temperature may have caused mutation in germ cells.

2) Griffith's experiment :- Dizziness was transmitted to the next generation among white rats.

↳ Critic :- Not confirmed by others.

3) Guyer & Smith's experiment :- Experiment on antibodies against lens-proteins of rabbit. write here only

It showed that bodily changes can bring about formation of new RNA & this leads to formation of new DNA.

According to them :-

Somatic changes → Antibody (Protein) → RNA → DNA.

↳ Critic :- There is no proof for Protein converting to RNA.

• CRITICISM

① No proof regarding inheritance of acquired characters.

↳ **Weismann's Mutilation Experiment** :- He cut the tails of white rats for 20 generations but still tails were not eliminated in succeeding generations.

② Thus, Lamarck did not differentiate b/w germplasm & somatoplasm.

③ Many times, organisms shows tendency of reduction in size instead of increase.

↳ Eg :- Fern → flowering plants.

④ It postulate is against all known facts of biology. / It places too much weight on 'inner urge'.

↳ Eg :- Man has not developed wings even after desiring so.

⑤ Use and disuse theory also has many contradictions.

↳ Eg :- Heart size doesn't increase inspite of its continuous use.

• Contemporary Relevance.

→ Though Lamarckism lacks genetic support, but epigenetic evidences can be found in its favour.

no change in genes or DNA ; but change in their behaviour in response to environmental condn etc; thus producing phenotypic change

1) Inheritance of food-controlled coat colour in mice, as a result of heritable epigenetic changes.

2) Here, environmental conditions induce alterations in HSP-90 protein which brings about epigenetic changes.

↳ Critic :- The evidence may become doubtful if it is found that methylation and HSP-90 simultaneously affect both somatic & germ cells.

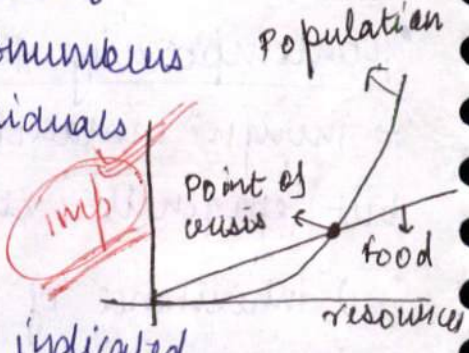
• Conclusion

Lamarcks theory ~~provided~~ paved the way for future work on organic evolution. He was followed by Darwin who criticised his theory of inheritance of acquired characters.

Q.2 Discuss Darwin's theory

• Intro :- Darwin gave his theory of organic evolution in his book 'On the Origin of species by Natural selection' (1859).

↳ Darwin describes evolution as 'Descent with Modification'. He suggests that there is constant struggle for existence and this leads to survival of the fittest through natural selection. Thus, progeny of the fittest outnumbers others in subsequent generations.



imp

• Factors influencing Darwin

1) Malthusian essay on population :- It indicated that while population increases exponentially, food production is limited, thus leading to struggle for existence.

2) Theory of Uniformitarianism by Charles Lyell

[∴ Principles of Geology' (1830)] :- Environment is changing continuously.

3) Ideas of wallace on Evolutionary Biology

4). Industrial revolution in England :- Only the most fittest industries survived while others faded.

5) Empirical evidence collected during his voyage on board HMS Beagle (1831-36)

↳. Fauna of Galapagos Islands :- & few mammals (rat & bat).

a) No fishes and amphibians ∴ Dominance of reptiles represented by giant tortoises & lizard.

↳ In absence of mammals, reptiles are the superior group.

b) Darwin's finches :- They have great modification in beaks for diverse food habits.

↳ Darwin explained that finches developed in Galapagos and in light of stiff competition for food migrated to adjoining land where they developed differently, hence difference in beaks.

↳.

Finches

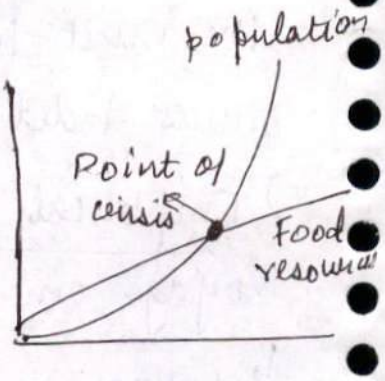
- Ground finch (seed eaters)
- Vegetarian tree finch :- Parrot like beak (fruit eaters)
- Insectivorous tree finch (woodpecker like beak) :- insect eaters
- Warbler finch (slender beaks). :- insect eaters

6) Morphological evidence :- hand of man, ~~leg~~ hind limb of horse, paddle of porpoise, wings of bat – all have same skeletal pattern. → Homologous Organs

Theory of Natural Selection

1) Over-production :- Organisms give birth to large number of young ones to increase the chances of survival.

2) Struggle for existence :- since population increases by a large degree while food is limited. This leads to :-



↳ intraspecific struggle :- most fierce competition

↳ interspecific struggle

↳ struggle against changing environment

3) Variations & heredity :- Competition compels organisms to change according to most suitable conditions. This causes variations which are passed onto next generation.

→ Sources of variation :-

a) Individual variation due to re combination of genes :- Highest importance.

b) Spot variation or mutation :- minor importance

c) Variations due to use & disuse

4) Survival of the fittest through natural selection :- Only those individuals with beneficial variations that aid them in ~~surviving in~~ the changed environment survive and reproduce.

↳ This leads to origin of new species

Darwin's other theories.

1). Theory of artificial selection :- Production of new useful variety of plants and animals under human control.

↳ Eg:- Race horses, cattle etc.

2). Theory of sexual selection :- There is contest among males for females based on color, ornamentations etc.

↳ Thus, in successive generations, progeny of successful males with better means of defence or charms outnumber others.

↳ Eg:- Stag with beautiful horns, cock with heavy spur & strength in wings.

3). Theory of common descent :- He suggested that related groups of individuals have common ancestor. ↳ 'Descent of Man' (1871)

↳ Eg:- Man & apes.

4). Theory of Pangenesis :- Explained inheritance through pangenes (small particles) produced by ~~sm~~ somatic cells.

CRITICISM & ACCOMPLISHMENTS

1) His theory of natural selection is widely accepted.

2). He laid the foundation of scientific study of organic evolution. He criticised the theories put forward by orthodox groups.

3) His work inspired future social & physical scientists to develop neo-Darwinian and synthetic theory of evolution.
   ↳ He also inspired classical evolutionists like Tylor and Morgan. (they came with their theory of cultural evolution)

4) His theory of common descent has also been found to be correct

- **CRITICISM**

1) Lack of scientific experiments to back his work.
2) His theory of 'Pangenesis' or 'blending inheritance' defies the laws of genetics.
3) He laid more emphasis on individual differences as compared to mutation.
4) Darwin is criticised for not providing explanation for origin of variation
5) He couldn't explain ~~to~~ the reason behind negative variation.
   ↳ Eg:- horns of Irish deer responsible for its extinction.

- **Conclusion**

Despite its criticism, Darwin's theory has largely withstood the test of time. His theory of natural selection combined with laws of genetics provide a holistic picture of organic evolution.

Q.3 Compare Lamarck & Darwin's theory.

• Intro :- Lamarck & Darwin explained organic evolution in their books - - - - - - - - . [Darwin called it 'Descent with modification'] X

→ While Lamarck proposed theory of inheritance of acquired characters, Darwin is famous for his theory of natural selection.

• Ernst Mayer (1982) has compared Lamarckism & Darwinism as follows :-

• **Similarities**

1). Evolution as such :- Both challenged traditional view that would has not undergone any change. They proposed the concept of evolution.

2) Gradualness :- Both believed in gradualness of evolution & discarded essentialism.

3) Theory of use and disuse :- Both used it to explain variation.

4) Both failed to distinguish between somatic and germinal variations with regards to principle of inheritance.

5) change in env. → driven of evolution

• **DIFFERENCES**

Lamarckism	Darwinism
① It was prior to Darwin in 1809	① Time - 1859.

(2) He gave more emphasis on vertical aspect of evolution

(3) Cause of evolution :- elan vital / inner urge or force

(4) Too much weight on 'internal urge'; seemed illogical

(5) Gave theory of inheritance of acquired characters

Eg :- neck

(6) Did not explain descent theory.

(7) Eg :- Giraffe neck - use & disuse

(8) Criticised by many; most of the theories discarded.

(5) Focussed on both vertical + horizontal

(3) Cause :- due to struggle for existence followed by favourable variation. Hence, survival of the fittest through natural selection.

(4) Based on logic & empirical evidence from Galapgos islands

(5) Believed that all characters are inheritable based on which is favoured by natural selection

Eg

(6) Explained theory of evolution by common descent :- Eg - Man & ape

(7) Eg :- Giraffe with long neck favoured by natural selection + differential reproduction.

(8) Natural selection largely accepted.

Q.4 Post-Darwinism / Neo-Darwinism / Discuss how neo-Darwinism integrated the fields of genetics & evolution.

- Intro :- Neo-darwinism was first used by George Romanes in 1896 to refer to integration of Darwin's theory of evolution by natural selection with Weismann's germ plasm theory (Later Mendelian genetics).

Neo-Darwinism suggests that evolution occurs when particular type of trait is favoured by natural selection in an environment and it is genetically transmitted over generations causing change in gene frequency

imp

Darwinism (natural selection, variation etc) + Mendelian genetics (Mutation, speciation etc)

→ Neo-Darwinism

→ It was developed to eliminate the shortcomings of Darwin's theory :-

- Theory of 'Pangenesis' or 'blended inheritance'
- No explanation for origin of variation
- Mutation given secondary importance in comparison to individual variation.
- lack of scientific experimentation.

- **Basic tenets of neo-Darwinism**

1) Evolution :- It suggests that evolution takes place gradually through natural selection.

① Evolution and Role of genetics :-

→ Darwin referred to evolution as 'Descent with modification' through natural selection.

→ Later, with re-emergence of Mendelian genetics in 1901, evolution came to be expressed in terms of change in gene frequency which is inherited over time.

② Role of environment :- Certain traits are favoured in a particular environment as they enhance survival & reproductive success.

③ Variation and its causes :- Variation in population is prerequisite for evolution by natural selection. Its sources are :-

3.1) Genetic recombination :- It is considered 2° to mutation

3.2) Mutation : It is the 1° source of variation.

3.3) Genetic Drift

3.4) Gene flow.

3.5) Hybridisation.

3.6) Chromsomal variation :- Eg :- Human chromosome 2 has evolved because of fusion of 12th & 13th ape chromosome.

④ Heritability and Natural selection :-

Traits and genes which are favoured by natural selection are inherited from one generation to the next.

Differential reproductive success leads to accumulation of favourable genes.

(5) **Speciation** :- Neo-darwinism also suggested formation of new species due to geographic or reproductive isolation.

- **CRITICISM**

1) It provides explanation of past evolutionary process but fails to provide future direction.

2) There is over-emphasis on chromosomal variation and genetic recombination, while genetic drift & hybridisation are undermined.

3) Role of migration in evolution is still uncertain.

4) Gradualism is challenged and more focus is given to punctuated equilibrium.

- **Conclusion.**

Neo-Darwinism establishes a balance b/w evolutionary theory and Mendelian genetics. The field of genetic engineering is progressing day by day and ~~is~~ will affect the course of human biological & cultural evolution.

Micro evolutionary forces cannot cause macro-evolutionary changes.

→ Role of evolution → Darwin's scheme ⇒ Limited resources → struggle for existence ⇒ variation ⇒ Natural selection ⇒ survival of fittest

→ " " genetics → Weismann's germplasm (1892) ↓ Mendel (1901) rediscovery by De Vries

Population genetics studies ⇒ Distinguished b/w somatoplasm & germplasm. change in latter only inherited

Fisher, Haldane, Morgan's Fruitfly exp (1912)

2) Evolution came to be seen as change in gene freq.

3) variation causes. 4) speciation.

Q.5 Synthetic theory of evolution?

• Intro :- It combines Darwin's theory of evolution by natural selection with Mendelian genetics. The term was coined by Julian Huxley in his book, "Evolution: The Modern Synthesis" (1942).

some of the prominent scholars were Sewall Wright, Huxley, Fisher, Ernst Mayr etc.

---- same as Q.4 ----

additional points for basic tenets

1) Evolution is gradual :- Microevolutionary processes (changes within species) accumulated to pave the way for macroevolutionary changes (eg- origin of new species).

• Developments leading to synthetic theory.

Lamarckism (1809)

↓

Darwin's evolution by natural selection ('Origin of species', (1859))

&

Alfred Wallace's evolutionary theory.

↓

Weismann's germ-plasm (1892).

↓

Rediscovery of Mendelian genetics by Hugo de Vries & Carl correns (1900)

↓

Morgan's fruit flies (Drosophila, 1912)

:- He showed that Mendelian genetics supported Darwinism as mutation in fruit fly increased genetic variation that helped in natural selection.

↓ mathematical

Fisher & Haldane's population genetics. (1930).

↓

Huxley coined the term 'Modern Synthesis' (1942).

Dobzhansky's 'Genetics & the origin of species' (1937).

:- He combined Morgan's chromosome theory & population genetics with principles of natural selection.

---

imp **Darwin's evolutionary scheme**

Over-reproduction.
(increased chances of survival)

↓

Struggle for existence.

↓

Favourable variations (due to individual variation (1°) & mutation (2°))

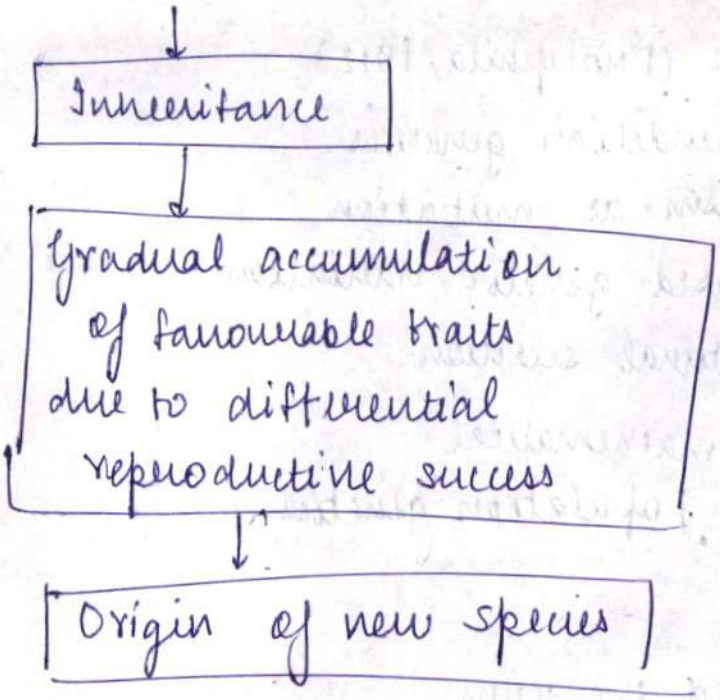
Unfavourable variations

Survival of the fittest

↓

Natural selection

eliminated



Q.6 Explain organic evolution.

- Intro :- Organic evolution refers to gradual process of ~~go~~ change in gene frequency of a population in favour of more adaptive traits. Darwin defined it as 'descent with modification' while proposing his theory of evolution by natural selection in 'Origin of species' (1859).

- Evidences of organic evolution :-

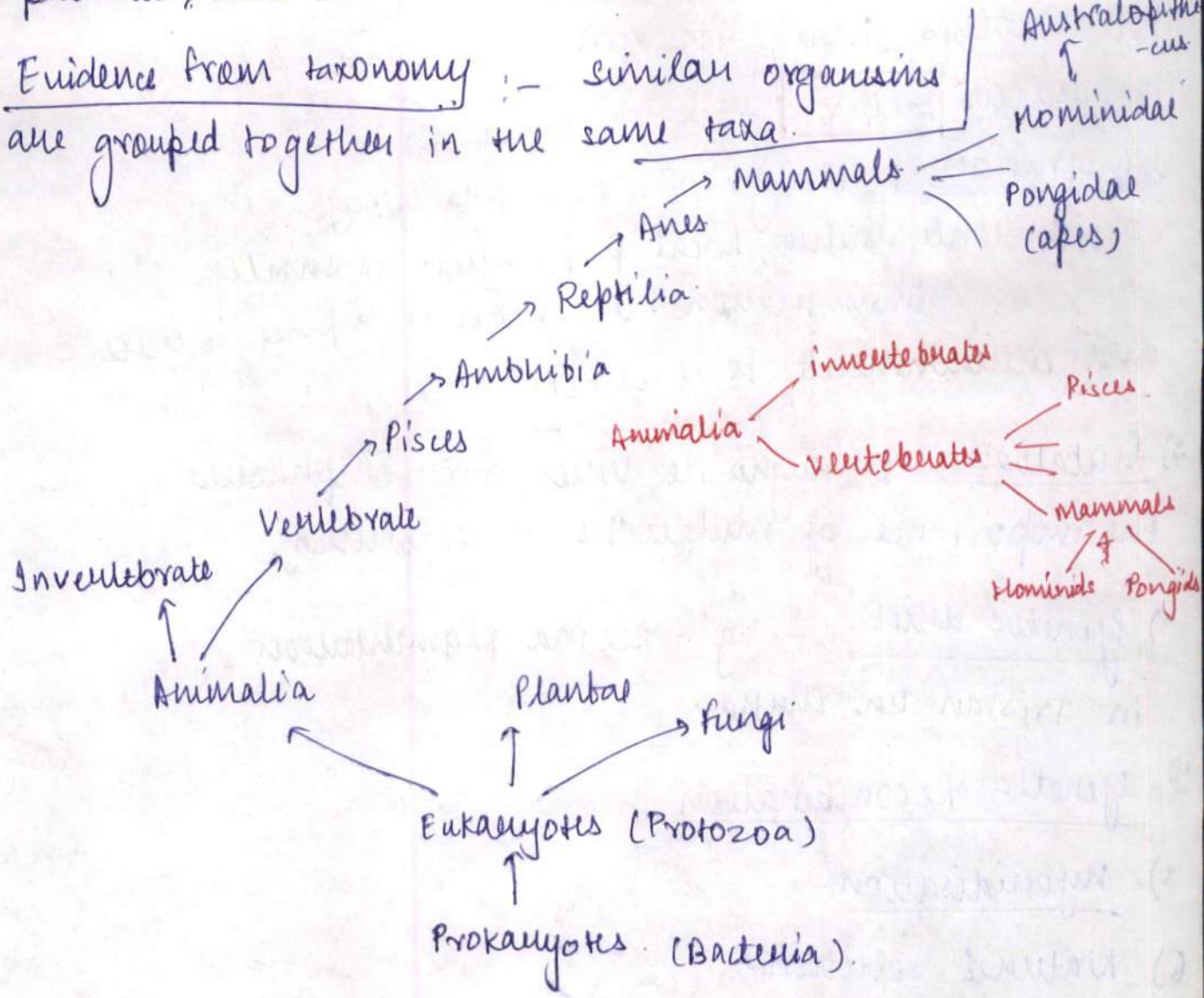
1) Palaeontology and comparative anatomy - Fundamental similarity in fossilised bone structure of primates & humans.

2) Biochemical similarity :- All primates have similar biochemicals like carbohydrates, protein, fat, nucleic acid etc.

Homologous organs - common ancestors.

(3) Embryological evidence: (Recapitulation theory) :- similarity b/w human embryo & embryo of other organisms including primates, fishes etc. → Ernst Heckel

(4) Evidence from taxonomy :- similar organisms are grouped together in the same taxa.



(5) Geographical distribution :- Related organisms & their fossils found in the same region.

↳ Eg:- Chimpanzee & Gorilla in Africa.
→ Orangutan & Sivapithecus in Asia.

; Marsupials in Australia only : absence of placental mammals for a long time.

(6) Cytogenetic evidence :- G bands of ape chromosome 12 & 13 same as G bands of human chromosome no. 2.

⑦ Immunological evidence :- similarity in antigen antibody reaction

• Mechanism of organic evolution

→ It involves change in gene freq. due to various factors :-

1) Migration :- change in gene frequency occurs only when local population is small immigration takes place in a place where and environment is unstable.

2) Mutation :- Hugho de Vries first emphasised the importance of mutations in evolution.

3) Genetic drift :- Eg :- Retina pigmentation in Tristan Da Cunha.

4) Genetic Recombination

5) Hybridisation

6) Natural selection.

7) Gene flow

8) Isolation :- It can cause inbreeding.

• Theories of organic evolution

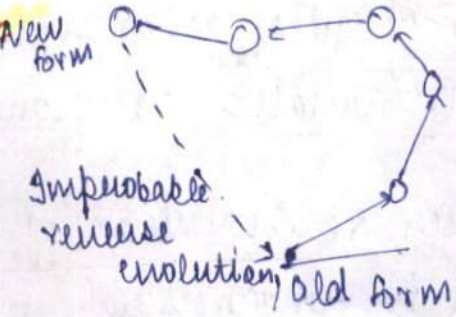
1) Lamarck

2) Darwin's

3) Neo-Darwinism

4) Modern Synthetic Theory.

imp.



Ecological rules of evolution.

Q.7 Dall's rule ?

→ Organisms in different environments adapt differently to enhance their chances of survival. Such adjustments in accordance with environmental condn are called ecological rules of evolution.

→ Dall's rule given by Belgian Palaeontologist Louis Dall in 1893.

→ He proposed that evolution is irreversible & irrevocable. A structure or organism that changes its form in course of evolution does not reverts back exactly to its earlier form. It always keeps traces of intermediate stages through which it has passed.

→ Reason :- Evolution occurs as a response to environmental changes in order to adapt better to surroundings.

b. Since environment is continuously changing & there is negligible possibility of reversion of environment to primitive times, evolution is also considered irreversible.

→ Eg's : (1) Throughout Pleistocene period, humans adapted to changing environmental condn with irreversible changes like lower jaw, dentition, erect posture, brain size etc.

(2) Loss of gills (imp.) as organisms adapted to non-aquatic environment.

→ However, re-evolution of certain characters similar to an ancestral form can occur.

↳ Eg:- Certain extinct flying reptiles had wings; however wings in birds & bats re-evolved independently.

Q.8 Cope's rule.

→ Edward De cope, American Palaeontologist gave this rule on the basis of extensive study of fossils of mammals.

→ It states that an organism in course of evolution tends to ↑se in size until nature imposes some ~~on~~ restriction on this size-increase.

→ Eg:- (1) Homo sapiens taller than australopithecus
↳ Homo erectus who were less than 5 ft.
(2) Evolution of herbivores like horse, camel etc
(3) Dinosaurs etc.

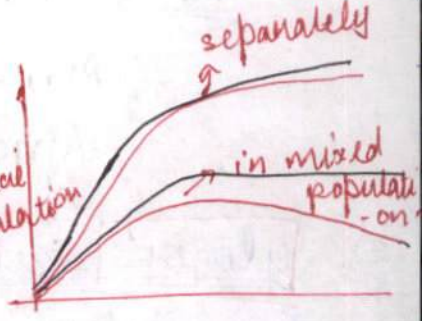
→ Exceptions :→ rule is not universal.
(1) Carnivores don't show ↑se in size (energetically not favourable for them to hunt with large bodies)
(2) Burrowing mammals (moles, rabbit etc):- ↑sed size means difficulty in burrowing
(3) Bat :- ↑sed size will deter flying.

→ Explanation :- (1) ↑sed ht. facilitated distant sight so that carnivores could be avoided.
(2) fruits could be obtained from tall bushes.
(3) locomotion could be rapid.

④ for humans :- not much balancing act required on land as it is on trees
∴ Tsc in height favourable on land.

Q.9 Gause's rule ?

→ It states that when two or more species occupy the same ecological niche, they face competition for food, space, light etc from each-other



As a result, one of them will either shift to a separate niche or become extinct.

imp.
— P. aurelia
— P. caudatum

→ Reason :- This rule is in conformity with Darwin's postulates of struggle for existence & survival of the fittest.

→ food & space are limiting factors leading to competition.

→ Eg :- ① Paramecium Aurelia & Paramecium caudatum exist at same trophic level. when cultured separately, both flourish. When cultured together, P. caudatum is eliminated while P. aurelia survives.

② Pongids & hominids :- former stayed in the forests while latter moved to grasslands.

Q.10 Other rules ?

1) Jordan's rule :- closely related species or sub-species are not found in the same geographical range & usually separated by some physical barrier } to avoid competition.

→ Thus it highlights the importance of geographic isolation in speciation.

→ Eg :- A. afarensis occured in eastern Africa & A. africanus in south Africa.

2) Gloger's Rule :- states that black pigmentation is found in hotter areas whereas it is absent in colder areas.

→ Reason :- Black color absorbs most of the sunlight at skin surface and prevents it deep penetration which can destroy Vitamin D structure.

→ whereas, white skin allows meagre sunshine to penetrate into skin and aid in synthesis of Vit. D (used for calcium absorption & bone formation).

3) Allen's rule

↳ It states that extremities (like limbs, ears etc.) tend to be ↑sed in size in hotter areas. and ↓sed in size in colder areas.

↳ Reason :- In hot areas, large body surface area desirable as it will allow more ~~but~~ blood below the skin to come in contact with surrounding air & more heat is lost; in cold areas heat will be conserved.

(more surface area as compared to body mass).

↳ Eg:- ① Arctic fox has shorter limb & tail.

② Nilotic Negro :- habitant of hot humid climate have longer legs & are tall; sweating is ineffective in them due to humid climate; hence heat lost through radiation alone.

↳ However, people in hot, dry climate tend to have shorter limbs :- net volume & surface area is kept low to avoid sun-stroke. Eg:- Gypsies.

③ Eskimos (cold climate) have shorter limbs.

④ Bergmann's rule - (relationship b/w body size & temp.)

↳ Organisms tend to have larger bodies in colder climates & smaller size in warmer climates.

↳ Reason :- Usually, trunk is bulky & more in size than limbs; larger body means greater body-mass which means more metabolic heat.

↳ Eg:- ① Polar bears in Alaska

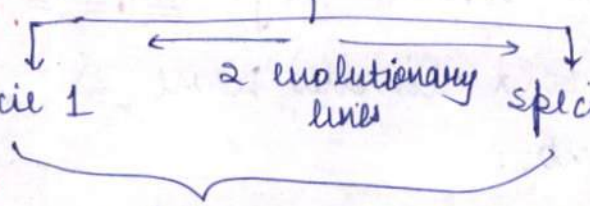
② People in Siberia tend to be heavier & bulky.

Q.11 Explain parallelism & convergence.

• Intro :- similarity in some morphological features among 2 or more species can be due to either parallelism or convergence.

→ Parallelism (homology) :- when 2 species emerge from a common ancestor & develop in same ways, while adapting to their respective environmental condn. paralleling each other

common ancestor.



similar morphological features.

↳ Though, the 2 species show similar features, they have evolved independently of each other.

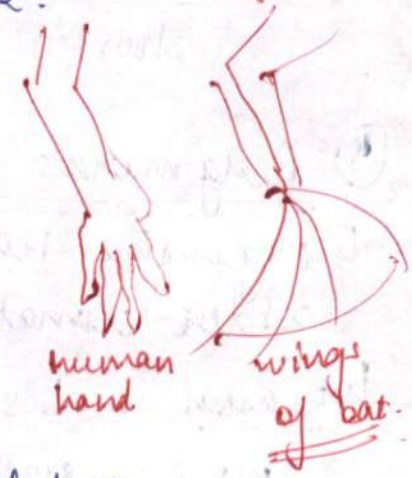
↳ Eg :- ① Old & New world monkeys developed from a common ancestor 25 mya; they show similar features.

② Absence of tail in man, gibbon & great apes :- all of them evolved from a common ancestor in separate evolutionary lines in parallel fashion.

• Convergence (Analogy) :- when 2 species don't share a common ancestor but they develop similar features due to similar evolutionary

• Homologous evolution of structure :- can have different function but have same ancestry.

Eg :- wings of bat, forelimb of monkey



• Analogous structure :- They have similar fxn & form but not related by descent from a common ancestor.

Eg :- wings of bats & birds.

③ Thorns of cactus & leaves of oak, pelpal etc.

pressure & environmental conditions.

→ Hence, development of common features in divergent evolutionary lines.

Different ancestor :- specie 1 → Develop common feature ← specie 3 ← specie 2 ↓ imp.

→ Eg :- ① Development of wings in birds & bats.

② streamline shape in whale & fishes.

- **Relationship between parallelism & convergence**

→ In some cases, it is difficult to suggest whether similarity among organisms is due to parallelism or convergence.

→ structural resemblance among related groups is due to parallelism while among unrelated groups is due to convergence.

→ Both processes are crucial in charting the evolutionary ~~process~~ history of different organisms including man.

Q.12 Adaptive radiation ?

- Intro :- Adaptive radiation is a process through which population of a species diversify rapidly into a number of new forms. This is due to adaptation to diverse environmental niches in different directions.

- Features of adaptive radiation → Pre-requisite → several eco-niches, large population, reproductive isolation ↳ geographical barriers

① Common ancestry :- The newly formed species should share common ancestry.

② Phenotype-environment correlation :- Morphological & physiological features develop in response to environmental condition.

③ Trait utility :- The developed trait in newly formed species provide certain advantage to ~~that~~ the organism in that particular environment.

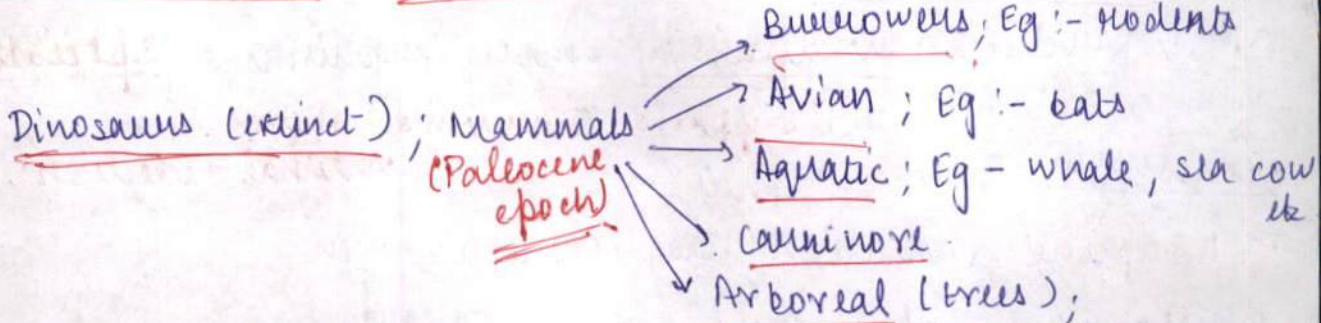
④ Rapid speciation :- There is rapid increase in number and types of evolving groups of organisms around the time ecological & phenotypic divergence is underway. → This is a pre-requisite.

⑤ Availability of several eco-niches :- This will allow evolution of a species into several dissimilar organisms.

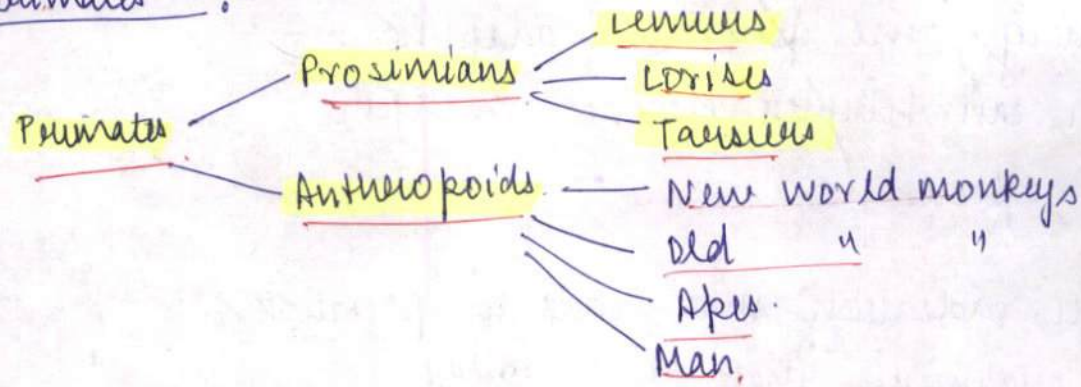
- Examples of adaptive radiation

① Extinction of dinosaurs at end of Mesozoic era and adaptive radiation

of mammals into many distinct lines during Paleocene epoch. (Cenozoic era)



② Adaptive radiation of primates :-



③ Adaptive radiation of Darwin's finches :-
They developed different beaks while adapting to different food habits as per their eco-niches.

Eg:- seed-eating short beaked finches,
insect-eating thin-sharp beaked finches
fruit eating long-beaked finches



• **Methodology to study adaptive radiation**

1) Morphological features of fossils.
2) Comparative anatomy of living organisms

• ~~Advan~~ **Significance**

1) Prevents competition and subsequent extinction due to limited food & other resources.

(2) It enhances better exploitation of diverse resources

(3) It produces new diversity among organisms. – Speciation

(4) Supports Darwin's theory of natural selection.

• conclusion

thus

→ Adapting radiation has contributed in development of several species existing today. Since, the environment is changing continuously, the process of adaptive radiation can further lead to emergence of new species.

→ Adaptive radiation thus leads to speciation. several organisms that exist today have radiated from a common ancestor and subsequently adapted to their diverse environmental condition

Q. 13 Mosaic evolution ?

• Intro :- Mosaic evolution refers to differential evolution of component parts of an organism. That is, rate of evolution of one ~~structure varies from other~~ part of an organism is different from the other part.

• Basic tenets

(1) Evolution in stages :-

→ In the course of evolution, changes take place in stages and not all at once.

→ Thus, changes in one part of the body does not necessarily mean changes in other parts too.

→ Hence, evolution of traits occurs at different rates both within & between species.

→ Eg:- Human evolution :- Bipedalism & modification of pelvic girdle in Australopithecus occured well before there was any significant change in brain size.

(2) Different parts of an organism evolve at different rate

(3)

(4) Phenotype - env. correlation

↳ A particular trait which has more utility in a certain env. develops first.

- **Importance**

① Mosaic evolution aids in macro evolution & speciation. - small changes over a period of time accumulate to cause speciation.

② It provides a flexible framework within which different parts of an organism has to develop in relation to other parts.

③ It helps in resolving many practical problems like question on missing links etc.

④ It demonstrates overall adaptive pattern of evolution of an organism.

Since, all changes don't take place at once; it is more flexible & energy efficient.

- **Conclusion**

Thus, evolution of an organism can be inconsistent & asymmetrical. Hence, it is important that evolution of whole functional system is taken into account rather than a single part.

Q.14. Explain the biological & cultural factors that helped in human evolution.

→ Defn of evolution:

• Intro :- Human beings have evolved through synergetic interaction b/w biological and cultural factors. From the late miocene - early pliocene period (13 - 3 mya), first fossil evidence of hominin has been found.

Thereafter, began the phase of bio-cultural evolution.

• **Biological factors**

1) Bipedal locomotion & erect posture :- This provided evolutionary advantage in grassland environment.
↳ It also freed the hands for carrying food, making tools etc.

Developed as a result of curved vertebral column, bowl-shaped pelvis, & presence of heel & arch in foot.



2) Expansion & evolution of brain :- Size of human brain is twice times that of great apes (1400 cc) (400 - 500 cc). The area devoted to frontal lobe, parietal lobe & cerebral cortex is also greater
↳ This enables increased intelligence, memory, reasoning etc.

3) Evolution of primate hand :- Human hand is more dextrous due to increased length of thumb as well as greater angle b/w thumb & index finger.
↳ Thus, more specialised precision & power grip - development of more complex & efficient tools.

4) Modification of facial features & dentition

↳ Thick enamled teeth, canines are no more projecting outside. Absence of diastema and reduction in size of incisors.

↳ This indicates the use of tools & fire (cooking) for food preparation.

↳ Other changes include – presence of chin, well developed forehead, nasal bridge etc.

5) Reproductive process :- Babies with enlarged brain required broadening of female pelvis region.

↳ This also resulted in prolonged infant dependency

↳ more scope for cultural learning & evolution.

Birth of easily birth &

• Cultural factors → first by homo habilis

1) Tool Making & use :- While it was the result of developed brain & freed hands

→ It further influenced the dentition pattern

→ ~~It is~~ It also enabled man to hunt down large animals and carry out complicated activities

diagram

2) Language & speech :- speech developed as a result of enlargement of Broca's & Wernicke's area in human brain.

↳ Presence of FOXP2 gene is also associated with development of language.

↳ Development of language helped in more efficient transmission of not only simple but also complex learned behaviour. This helped in evolution of culture.



Hand axe



Cleaver

3) Prolonged infant dependency necessitated mother-infant proximity and support from male members → led to development of families

Enlargement of brain → Broadening of pelvis & prolonged infant dependency → Mother-child bond → support from male partner → Male-female bonding → Marriage, Family, Division of labour

④ Evolution of socio-cultural institutions

⑤ Use of clothing due to various socio-cultural practices reduced the presence of body hair in humans.

⑥ Diet :- change in diet due to use of tools & fire brought about change in dentition pattern.

↳ It is still continuing as some individuals don't get 3rd molars throughout their lifetime. } evolution is a continuing process.

↳ Eg :- Hadza of Tanzania

• Conclusion

Thus, biological & cultural factors together brought about human evolution. The process is still continuing, however the pace of cultural evolution has increased several folds, posing a challenge for humans themselves & other species with industrialisation & urbanisation

Q. 15 Micro & Macro evolution

- Intro :- evolution refers to a gradual change in gene frequency of a population & development of more adaptive traits.

Micro		Macro
1) Small scale changes within a species		1) large scale changes involving different species
2) changes cannot be seen easily;		2) since changes are large scale, they can be seen in form of morphological differences
3) leads to race formation or sub-species within a species		3) leads to speciation - formation of new species
4) studied on living population - under the head of population genetics		4) studied on both living population & fossils - under head of palaeoanthropology
5) Eg:- Mongoloids, Negroids among humans / white tiger - sub-species; absence of melanin coding gene		5) Eg:- Homo erectus to Homo sapiens

b) Time-less comparatively

b) Time - more

→ The dichotomy of micro & macro is used for human convenience; not distinguished by nature.

→ Micro-evolutionary changes over a long time accumulated to pave way for macroevolutionary changes.] synthetic theory.

6) Causes – i) small scale mutation
ii) natural selection.
iii) Gene flow.
iv) Genetic drift
v) Hybridisation & isolation

6) Causes – 2 schools

gradualism
↓
gradual micro-evolution adding to result into macro evolution

Darwin, Fisher & Huxley ← Synthetic theory

Punctuated equilibrium
Hugo De Vries.
↓
evolution happens in a sudden manner in bursts. A new species is formed during a sudden speciation event, & thereafter there is no change in it over a period until another burst occurs.

Q.16 Is evolution ongoing?

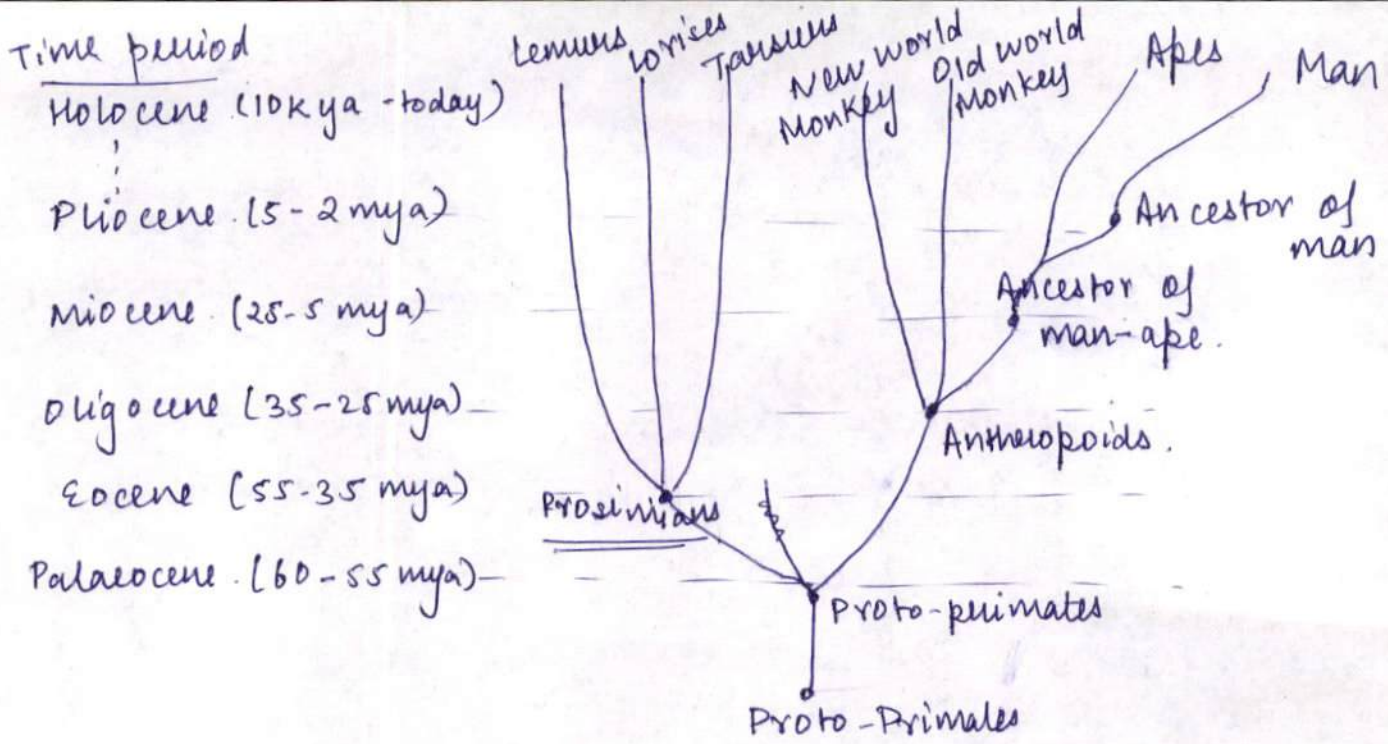
→ More migration (ICT) & hybridisation
↓
more variation
↓
pre-requisite for evolution

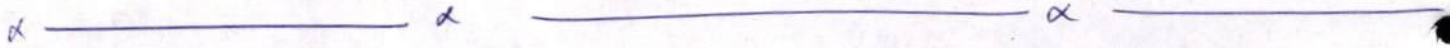
↔ However, less interbreeding (isolation) or genetic drift

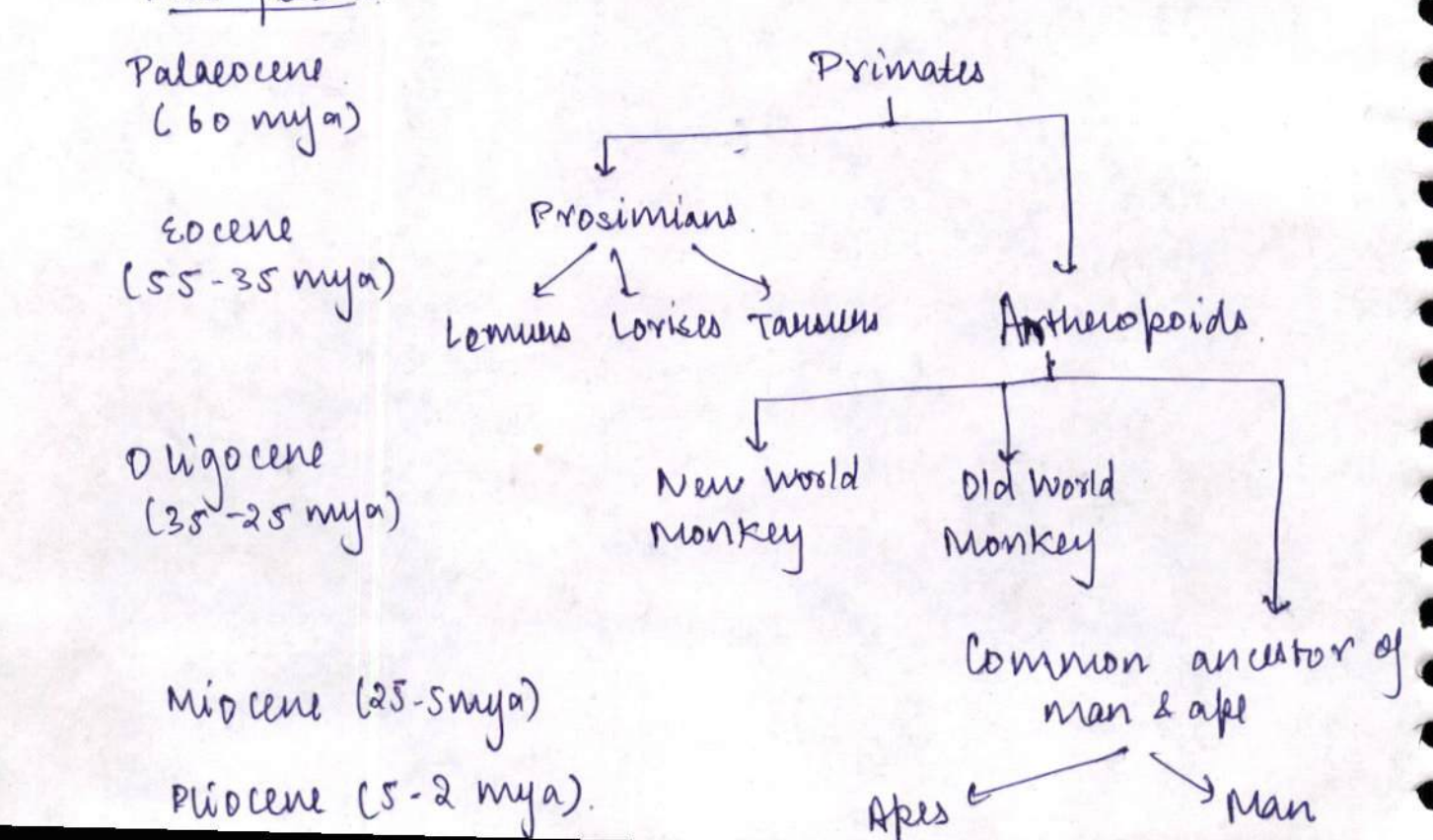
Eg – ① absence of 3rd molar throughout lifetime
② ↑ing avg height of children in almost all soc.
↓
due to better nutrition.

egs of micro-evolution.

↳ pace of cultural evolution >>> Biological evolution.


Time period
Holocene (10Kya - today)
Pliocene (5 - 2 mya)
Miocene (25 - 5 mya)
Oligocene (35 - 25 mya)
Eocene (55 - 35 mya)
Palaeocene (60 - 55 mya)
Lemurs
Lorises
Tarsiers
New world Monkey
Old world Monkey
Apes
Man
Ancestor of man
Ancestor of man-ape.
Anthropoids.
Prosimians
Proto-primates
Proto-Primates




Time period.
Palaeocene (60 mya)
Eocene (55 - 35 mya)
Oligocene (35 - 25 mya)
Miocene (25 - 5 mya)
Pliocene (5 - 2 mya).
Primates
Prosimians
Lemurs
Lorises
Tarsiers
Anthropoids
New world Monkey
Old world Monkey
Common ancestor of man & ape
Apes
Man

Unit-1.5 Primates

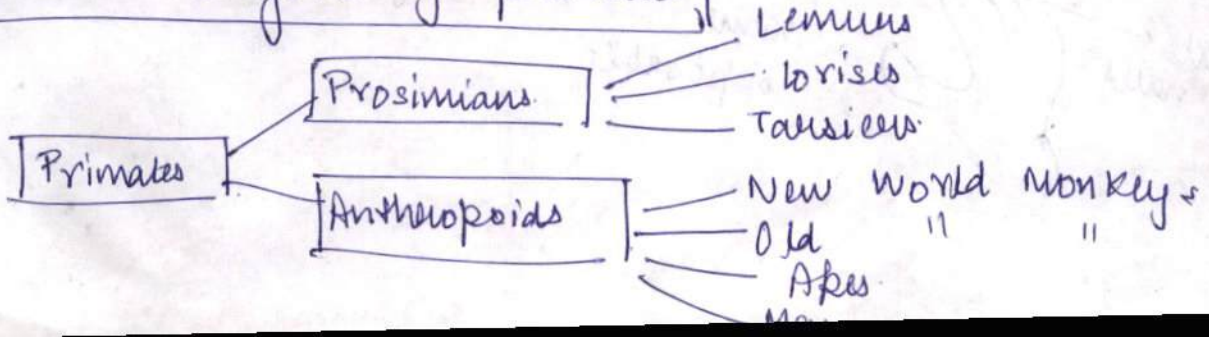
- Timeline

Era	Epochs	Time	life forms
I Cenozoic	Holocene / Recent	10,000 yr ago - Recent	Modern man (10,000 yr ago)
(Quaternary (1 mya - present))	Pleistocene	2 mya - 10,000 ya	early form of man
(tertiary (60 - 1 mya))	Pliocene	5 - 2 mya	Ancestor of man
	Miocene	25 - 5 mya	Ancestor of ape & man.
	Oligocene	35 - 25 mya	New world & old world monkeys
	Eocene	55 - 35 mya	Age of Prosimians.
	Palaeocene	60 - 55 mya.	Primates appear.
II Mesozoic	Cretaceous, Jurassic, Triassic.	200 - 60 mya.	Reptiles (dinosaurs), birds, mammal appear.
III Palaezoic	-	500 - 200 mya	fishes, amphibians

Q. What are the characteristics of primate? / 'Man is a primate' - Discuss. (Describe features common to man & primate).

- Intro :- Primates belong to the class mammalia of kingdom Animalia. They first appeared in the Palaeocene or early eocene epoch (60 - 55 mya) following a major geological transition from the Mesozoic to Cenozoic era.

- Various categories of primates



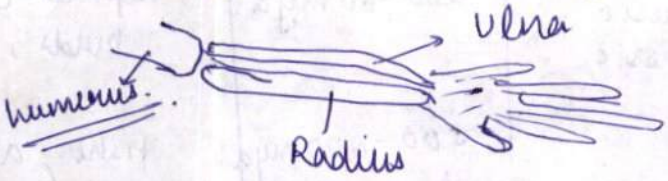
• Characteristics of Primates

I General Mammalian features :-

1) Covered with dense hair that provides insulation. (less prominent in humans)
2) Warm-blooded
3) Give birth to young ones; nourishment of child through mother's mammary glands.
4) Long period of infant dependency aiding transmission of learned behaviour.

II Specialised features of primates :-

1) Structure of limbs :- Double bones in the lower portion provide rotating forearms.



↳ Both hindlimbs & forelimbs can grasp things due to their arboreal existence

2) Primate hands :- They have prehensile grasping hands.
   - ↳ Fine digits
   - ↳ Broad & flat nails instead of claws
   - ↳ hairless, sensitive pads on fingers, toes, heels & palms to help in gripping
   - ↳ opposable thumb. (precise & powerful grip).



3). Clavicle :- Prominent clavicle that provides greater freedom of movement.

4) Omnivorous :- Primates said to have evolved from insectivorous ancestors and also depend on frugivorous diets.

5). Dentition :→ Chewing teeth (molars and premolars) are less specialised.

↳ canines and incisors have greater specialisation especially in lower primates ('dental comb' for grooming).

6). Reduced sense of smell and ~~snout~~ reduced snout/muzzle.

:- Olfactory lobe of brain has also reduced.

7). Enhanced visual ability :→ Larger portion of brain is devoted to vision.

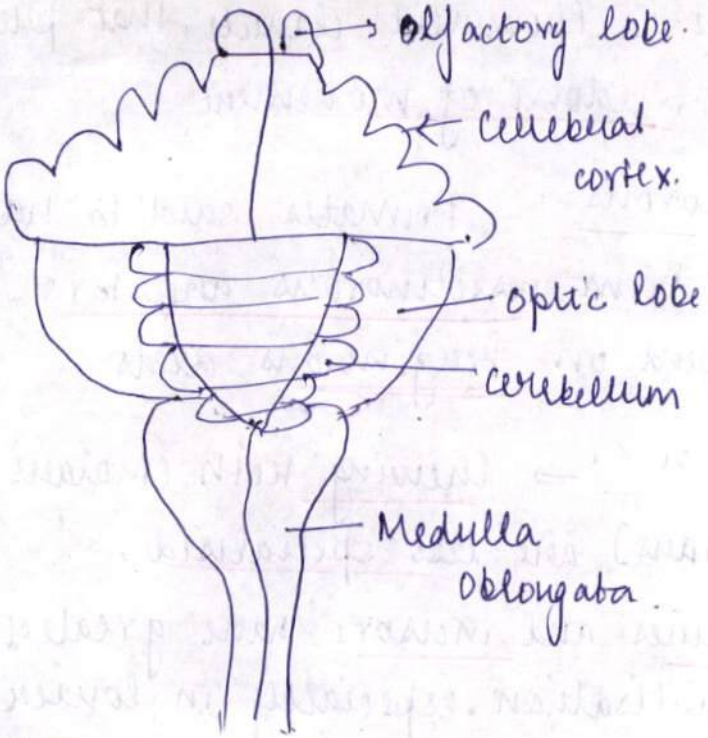
↳ forward positioned eyes that can see color.

↳ This helps in 3D vision and precise information of direction & distance crucial for arboreal survival.

8). Changes in skull & brain :- larger brain relative to body size (1400 cc in man).

↳ increased size of frontal, parietal & occipital lobe, as well as cerebellum. (for sound balance).

Coronal section of primate brain



9) Reproductive processes :- Reduced no. of offsprings and prolonged infant dependency.
↳ longer post-natal life span.

10) Primates are social animals :- they live in groups where infants learn the complex behaviours from adults.

- Conclusion

These unique physical & behavioral features of primates are both the result as well as cause of evolutionary pressure of arboreal life. Humans have gone one step ahead through both biological as well as cultural evolution.

Q.2. Describe the primate taxonomy?

- Intro :- Simpson (1945) gave the gradualistic classification of primates dividing it into two suborders :- prosimians and the anthropoids / simians.

→ The overall Primate taxonomy is as follows :-

Kingdom - Animalia

↓

Phylum - Chordata

↓

Class - Mammalia

↓

Order - Primata.

Suborders - Prosimians | Anthropoids / Simians.

Prosimians → Adapids | Omomyids

Adapids → Lemuriforms | Lorisiforms

Lemuriforms → Lemur, Indri, Aye-Aye.

Lorisiforms → Lorises, bush babies etc.

Omomyids → Tarsiers

Sub order :- Anthropoids.

Anthropoids → Platyrrhines | Catarrhines

Platyrrhines → New World Monkeys.

Catarrhines → Cercopithecoids | Hominoidea

Cercopithecoids → Old World Monkeys.

Hominoidea → Pongids | Hominids

Pongids → Lesser apes | Greater apes

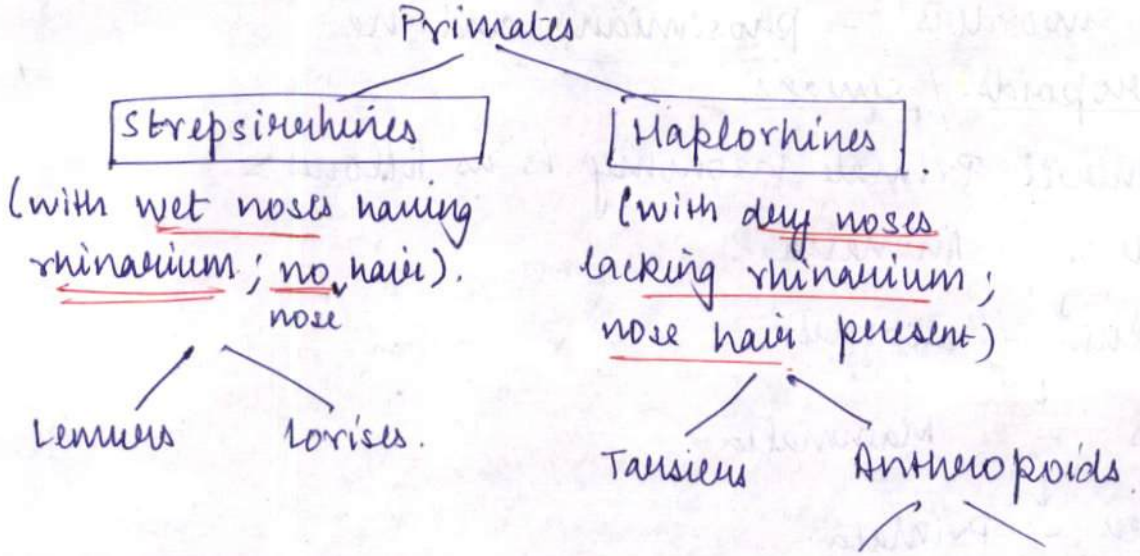
Lesser apes → Gibbon.

Greater apes → Orangutan, Gorilla, Chimp

Hominids → Humans

- Characteristics of Prosimians

- Alternate classification



* The earlier classification (Prosimians & Anthropoids) is based on evolutionary rate. That is, prosimians evolved around Palaeocene - Eocene epoch. Anthropoids appeared in Oligocene.

* whereas, the alternate classification is based on anatomical features and organisms with similar characteristics are grouped together.

Q.3 Differentiate between prosimians & anthropoids.

- Intro :- Simpson (1945) divided the primates into 2 suborders :- Prosimians and anthropoids. The Prosimians include lemurs, lorises and Tarsier. While anthropoids include New world monkeys, Old world monkey, apes and humans.

• Common features

① Arboreal existence :- Both suborders include organisms having arboreal characters like grasping limbs, rotating arms etc.

② Similar pentadactyle hand plan & opposable thumb.

③ Retention of clavicle in both

④ Both have frugivorous or omnivorous/insectivorous organisms.

⑤ Dentition :- same order of 4 types of teeth - incisor, canine, premolar & molar, though dental formula differs.





⑥ stereoscopic or 3D vision due to forward positioned eyes.
↳ Enlarged visual centres in the brain

⑦ Larger brain relative to body size as compared to other mammals.

⑧ Reduced number of offsprings & longer infant dependency.

⑨ Both have organisms that live in social groups (eg - Tarsiers, apes etc.).

• Differences

Prosimians

① They appeared during palaeocene - eocene epoch around 55 mya.

Anthropoids

① They appeared a little later during oligocene epoch (35 mya).

② They have smaller brain size.

③ They have naked moist nose with rhinarium (except tarsiers)

④ They have greater smelling ability.

⑤ They have longer snouts.

⑥ Their hands are not highly dextrous. They also have a toilet claw for grooming



↳ They couldn't. no toolmaking



⑦ Their upper lip is attached to the gums and has a cleft in between

⑧ They ~~usually locom~~ are arboreal. Mode of locomotion is quadrupedalism or vertical clinging & leaping

② They are complex brained primates.

③ They lack rhinarium and have dry nose with hairs.

④ smelling sense is less.

⑤ They have reduced snout or flat faces.

⑤ They can show variety of facial expressions

⑥ They have highly dextrous hands and lack toilet claw.

↳ They could perform advanced functions like tool making etc.





⑦ Upper lip is not divided & is neither attached to the gums.

⑧ They are both arboreal & terrestrial. Mode of locomotion is - brachiation,

quadrupedalism, bipedalism

(9) These include lemurs, lorises, tarsiers

(9) - - -

(10) reverse ← (10) Prolonged infant dependency; greater degree of transmission of learned behaviour from adults to child.

(11) Dental comb :- lower jaw

(11) No dental comb.

• Conclusion

The fossil evidence is still very little to provide a more complete picture of primate evolution. When more fossils become available, we may be able to evaluate the differences in a better way.

(12) They live both in groups (lemurs) & solitary (lorises)

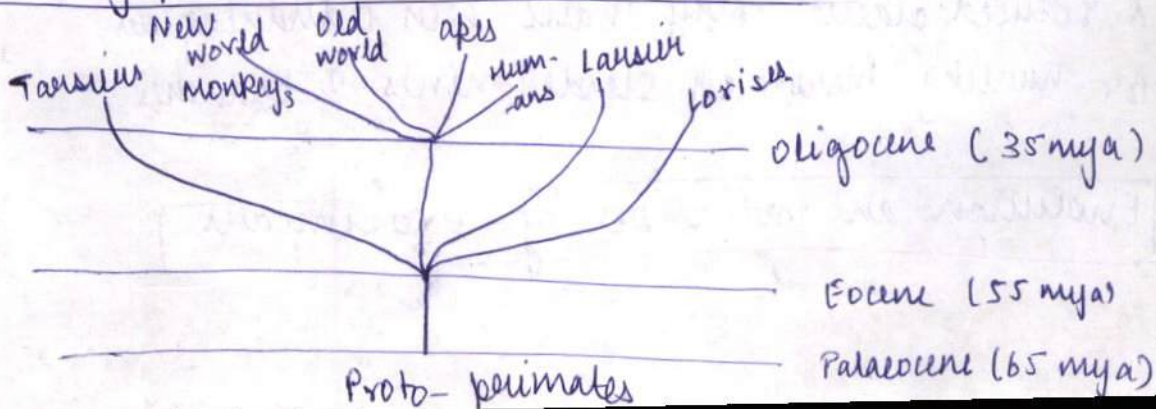
(13) No toolmaking

(12) mostly live in groups

Q.4 Explain the evolutionary trend of primates

• Intro :- The order primates is classified into two sub-orders :- prosimians and anthropoids. It is believed that primates evolved from insectivorous ancestors and first appeared during palaeocene epoch (65 mya).

→ Radiations of primates in different directions



• Theories of primate evolution

1) Arboreal Theory :- It suggests that primates evolved from insectivores that took to the trees.

1.1) Eyes & sense of vision :- Arboreal behaviour favoured vision over smell to enable precise information of distance. Thus, location of eyes was made more forward for 3D vision and snout was gradually reduced.

1.2) Changes in hand, feet & nails :- To enhance grasping capability, hand & feet have opposable thumbs. Replacement of claws with flat nails also aided grasping.

↳ Criticism :- 1) Many mammals living in trees don't have primate like features.
Eg:- tree squirrel. (it has claws, great smelling sense etc.)
2) Other animals who have primate like features but do not live in trees.
↳ Eg:- Cats having forward facing eyes etc.

2) Visual Predation theory :- given by Mary Cartmill (1992)
:- It suggests that primate features like forward facing eyes, grasping hands & feet & reduced claws may have been advantageous for hunting insects on slender vines & branches.

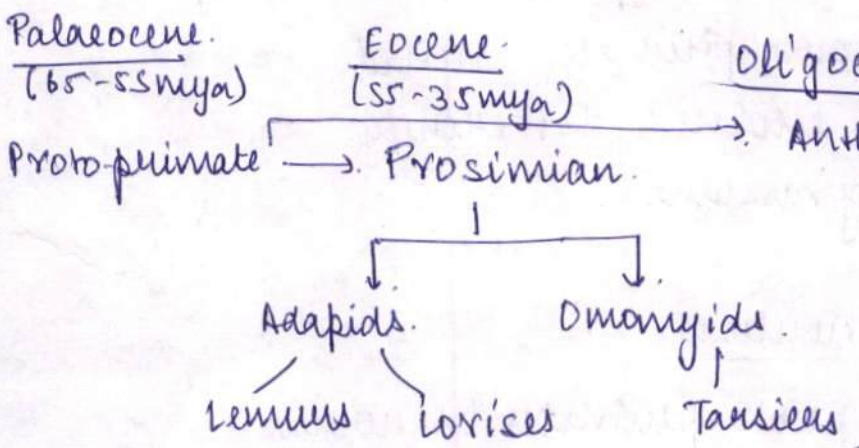
• Evolution and radiation of Procimians

① The earliest primates emerged during the palaeocene - eocene epoch (60 - 55 mya) from insectivorous ancestors.

② Reason for emergence :- Transition from mesozoic to cenozoic era was supplemented by major seasonal and geographical changes - much driven climate & continental drift.

↳ This led to changes in vegetation, extinction of many primitive species (eg - dinosaurs) & emergence of new species (eg - primates).

③



• Evolution and radiation of Anthropoids.

① Earliest fossil evidence of anthropoids have been found from fayum deposits of Egypt from Eocene - oligocene epoch. (35 mya).

↳ Eg :- Catopithecus. (size of squirrel monkey, mixed diet of fruit & insects, small eyes - hence diurnal).

Oligocene (35-25 mya) → Miocene (25-5 mya) → Pliocene (5-1 mya)

Anthropoids appear
- New World Monkeys
- Old World Monkeys

Ancestors of ape and man
Eg:- Sivapithecus
~~(ancestor of orangutan)~~
Dryopithecus etc.
↓
Ramapithecus.

ancestors of man appear.

- Reason for evolution :- Climate becoming ~~more~~ more warmer & drier. This led to reduction in forests and emergence of grasslands (savannahs)
  - Hence, due to increased competition for forest land, some primates shifted to grasslands and evolved differently (man shifted to grassland).

- Geographical distribution.

(1) Fossil evidence of proto-primates (squirrel-like) as well as prosimians have been found from both Europe & North America which were part of one landmass during palaeocene.

(2) New World Monkey have said to be emerged in Africa & then migrated to south America
  - either directly from Africa to south Am. (during oligocene, distance b/w two was less and there were islands in between)
  - or from Africa → North Am. → South Am. (unlikely route since distance b/w

North & South Am. was vast).

(3) fossil evidence of old world monkeys, apes and early hominids have been found from Africa, Europe & Asia.

- Ls Dryopithecus - Europe
- Ls. Sinapithecus - ~~Africa~~ Asia
- Ls Ramapithecus - Asia

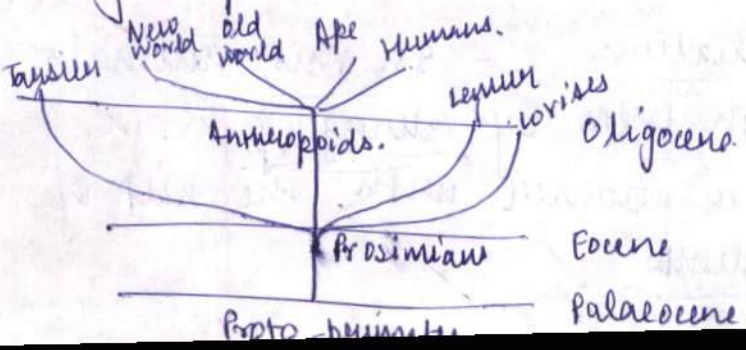
} Miocene. (9-15 mya).

- Conclusion.

~~Still~~ Due to lack of fossil evidence, particularly from palaeocene - eocene epoch (55 mya) and later miocene period (10-5 mya), the evolutionary link of primates is still incomplete and requires more understanding.

Q.5 What are different types of primate adaptations? (both arboreal & terrestrial adaptations).

- Intro :- Primates first appeared during palaeocene - eocene epoch (60-55 mya). From there, they radiated in different directions and evolved in accordance with their environmental conditions by developing different kinds of adaptations.



• **Arboreal adaptations** :- adapted to living on trees.

Physical adaptations

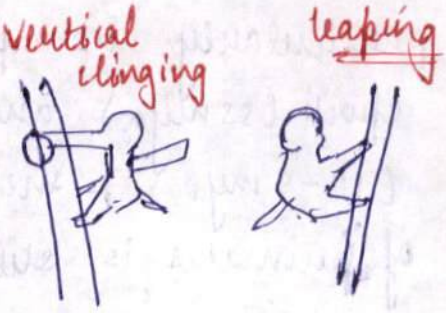
① Primate hands :- survival on trees require good grasping to decrease the risk of falling down.

1.1) This is achieved by prehensile hands and feet as well as opposable thumb.



1.2) claws are also replaced by flat and broad nails





② Primate feet & locomotion :-

2.1) There are 3 types of arboreal locomotion :-

i) Vertical clinging & leaping :- In this, animal while on rest, clings to a branch in vertical position (erect trunk). When it moves, it leaps (jumps) from one branch to another by using hind limbs for pushing.

↳ adaptation :- long hind limb & short fore limb.

↳ tarsiers have long tarsal bone to provide extra spring.

↳ Eg:- Prosimians like tarsier, lemur etc.



ii) Brachiation :- In this, animals move through trees by swinging from one branch to another with the help of prehensile limbs.

↳ Eg :- Lesser apes (gibbons), chimpanzee etc.

↳ Adaptation :- Prehensile limbs, opposable big toe

↳ small body size (eg :- Gibbons).

↳ 2 bones in lower arm of both limbs (forelimb - radius & ulna; hindlimb :- tibia & fibula) - allows greater rotation.



iii) Quadrupedalism :- It involves walking on all four limbs (2 hind limbs + 2 forelimbs)

2 types :- a) Palm & fist walking :- Orangutans } both terrestrial & arboreal.

b) Knucle walking :- Gorilla & Chimpanzee.



↳ Arboreal adaptation :- big toe of monkey's is at greater angle and more prehensile than prosimians.

↳ ↳ thickly padded fingers for greater friction.

③ Dentition :- Dental formula of prosimians (lemurs, lorises) & new world monkeys is 2133. Old world monkeys & apes have dental formula - 2123. Shows omnivorous diet :- frugivorous + insectivorous

↳ reduced ~~in~~ no. of incisors (2) :- increased use of hands in manipulative work like food preparation.

↳ Prosimians incisors form dental comb used for grooming.

↳ Projecting canines

↳ Less specialised chewing teeth (Molar & pre-molar)

(9) Evolution of brain :- Reduced size of olfactory lobe and increased occipital lobe (for vision).

↳ Other eye specific adaptation :- forward facing eyes for 3D vision.

↳ This provides more accurate & precise information about distance & environment necessary for arboreal existence.

• Terrestrial adaptations.

(1) Primate hands :-

→ Hands are more dextrous due to increased length and angle of thumb.

→ This allows remarkable power & precision grip.

(2) Primate feet & locomotion :- Normally 2 types :-

2.1) Quadrupedalism

↳ Palm & fist walking :- Eg - Orangutan

↳ knuckle walking :- Chipanzee & Gorilla.

2.2) Bipedalism :- walking erect on 2 feet

↳ It might have emerged to adapt more effectively to grassland life.

→ Behavioral adaptations

Living in social groups :-

→ to assist mothers & infant child.

→ This also provides evolutionary advantage in terms of transmission of learned behaviour.

→ safety :- many ground living apes also seek nightly shelter in trees.

2) Communication :- through alarm calls, gesture calls etc.

Eg :- Gibbons use singing for differentiating & claiming territories.



↳ Anatomical changes :- shortening & broadening of pelvis → bowl-shaped
↳ longer & straight hind-limbs.
↳ lumbar curve in the spine (vertebral column is curved)
↳ arched, non-prehensile feet.

(3) Dentition :- chewing teeth (molars & premolars) are not very specialised – due to ~~pre-pa~~ use of tools & cooking to prepare food.
↳ canines don't project outside – allows vertical & horizontal moving of jaws for efficient chewing.

(4) Evolution of brain :- large brain size.
↳ decreased olfactory lobe
↳ specialised areas for speech & language
– Broca's area & Wernicke's area

(5) Reproductive process :- fewer offsprings
↳ increased infant dependency period allows transmission of learned behaviours.

→ Behavioral adaptation :-

(1) Toolmaking :- Terrestrial primates including both great apes & humans have resorted to tool making due to dextrous hands.

(2) Communication :- while humans have developed unique languages, other primates also communicate through alarm calls, gesture calls etc.

(3) Living in social groups.

• Conclusion

These adaptations have provided primates evolutionary advantages to survive and prosper in different ecological niches.

Q.6 Describe primate behaviour.

• Intro :- same as Q.5 - - - -.

• Primate behaviour

prolonged infant dependency → mother-infant bond → living in social groups to support mother-infant.

① Primates live in social groups consisting members of all ages & both sexes.

↳ Among some Bonobos; groups are centred around females rather than males.

↳ social groups provide safety & help in acquisition of food.

② Social grooming behaviour is :- It used to strengthen links; it sometimes also depicts presence of dominant & inferior groups.

Establish social & political links through offering of meat etc.

③ Parental care :- Most fundamental social unit is mother-infant bond.

↳ Longer infant dependency period also allows transmission of learned behaviour.

④ Reproduction & sexual behaviour :- In primates, females (except humans) are seasonally receptive. Hence, pair bonding between male & female is rare except in few cases.

multimale-multifemale groups.

⑤ Dominance & aggression :- Primates usually have hierarchies where higher ranking males have more advantage in terms of

Gorillas show aggression through chest-beating

(existence of alpha male/female)

mate-selection, food, space etc.

↳ Aggression is also showed by primates through projecting canines etc. It is generally due to competition for mates, food, higher position etc.

⑥ Territorial range :- Most primates occupy and defend their home range area.

↳ Eg :- Gibbons use singing to signify their territorial area.

⑦ Communication :- Non-human primates communicate through scent, body postures, vocalisation, alarm calls, gesture calls etc.

⑧ Tool use :- Humans & even great apes have been observed to use tools to carry out their daily activities

⑨ Primates are both arboreal & terrestrial (esp. later primates).

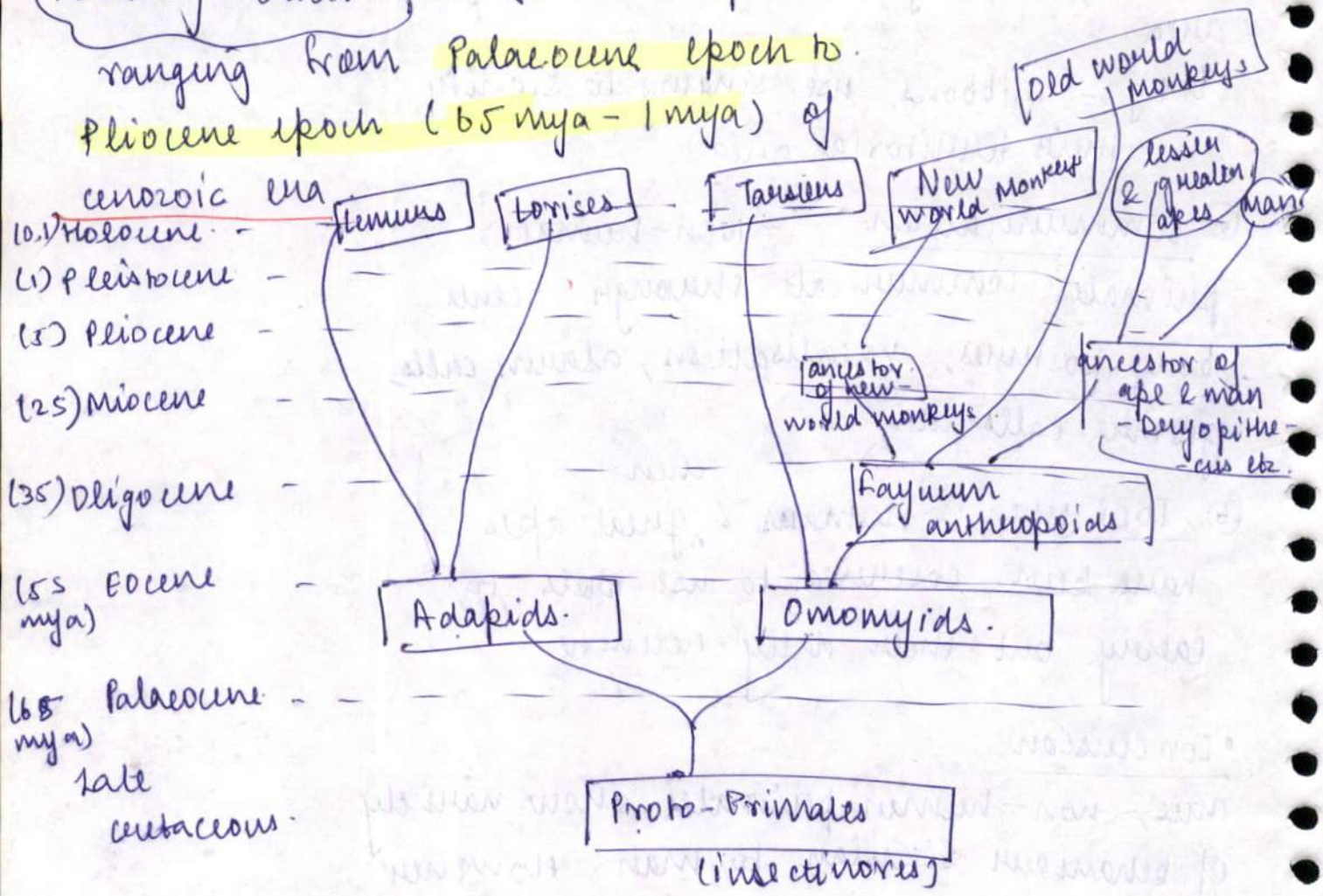
• Conclusion

Thus, non-human primates show variety of behaviour similar to man. However, rapid industrialisation & urbanisation is destroying their natural habitat. This brings about change in their social behaviour.

Q. 7 Fossil primates of tertiary period.

- Intro :- Living primates have evolved & adaptively radiated from a common ancestor over the last 65-55 million years. Study of such fossil primates help in establishing missing evolutionary links.

- Tertiary Period :- It is the period ranging from Palaeocene epoch to Pliocene epoch (65 mya - 1 mya) of cenozoic era



- Palaeocene primates (65-55 mya).

1) Region :- Fossils have been found from North America & Europe.
2) Fossils mainly consist of teeth & fragments of jaw.
3) One such archaic primates are plesiadapiforms
4) They these are different from prosimians & anthropoids which evolved into living primates.

5) However, they can be regarded as an offshoot in the primate evolutionary tree.

6) Characteristics of Plesiadapiform :-

i) squirrel like animal with large snout :- enhanced smelling sense.

ii) little or no stereoscopic vision.

iii) insectivorous/- large incisors
omnivorous diet

iv) Presence of claws & non-prehensile hand & feet.

- **Eocene primates** (55-35 mya)

1) Region :- fossil records have been found from.
North America, Europe & Asia.

2) These fossil records can be divided into 2 categories :- adapids & omomyids.

3) These shows similarity to present-day living prosimians :-
↳ Adapids - Lemurs & Lorises
↳ Omomyids - Tarsiers.

4) Adapids :- Diurnal, frugivorous diet, sexual dimorphism in canines
↳ small, broad face with stereoscopic vision & reduced muzzle.
(moist naked nose with rhinarium; no nose hair)

5) Omomyids :- Nocturnal, omnivorous/insectivorous diet, long tarsal bone etc.
(dry nose; presence of nose hair)

- **Oligocene primates** (35-25 mya).

1) The fossils show similarity to present-day anthropoids.

2) Region :- most of them are from Africa.
↳ Fayum deposits near Cairo, Egypt.

3) Oligocene anthropoids from Fayum can be grouped into 2 categories :-
↳ monkey like parapithecids / platyrrhines
↳ ape like propliopithecids / catarrhines

4) Parapithecids are considered to be ancestors of new world monkeys
:- similar to present day squirrel monkey
→ small size & relatively smaller brain

5) Propliopithecids included ancestors of both old world monkeys & hominoids (apes & human)
→ frugivorous diet
→ 3 premolars
→ 2 premolars, share dental formula of catarrhines.
↳ They show many similarities with gibbon.

• Miocene - Pliocene primates (25 - 5 mya; 5 - 2 mya)

1) Region :- The fossil records have been found from Africa, Asia & Europe.
[Reason :- during miocene increased temp. & aridity → more grassland].

2) They are considered as fossil records of proto apes - ancestors of hominoids.
(found in Kenya, Uganda)
↳ Eg :- Proconsul from early miocene.

3) Later miocene saw following primates (15 mya).
i) Dryopithecus :- lived in Eurasia
↳ chimpanzee sized ape; showed similarity to present day apes & humans.
↳ mainly arboreal
↳ omnivorous
↳ thin tooth enamel; pointed molar cusp - similar to present day fruit eating chimpanzee.

ii) Sinapithecus :- found in western & southern Asia.
↓
sivalik hills of India

↳ flat & thickly enamled teeth :- diet - hard, tough & gritty items like seed.

↳ arboreal but also moved on the ground due to their presence in grassland environment.

↳ presumed to be ancestral to orangutan. :- climbing & suspension ;- imp behavioural features

(1) found

iii) Ramapithecus :- fossils from sivalik region of India & Kenya, Africa (Kenyapithecus)

↳ many scholars suggest that ramapithecus separated from dryopithecus lineage in miocene.

↳↳ They were thought to more closely resemble the ancestors of modern day homo sapiens. (3)

(ramapithecus similar to sinapithecus except it had smaller canine; it is believed to be female of sinapithecus)

↳ many scholars suggest that ramapithecus was the first step in evolutionary divergence of humans from the common hominoid stock (represented by dryopithecus) (2)

↳ others suggest that ramapithecus resemble fossils of primate sinapithecus which is regarded as ancestral to the orangutan. (4)

[It was smaller in size as compared to sinapithecus but had almost all its features]

4) The Pliocene period saw fossils of first bi pedal hominins - Australopithecus etc.

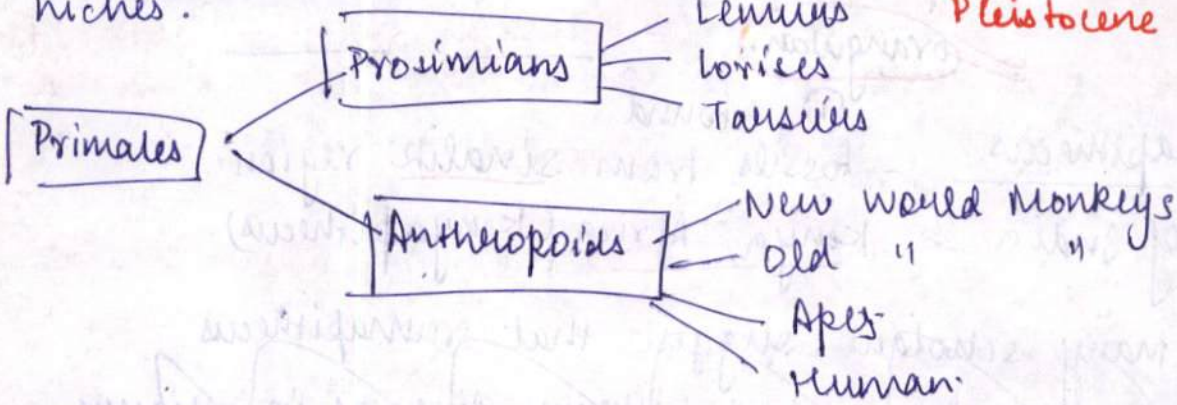
• conclusion

The fossil evidence is still scarce to chalk out the full evolutionary pathway of primates. with more fossils being discovered, the evolutionary links could be understood

Q.8 Describe living major primates. → by Simpson (1945).

• Intro :- Primates can be divided into 2 suborders - Prosimians & Anthropoids. The first primates emerged in Palaeocene-eocene epoch (65-55) mya. Thereafter, they radiated in different directions and evolved according to their respective ecological niches.

- Tertiary period
  - Palaeocene
  - Pliocene
- Quaternary
  - ~~Palaeisto-~~ Pleistocene
  - ~~cene~~ to Holocene



• **Lemurs.**

↳ Region :- Madagascar, South & East Africa.

↳ Egs :- Lemurs, ~~Ind~~ Indris, Aye-Aye, Gnori

↳ Features :- i) Arboreal; locomote through quadrupedalism & vertical clinging & leaping.

Diet — 2) Mostly frugivorous; also feed on lares, bark, flowers etc.

Nose & eyes — 3) Naked moist rhinarium in nose.

4) Muzzle facial :- greater dependence on smelling sense.

5) Lateral eyes.

Limbs — 6) Hind limbs longer than forelimbs

Brain — 7) Small sized brain relative to other primates

Extra — 8) Presence of toilet claw & dental comb for grooming

Dentition — 9) Dental formula :- 2133/2133.

• Other common char. of prosimians :- (1) multiple breast pairs (2) Duplex or two horned uterus.

Behavioral
10) some lemurs are solitary while others live in social groups.
11) They produce fewer offsprings; single or twins.

• **Lorises**

↳ Region :- south east asia, sub-saharan Africa.
↳ Eg:- Loris, Bush baby etc.
↳ Features :- 1) same as lemurs.
2) feed on both fruits & insects.
(3) - (11) same as lemurs.
(12) They are mostly shy & solitary.

• **Tarsiers** :- small sized (size of a rat).

↳ Region :- Philippines, Indonesia.
↳ Features :- (1) ---- same.
(2) They feed on insects & sometimes smaller animals
(3) They have large & more forward facing eyes - thus they have highly developed stereoscopic vision.
↳ This helps in their nocturnal lifestyle.
(4) No rhinarium in nose :- reduced dependence on smell.
(5) extra enlongated tarsal bone for additional spring during leaping
(6) relatively smaller sized brains; enlarged visual centres
(7) Presence of toilet claw; no dental comb.
(8) Dental formula :- 2133/2133.

(9) They live in family groups composed of mated pair & their offsprings.

• Platyrrhines / New World Monkeys. [less closely related to humans]

↳ Region :- ~~New World~~ South America, Central America

↳ completely Arboreal ; locomote through quadrupedalism, brachiation.

↳ (2) They have broad, flat bridged noses, with nostrils facing outward.

(3) Dentition :- They have 3 premolars ; no canine - premolar sectorial system.

(4) Diet :- insects, fruits, leaves etc.

(5) They have prehensile tail.

(6) They do not have ear tube.

(7) Cheek pouches are absent.

(8) In some cases, males may be involved more in parental care (carrying infant) than females.

(9) They live in social groups.

(10) Snout reduced ; eyes enlarged and forward facing

(11) Eg :- Marmosets, Tamarin, Howler monkey, squirrel monkey etc. (They have great diversity ; species of all sizes).

* In some, thumb non-opposable or absent.

• Catarrhines - Old World Monkeys.

↳ Region :- Old world :- Africa, Asia, Europe.

(1) some are partly arboreal and partly terrestrial while others spend relatively more time on ~~group~~ ground (eg :- gelada baboon)

(2) Locomotion :- brachiation quadrupedalism.

(3) They have narrow noses with nostrils facing downward.

(4) Dentition :- They have 2 premolar.
2123/2123. (same dentition in hominoids; thus more closer to human beings).
↳ canines with premolar form a sectorial system

(5) They have cheek pouches. (pouches store food for later eating & digestion).

(6) Diet :- fruits, leaves, seeds.

(7) Non-prehensile tail.

(8) They have ear tube.

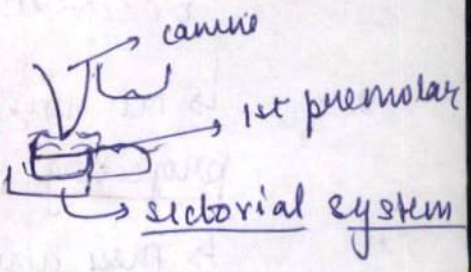
(9) show less dimensity than platyrrhines.

(10) Snout reduced; eyes forward facing

(11) They have an adaptation called ischial callosities that enables them to sit comfortably for long periods.

(12) Live in social groups; males lend a helping hand to females in parental care.

(13) eg :- macaca, colobus, common langur, etc.
Rhesus monkey
baboon



* have opposable thumb; thus hand can perform grasping activities more effectively.

- Hominoids
  - (1) Hylobatids :- lesser apes
  - (2) Pongids :- Great apes
  - (3) Hominins :- Human.

(14) They show sexual dimorphism :- males are larger, have longer canines & are more aggressive

Hylobatids / lesser apes

Common features

(1) Relatively large brain size; large cerebral cortex, thus can integrate data more effectively.

(2) Absence of tail

(3) Long arms & short, broad trunk.

(4) Wrist, elbow, shoulder joint rotating to a greater extent; thus allowing more movement.

(5) All hominoids, at least occassionally, move bipedally. ; locomotion :- quadrupedalism brachiation, bipedal-ism

(6) Dentition :- 2123/2123.

↳ Molars are flat & rounded ; 4-5 pattern on lower molars :- thus, less specialised chewing teeth indicating that they use tools or cooking for preparing food.

↳ All hominoids, except humans have Long projecting canines. & canine - premolar sectorial system

↳ They also have diastema (except humans)

:- gap b/w canine & first premolar.

↳ This helps them with their diet :- fibrous plant material, soft fruit, omnivorous diet.



- **Hylobatids / lesser apes.**

(7) flat faced ; reduced muzzle ; smelling sense less.

↳ more developed visual sense ; stereoscopic vision

↳ common chau.

↳ Region :- south east Asia

↳ Eg :- Gibbons & Siamangs.

↳ features :- (1) small in size (10-25 pounds)

(2) Mostly eat fruit (frugivorous)

(3) Live in small family groups

(4) show little sexual dimorphism

(5) Highly territorial :- gibbons advertise & inform about their territory through singing.

(6) Mostly arboreal ; spectacular brachiators

- **Pongids / Great apes**

I Orangutans

↳ Region :- Borneo & Sumatra

↳ primarily frugivorous & arboreal.

↳ sexual dimorphism is present :-
males weigh twice, have large cheek pads, throat pouches etc.

↳ size is large ; heaviest of arboreal primates

↳ They usually live solitary, except for mothers & their young ones. thus relatively unsocial

↳ Locomotion :- quadrupedalism, occasional bipedalism (in captivity) ; less frequent brachiation due to heavy size. (fist & palm walking)

↳ Reduced thumb & big toe. ; long arms & short legs.

II Gorilla. → show sexual dimorphism (males weigh twice than females)

↳ Region :- western equatorial Africa

↳ features :- ① Largest primates & heaviest

② Diet :- eat other parts of plant like stems, shoots, leaves, roots, flowers.

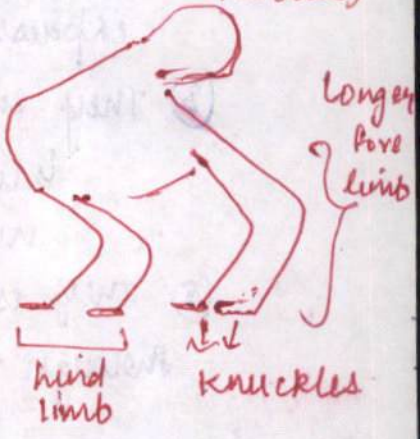
③ They are mostly terrestrial but also sleep on trees.

④ locomotion :- Knuckle walking (quadrupedalism) ; thus they have thickly padded knuckles.

⑤ They live in social groups consisting of dominant male.

⑥ longer forelimbs than hind limbs

⑦ Chest beating is innate in gorillas :- express anger & frustration.



III Chimpanzee

↳ Region :- forested areas of Africa.

↳ 2 distinct species :- common chimpanzee
& bonobo / pygmy chimpanzee

↳ Features :- (1) Both arboreal & terrestrial

(2) locomotion :- knuckle walking, occassional bipedalism

(3) Primarily frugivorous / omnivorous diet

(4) forelimbs & hindlimbs almost of the same length

(5) show sexual dimorphism :- Male weigh more & have longer canines

(6) They live in social groups with dominant male ; in some bonobos groups are centred around females rather than male. (They have dominance hierarchies)

→ They are social. extrovert

(7) They communicate through gesture calls, body postures & even facial expressions. (gorillas too).

(8) They engage in tool making (gorillas too).
↳ use stones & sticks to make weapons for hunting, breaking nut etc.

(9) They establish political & social relationship through offering of meat etc.

Q. 9 Distinguish between man & apes.

- Intro :- Apes and man belong to the same superfamily Hominoidae of suborder anthropoids. The first common ancestor of apes and man appeared in the miocene epoch (25 – 5 mya). Thereafter, they radiated in different directions and evolved in accordance with their particular ecological niches to form two families :-

Pongids (apes) — forest ecosystem

Hominins (Humans) — grassland ecosystem.

- **Similarities**

take from Q.1 or common features of hominoids.

- **Differences**

Feature	Human	Ape / Chimpanzee
1) Type of existence	(1) Completely terrestrial	(1) Partly arboreal & partly terrestrial.
(2) Locomation	(2) Bipedalism :- erect posture.	(2) Brachiation, quadrupedal-ism – knuckle walking, occasional bipedalism by greater apes.
(3) Skull.		
3.1 Cranial capacity	3.1) 1400 cc :- Larger cranial capacity increases intelligence & memory; thus enabling humans to undertake complicated activities (with increased cerebral cortex.)	3.1) 200 – 500 cc. :- chimpanzee can also make tools and memorise but not as effectively as man.
3.2) Brain	(3.2) Large size of frontal, Parietal & temporal lobe :-	(3.2) → size of all these lobes is relatively less in apes.

Thus, Need memory, language structuring, complicated thinking, reasoning in man.

→ Occipital lobe is smaller in man as compared to apes. more developed visual cortex & less developed olfactory lobe in man than apes.

→ apes have larger occipital lobe (concerned with visual perception) ∴ more useful for arboreal existence.

3.3) Facial skeleton

(3.3) They have more developed cranial skeleton as compared to facial skeleton

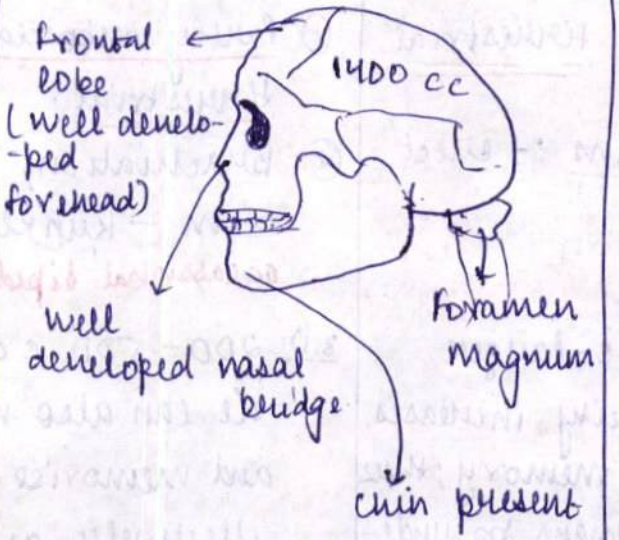
(3.3) Facial skeleton is more developed

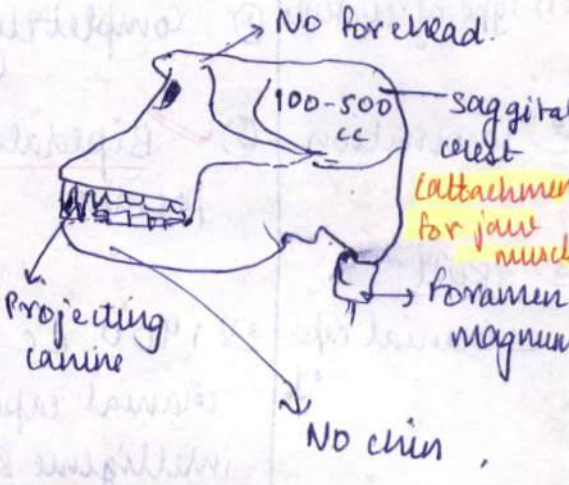
↳ Orbit
→ eyes are larger and more closer
→ eyes are smaller & placed apart.

↳ Forehead
→ well developed
→ poorly developed

↳ Foramen Magnum
→ Placed anteriorly on the base of the skull
→ Placed posteriorly towards dorsal side.

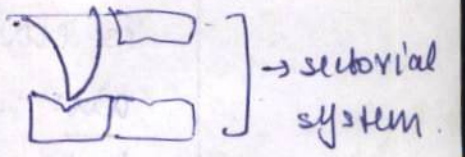
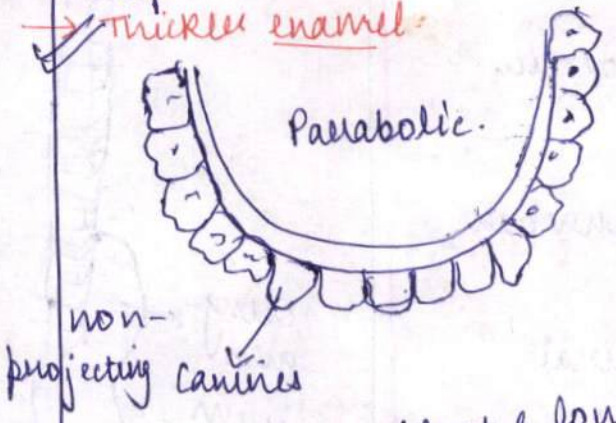
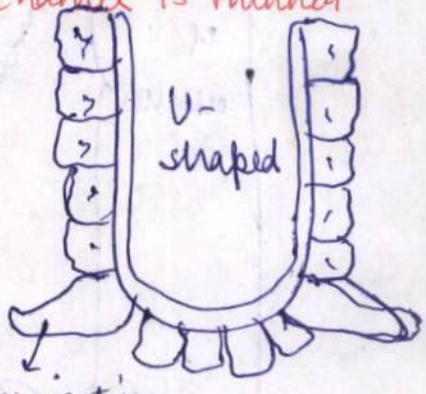
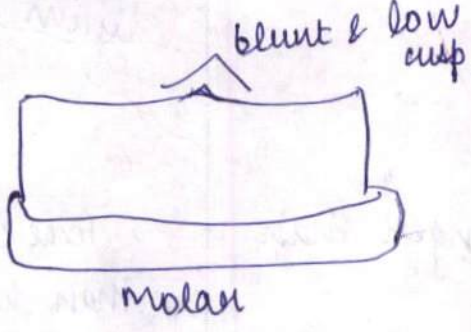
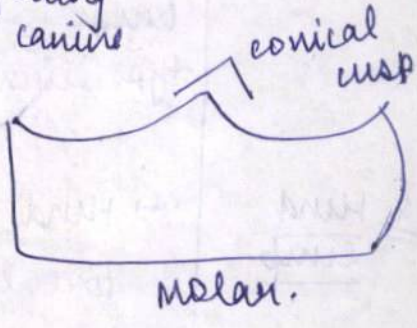
↳ Nose
→ Nose is elongated and nasal bridge is well developed.
→ Nose is depressed & broader; nasal bridge poorly developed.





↳ Jaw
→ size of jaw is small; chin present
→ size of jaw is moderately large; chin is absent

(2) Locomotion pattern

(9) Dentition & dietary habit	→ Dental arch is parabolic	→ Dental arch is U shaped
	→ Mandible (lower jaw) is small & light	→ Mandible is large & massive.
	→ No projecting canines.	→ Projecting & large canines
	→ Diastema & canine-premolar secoral system is absent.	→ Diastema & canine-premolar secoral system is present.
	↳ It indicates that man use tools & cooking for preparing food.	 → secorial system.
	→ human have low, blunt molars	→ In apes, molars have conical cusp.
	→ Thicker enamel.	→ Enamel is thinner
		
		
(2) Locomotory pattern & Hind limbs	→ Bipedalism	→ Brachiation; knuckle walking; occassional bipedalism
(3) Vertebral column	→ 4 curves in spinal column :- allowing man to stand erect	→ absence of such curves.
	→ compressed thoracic	→ Thoracic basket is

This enables humans greater freedom in vertical & horizontal movement of mouth.

cusp

non-projecting canines

Parabolic.

blunt & low cusp.

molar

V-shaped

Projecting canine

conical cusp

molar.

extended.

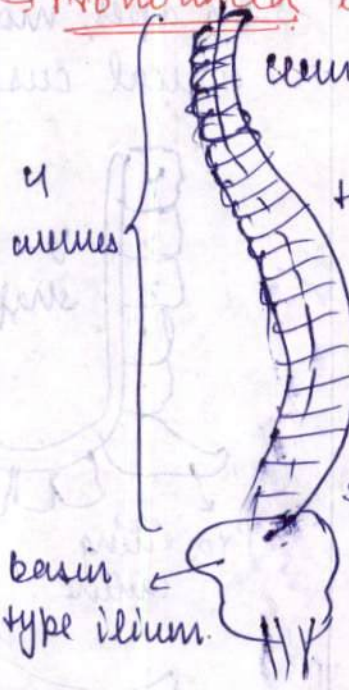
basket - thus centre of gravity passes through foot → weight is balanced.

→ Ilium of pectoral curve is basin type ; it provides greater support.

dish shaped pelvis

→ spinal column - pelvis axis is closer to pelvis - femur axis :- smooth transfer of body weight to feet.

→ Pronounced lumbar curve



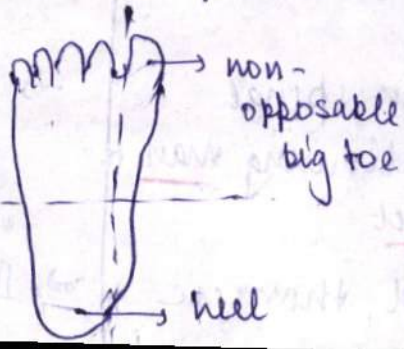
2.2 Hind limb

→ Hind limb longer than fore limbs

→ Heel is well developed

→ Big toe is non-opposable

→ Arched & non-prehensile feet

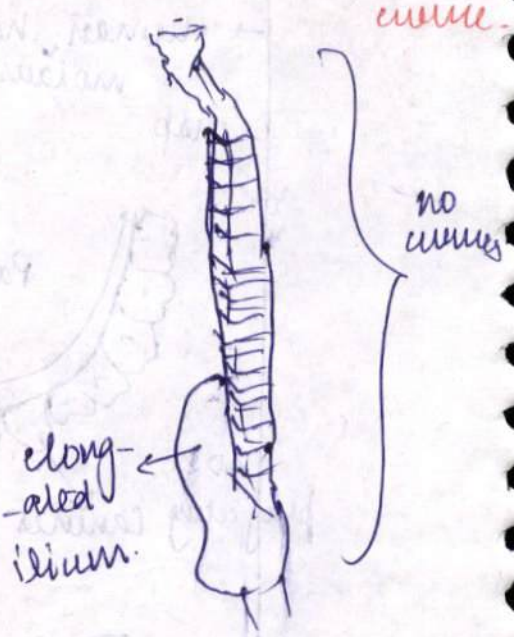


expanded ; thus centre of gravity is away from long axis of the body.

→ Ilium is elongated, thus provides less balance / support for bipedalism

→ elongated axis ; thus transfer of weight doesn't happen.

→ little or no lumbar curve.

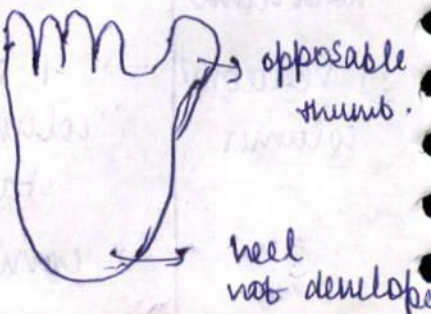


→ fore limb longer than hind limbs

→ Heel is poorly developed

→ opposable big toe.

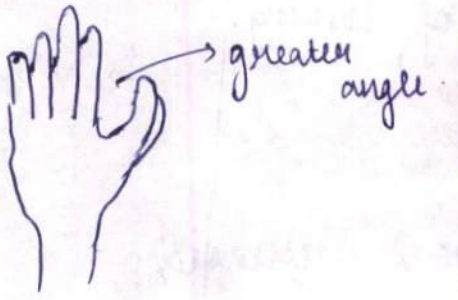
→ prehensile feet.

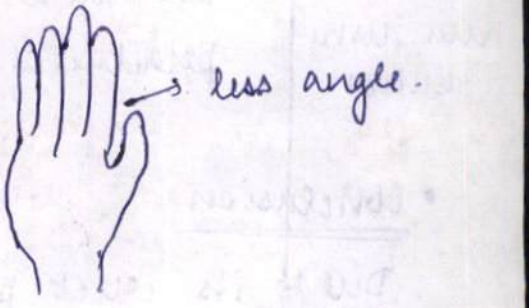


⑤ Forelimb	→ Length of thumb is more	→ less length
	→ Greater angle b/w thumb & index finger	→ angle is less
	→ Thus, more dexterous hand :- spectacular precision & power grip.	→ less dexterous hand
⑧ Sexual behaviour	→ Females can indulge in intercourse throughout the year.	→ Periodic or seasonal breeding / intercourse
	→ Male-female bonding is found.	→ Male-female bonding is rare.
• Behavioral difference		
⑦ Transmission of culture	→ Longer infant dependency causes greater transmission of learned behaviour (prolonged) → Thus, it aids in pronounced social learning & intellectual growth.	→ Though infant dependency is long, it is less as compared to man. → Hence, relatively limited transmission of learned behaviour.
⑧ Toolmaking	→ sophisticated & complex use of tools for almost all activities	→ use of simple tools for simple activities.









(9) Language & communication	→ They have properly structured language with grammar	→ No spoken language; though they make use of alarm calls & gesture calls.
	→ High degree of facial expression	→ lower degree of facial expressions.
	→ Well developed Broca's & Wernicke's area in brain	
(10) use of clothing & hair distribution	→ less dense hair distribution due to socio-cultural practice of use of clothing.	→ very dense hair distribution.
(11) Diet	→ Used meat eating; hunted even large animals	→ Omnivores, though limited to smaller animals.

- Conclusion:

Due to its erect posture & increased cranial capacity, man developed an evolutionary advantage over apes. This enabled him to undergo further cultural evolution in addition to physical evolution.

Q.10 Dentition?

→ 4 types of teeth:- Incisor, Canines, Premolar, Molar.

1) Incisor :- used for cutting.
   ↳ reduction in their size due to trend of eating pre-processed food.

2) Canines :→ used for tearing & shearing food
   ↳ Antagonistic display.
   ↳ with used use of tools for food preparation & weapons; their size also reduced.

3) Premolar :- grinding teeth; also provide cutting surface
↳ Their no. reduced too due to use of tools.

4) Molars :- grinding

→ write about canine - premolar sectorial system & diastema: (gap b/w canine & 1st pre-molar).

→ Evolutionary pattern in reduction in no. of molars is still continuing. Further reduction. Possibility of in no. of molars as sometimes 3rd molar don't appear at all in ~~many~~ some individuals.

→ Dental formula :-

1) Man, apes, old world monkey
$= \frac{2123}{2123} \times 2 = 32$

2) New world monkey, lemur, lorises $= \frac{2133}{2133} \times 2 = 36.$

3) Tarsiers $= \frac{2133}{1133} \times 2 = 34$

Q.11 Explain the skeletal changes due to erect posture and its implications.

• Intro :- Bipedalism developed in hominins during late Miocene - early Pliocene period (10 - 4 mya). fossil evidence shows that Australopithecus which emerged in Africa in early Pliocene could walk upright.

• Theories for evolution of bipedalism

① Geological & climate change in late Miocene (15-5 mya) :- Reduction in tropical forests and increased grassland habitat due to more dense and hotter climate.

↳ This provided impetus to hominin to develop bipedalism for surviving in the grassland – better spotting of prey & predators.

② Efficient foraging :- Free hands could allow carrying food to safe places.

↳ This ~~att~~ increased reproductive efficiency, as females' energy was conserved.

• Skeletal changes

1) Skull :- Position of foramen magnum in humans is more anterior at the base of the skull. Thus, skull is erected at top of spinal column.

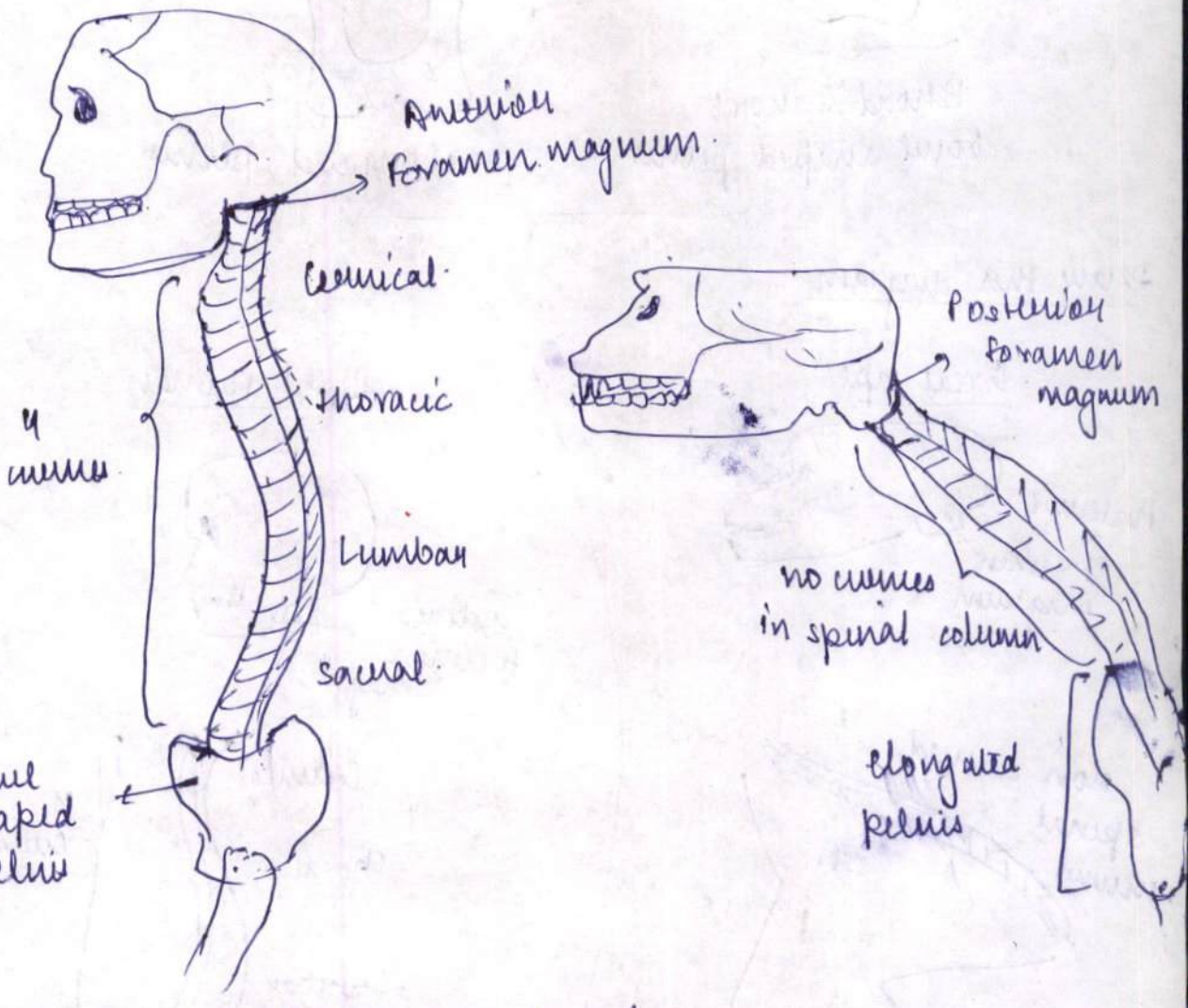
2). Vertebral column :- There are four curves which allows man to stand erect (including lumbar & thoracic curve)

↳ The pelvis in humans is also bowl shaped which provides greater support to internal organs and help in balancing

↳ In ~~proto-apes & modern~~ apes, the ilium of pelvis is more elongated

3). The spinal column - pelvis axis

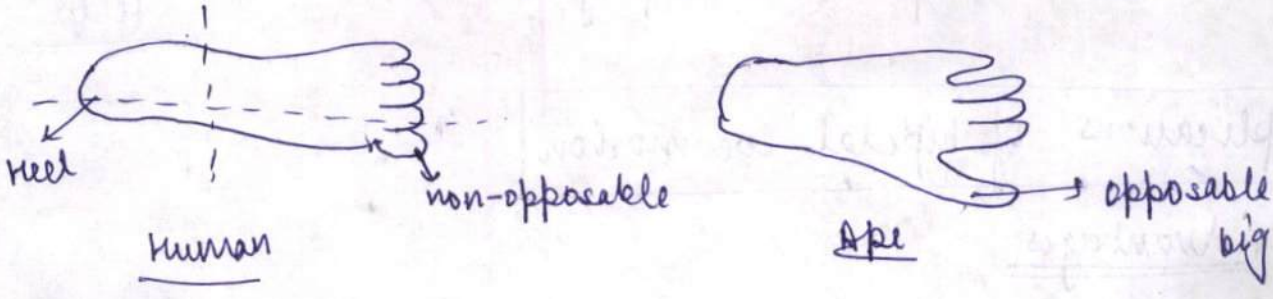
is also more closer to pelvis - femur axis allowing smooth transfer of weight to the feet.



4). Hind limbs are longer than forelimbs. Hence, they can bear more weight.

(5) Knees - knee joints enlarged to support body wt.

5). Heel is well developed in Humans. Big toe is non-opposable and foot is arched to provide greater support while walking





Human



Great ape

Broad & short bowl shaped pelvis

elongated pelvis

Draw this diagram

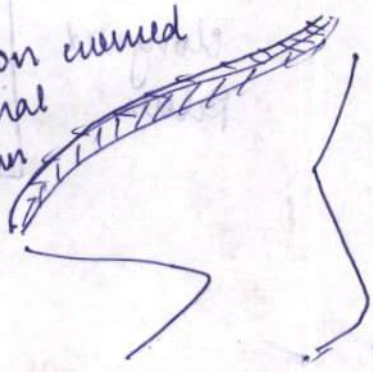
Great ape

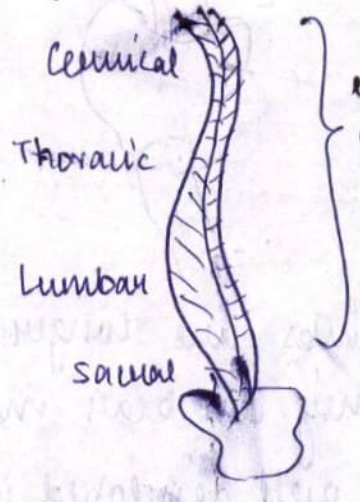


Biped Human



I Skull





II Vertebral column

III Pelvis

IV feet

from previous page

- **Implications of bipedal locomotion**

I) Advantages

1. Freed hands :- This allow carrying of food, making tools and carrying weapons.

② Better parental care & thus increased transmission of learned behaviours :-
freed hands could carry infants, males could carry food to females thus female energy is conserved which can be used for nourishing children.

③ ~~Better~~ Advantage in spotting prey from far-off distances and keeping safe from predators.

→ Energy conservation :-

④ Allows us to travel long distances efficiently — 75% more energy efficient than quadrupeds.

⑤ Helps in regulating body temp. & cooling eff - limited body area exposed to sun.] Thermoregulation

II Disadvantages

① Frequent pain in lower back, pelvis and knees due to great stress.

② Stress on lower body is more pronounced in females who have to go through child bearing. / painful birthing process - narrowing of birth canal.

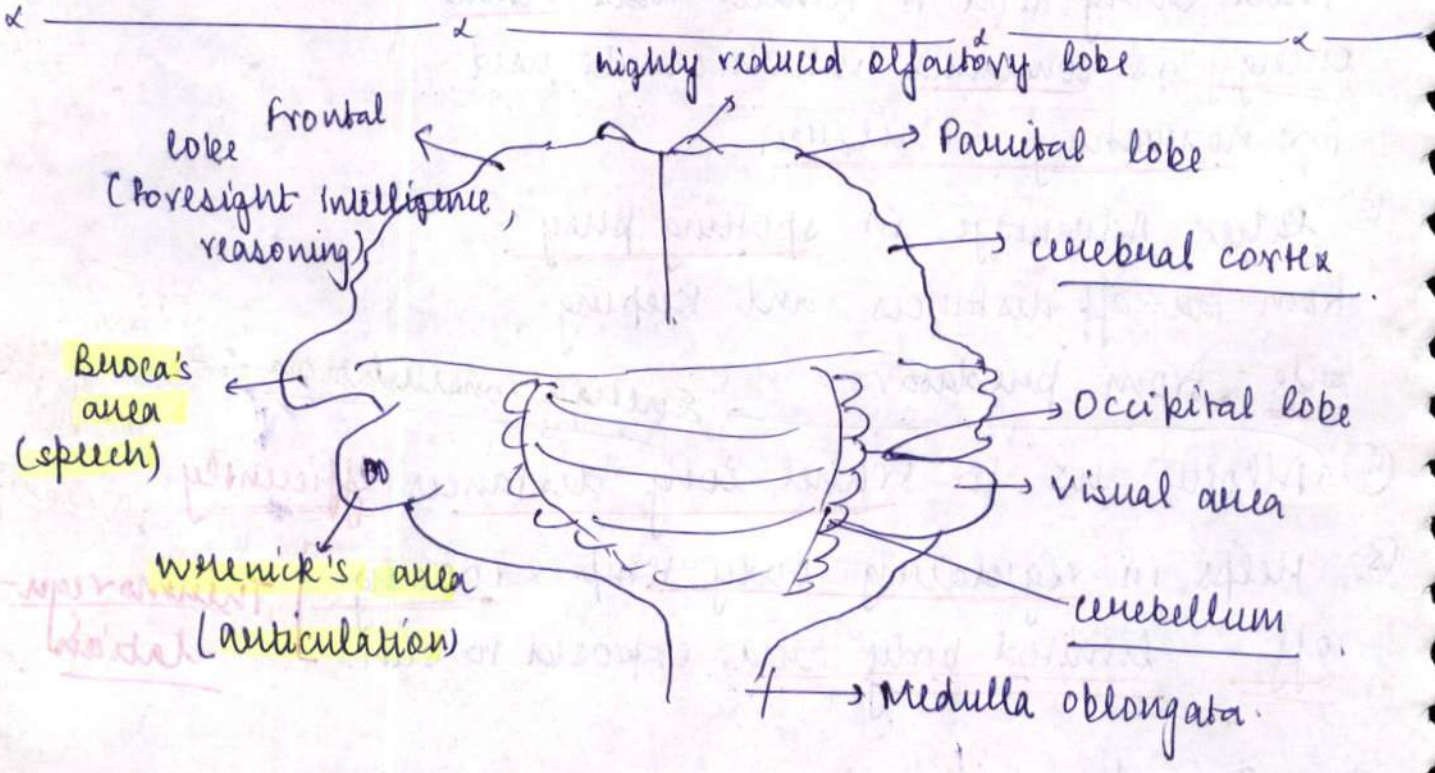
③ Reduced ability to grasp things using big toe ~~④~~ This also makes humans less efficient in climbing trees :- useful for collecting food & safety from predators.

~~⑤~~ while bipedalism saves energy while more walking, it is less energy efficient than quadrupedalism during running

- **Conclusion**

Thus, the advantages of bipedalism are much greater than its disadvantages or our ancestors never would have

evolved to become bipedal. ~~Some of the~~ Other hominoids also show bipedalism, though only occassionally.



Sagittal section of human brain

(splits the brain in right & left)



perpendicular section such that brain is split into right & left.

Q. 12 What is the significance of primatology in anthropology.

- Intro :- Primatology refers to the scientific study of primates - their physical as well as behavioral characteristics.

Since man belongs to the order Primata, study of primates help in establishing evolutionary links in anthropology.

Primata → Prosimians
Primata → Anthropoids

* **Scholary work in primatology**

1) Jane Goodall's 'Chimpanzee of the Gombe' (1986) :-
she carried out fieldwork among Chimpanzee's of the Gombe National Park in Africa in 1960s.

2) Her observation :→ Chimpanzees also make use of tools
   - They also feed on meat of small animals in addition to fruit
   - Dominance hierarchy among chimps & aggressive behaviour & competition for food, mates & space
   - social cooperation among chimps through sharing of meat etc & political

* **Significance**

1). Helps in understanding biological ~~link~~ relationship & evolutionary link b/w living & ancestral primates.

2) Helps in tracing the evolutionary line leading to modern day sapiens, that is, development of bipedalism, expansion of brain, hand ~~dextrexi~~ dextrousity etc.

3) Comparative studies helps in understanding human behaviour & decision making more clearly.

4) The similarity genetic ~~observed~~ b/w non-human primates (esp. great apes) & man also help in medical sciences - development of new medicines & vaccines etc.
   - Eg:- tonsilveld is made from weakened

version of common cold virus from chimpanzees.

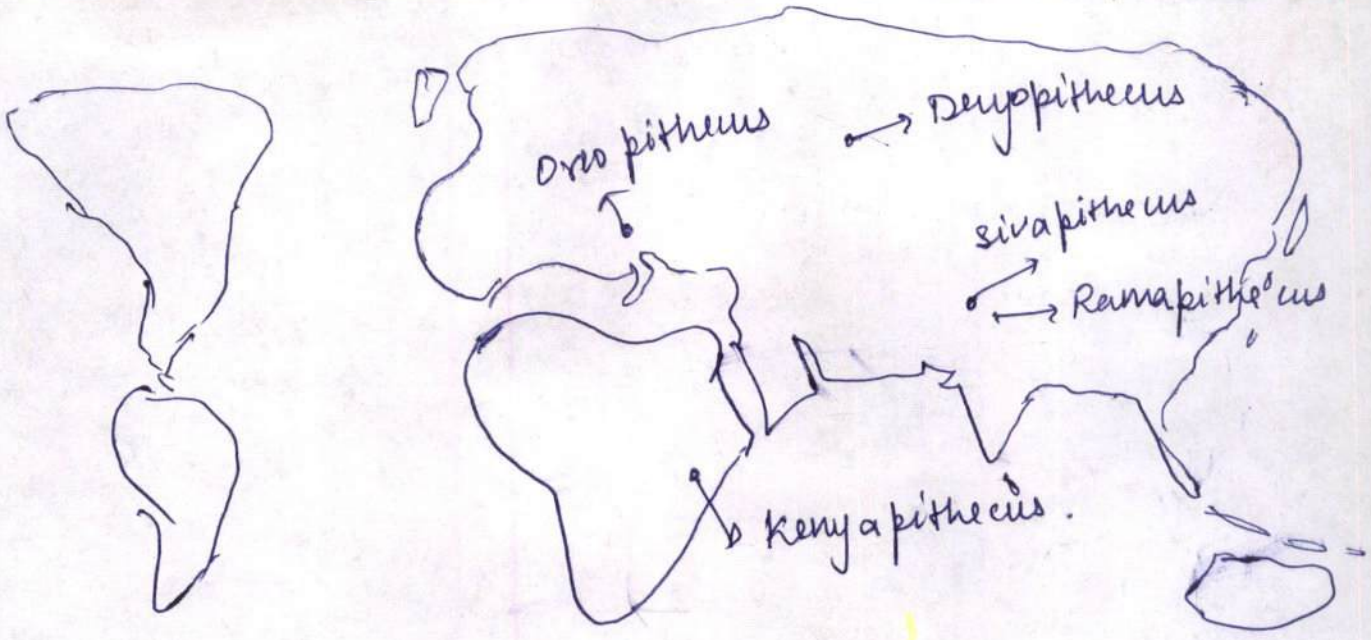
(5) It also provides an alternative way to study behaviour of non-human primates without adopting ~~the~~ a reductionist approach.

(6) It helps in understanding the impact of different ~~organisms~~ ecological niches can have on primate evolution.

- Conclusion.

Thus, primatology is of utmost significance in anthropological study of man. It not only provides information on ancestral linkage but also helps in understanding human behaviour & cultural evolution.

- Oreopithecus
  - Miocene period
  - fossils found in Europe (Tuscany (Italy)); contemporary of sinapithecus in Asia (10–13 mya).
  - lived in grassland (practiced occasional & limited bipedalism)
  - while Sinapithecus & Ramapithecus thought to be ancestral to the Pongid line (esp. orangutans), Oreopithecus more closely resembles the hominid line of descent.
    - smaller teeth
    - no premolar diastema.
    - bones of pelvis, hand & foot similar.
  - Though certain ape like features
    - longer forearm


Dryopithecus
Dryopithecus
Sivapithecus
Ramapithecus
Kenyapithecus.

→ Intro

→ Time span

→ Discovery

→ Geographical Dist.

↳ sub-species

→ Char. → I Physical

1) Stature

2) Cranial capacity. - ( )cc + parietal, Frontal lobe.

3) Skull and facial features

↳ sagittal crest etc.

↳ Nose.

↳ Jaw - ____ mandible; chin absent

4) Dentition - parabolic; smaller molar; diastema

5) Post cranial features

↳ spinal column & bipedalism

6) Limbs.

II Cultural :- 1) Tool making
2) Hunting
3) Social life
4) Communication
5) Transmission of culture
6) Others - Religion / fire etc.

→ Phylogenetic status

Unit - 1.6

Q.1 Phylogenetic status, characteristics & geographical distribution of australopithecines.

- Intro :- Australopithecines are considered to be the earliest hominids who lived 4-2 mya during the pliocene-pleistocene epoch. Their fossil evidence is mainly found from South & East Africa.

Discovery :-
1) In 1924, Raymond Dart found skull of small child in Taung named it A. Africanus
2) In 1938, Robert Broom described skull from Kromdraai, named it Paranthropus

- Types of Australopithecines

1) Gracile form :- A. afarensis, A. africanus etc. → light build & lighter jaw; ① ② moderate to less sexual dimorphism; ③ omnivorous ④ smaller brain capacity (400-450 cc)

2) Robust form :- Paranthropus robustus, P. boisei etc. → heavy build & heavier jaw; marked sexual dimorphism; herbivorous; larger brain capacity (500-550 cc)

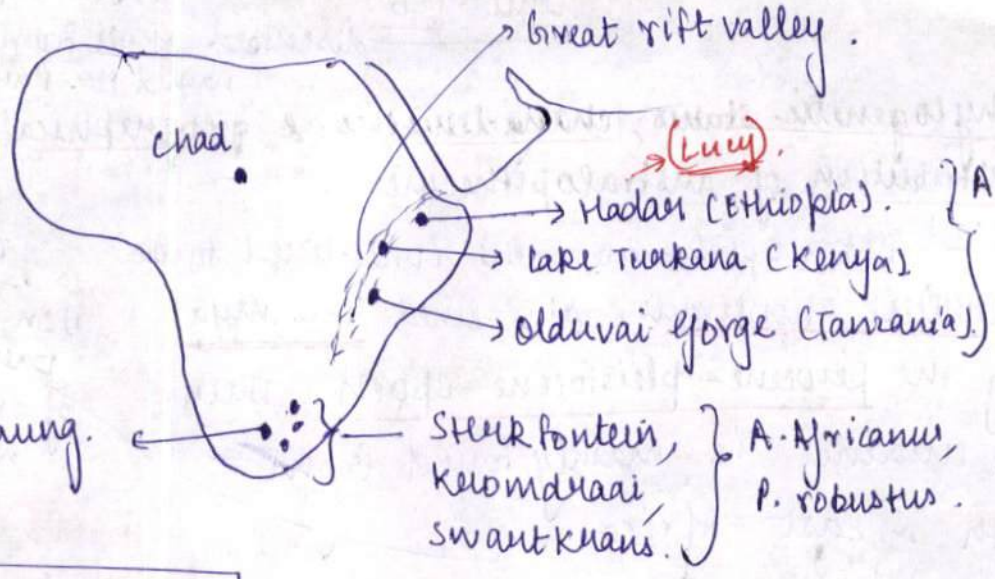
- Geographical Distribution

1) Eastern Africa :- fossils are found along the rift valley.
↳ Olduvai gorge (Tanzania), Kenya (around Lake Turkana), Hadar region in Ethiopia (Lucy found here) etc.
, Koobi Fora.
↳ Fossils :- A. Afarensis, P. boisei, A. garhi etc.

2) Southern Africa :- Fossils are found in caves
↳ Taung, Cape province; Sterkfontein, Kromdraai, Swartkrans etc.
↳ Fossils :- A. Africanus, P. robustus, A. sediba etc.

3) Recently fossil of A. bahrelghazali have been found from Chad, Central Africa.

If time constraint draw only diag.



• Characteristics

I Physical features :- a) Stature :- Light build (gracile) & Heavy build (robust)
↳ Small ht. (3-4.5 ft)

1) Skull & brain

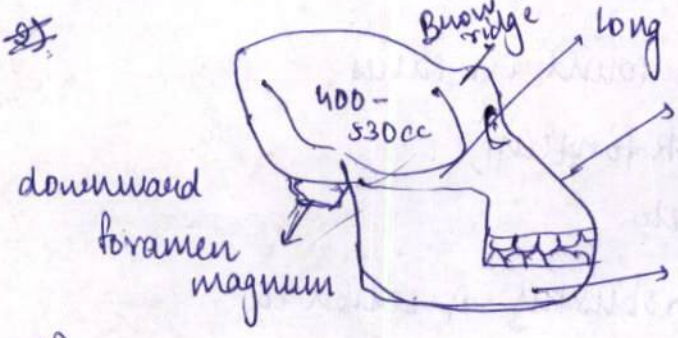
↳ Larger brain relative to body size. Cranial capacity of 400-530 cc.

↳ Marked Prognathism → protruding jaw. Facial features of skull are more prominent than cranial part.

↳ Receding forehead.; flat nose

↳ Sagittal crest reduced in gracils but prominent in robusts (they have ~~heavy~~ larger jaw).

↳ Foramen magnum on the downward side :- erect posture & bipedal locomotion.



2) Dentition (more man like with some pongid features)

↳ Dental arch is parabolic & without simian gap.

↳ Incisors are small & canines only have

slight projections – mainly herbivores.
↳ large molars. Bicuspid premolars like man.

3). Bipedalism & associated post-cranial features

↳ Lumbar curve in backbone.
↳ Broadened & short ilium.
↳ Femur with torsion angle.
↳ This would allow them to walk bipedally but with smaller steps & bent knees & back.



Eg:- trail of bipedal footprints at Laetoli site

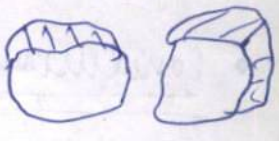
4) Limbs
↳ Forelimbs shorter than hind limbs.
↳ Well-developed arches in foot.
↳ straightening of knees.
↳ curved fingers - suitable for brachiation.

II. Cultural features:

1) Symbolic communication :- Expanded cerebral cortex (especially parietal lobe) indicates presence of some form of symbolic communi-cation (precursor to modern language).

2) Habitat :- They lived in grassland region.
↳ They were predominantly terrestrial but also arboreal in some ways.

3) Toolmaking :- Acc. to Dart, Australopithecines had osteokeratodontic culture [tools of bone, horn & teeth]
↳ choppers & chopping type
↳ A. garhi is also associated with stone tool implements (Gona tools from Gona, Ethiopia).



4). Social system :- They may have lived in a group. In some cases, there was a male living with many females

fossils of 13 people from Hadar by M. Leakey.

- Phylogenetic status

↳ It showed both human & ape like features but the former ones are predominating

↳ common belief that around 4 mya, there was single line of Australopithecines in Africa. Then ~~that~~ it divided into 2 or 3 branches

I 2 branch theory

A. Afarensis (3.8 – 3 mya)

Homo habilis (2-1.5 mya).
↓
H. erectus (1.6 – 0.1 mya)
↓
H. sapiens.

A. Africanus (3 – 2 mya)
↓
A. Robustus (2.3 – 1.8 mya)
↓
A. Boisei (1.8 – 1 mya)
↓
Extinct

II 3 branch theory

A. Afarensis

H. Habilis
↓
H. erectus
↓
H. sapiens

A. Aethiopicus
↓
A. Boisei

A. Africanus
↓
A. robustus

- Conclusion

Thus, australopithecines emerged in two forms (gracile & robustus) out of which the robust paranthropus ~~are extinct~~ evolved as a side branch. The latest fossil evidence suggests that A- garhi (2.6 mya) & A. sediba (2 mya) are immediate ancestors to homo,

Q.2 Describe about Paranthropus.

• Intro :- Paranthropus is a genus of early hominins with massive jaws and large teeth. They existed during the Pleistocene epoch (Pliocene - in Africa) around 2.3-1 mya. They are also considered as a form of robust australopithecines.

• Discovery
1) 1938, R. Broom - skull from Kromdraai

→ They mainly have 2 types: P. robustus, P. Boisei
P. Boisei: robust features more pronounced in P. Boisei. Hence, it is also called 'hyper robust'

• Geographical distribution.

1) Eastern Africa :- Olduvai gorge (Tanzania)
(- - - - - - same as Q.1 - - -
P. Boisei

2) Southern Africa :- P. robusta.

• Characteristics

1) Skull & brain :- Larger cranial capacity than gracile australopithecines around 500-550 cc.
↳ Massive face & jaw.
↳ Prominent sagittal crest to support large jaw & teeth.
↳ Large zygomatic arch.
--- rest same as Q.1 ---

2). Dentition
↳ Larger molars & premolars; massive muscle attachments to support heavy chewing due to their herbivorous diet.
↳ smaller incisors.

3) & 4) :- same as Q.1

(5) Sexual dimorphism :- Marked difference b/w body size of males & females.

II ~~Social~~ Behavioral & cultural features

①, ② & ④ same as Q.1

↳ Diet :- They had predominantly herbivorous diet consisting of hard grains & roots etc.

• Phylogenetic status

↳ Paranthropus had both human & ape-like features. Though, there ability of bipedal locomotion & large (relatively) cranial capacity makes them ~~ancestral to the hominin~~ one of the earliest hominins.

↳ They emerged as a side branch of australo-pithecines c. 3 mya and then became extinct 1mya.

↳ They are not ancestral to the genus homo.

I 2 branch theory :- --- diagram (same as Q.1) ---

II 3 " " :- "

• conclusion

Thus, paranthropus form a vital evolutionary link in the study of hominin line of descent. Their appearance outside Africa is doubtful. Thus, most of the fossil evidence have been found from southern & eastern Africa.

Q.3 1) **A. Afarensis** :→ (3.8 – 3 mya)

↳ Eastern Africa :- Olduvai Gorge, Laetoli (Tanzania). °- trail of bipedal footprints at Laetoli site.

↳ Hadar, Ethiopia – Lucy

↳ Kenya.

↳ 3'5" ht. ; small hominin ; lightly built.

↳ More ape like features as compared to A. Africanus (long arms, curved fingers, moderate sexual dimorphism).

↳ Brain size = 400 cc.

↳ Relatively larger incisors than A. Africanus

↳ Low & flat forehead.

↳ Prominent brow ridge.

[rest same as Q.1]

gave rise to different branches; common ancestor to A. Africanus, H. habilis, Paranthropus etc

2) **A. Africanus** :→ (3 – 2 mya) by Dart in 1924

considered part of 1 branch that emerged from A. Afarensis; ancestral to P. robustus

↳ Southern Africa :- Taung. (fossils of Taung baby)

↳ Ht – 4'

↳ more human like features as compared to A. Afarensis (less sexual dimorphism)

↳ Brain size = 450 – 460 cc.

↳ Relatively smaller incisors & canines

↳ Higher forehead

↳ less prominent brow ridges.

Q.4 Differentiate b/w Australopithecines & Paranthropus.

Australopithecines	Paranthropus
1) Time – 3.8 – 2 mya.	1) Time – later than Australopithecines (2.3 – 1 mya)
2) Type – A. Afarensis etc.	2) Type – P. robustus etc.
3) considered more human like ; ancestral to homo genus.	3) more ape like ; not ancestral to homo.

4) Lighter build with smaller jaw & face - gracile

5) smaller teeth (incisors & canines) :- omnivorous diet

6) sagittal crest, zygomatic arch absent or ~~have~~ reduced

7) Cranial capacity lower :- 400 - 450 cc.

8) Less sexual dimorphism

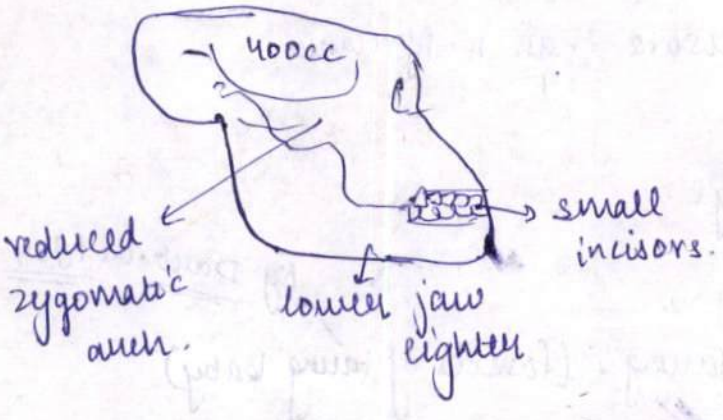
4) Heavier build with larger jaw - robust

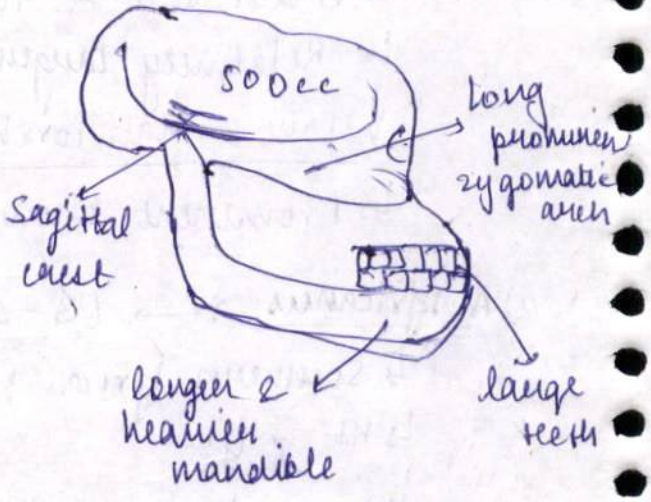
5) Larger teeth :- help in massive chewing associated with herbivorous diet

6) Prominent sagittal crest & zygomatic arch

7) Larger - 500 - 550 cc.

8) Marked sexual dimorphism





Q.5 Describe Homo Habilis.

- Intro :- Homo habilis is the first species of Homo genus and is considered ancestral to modern Homo sapiens. It emerged in Africa around 2 - 1.5 mya (Pleistocene epoch). It literally means 'handy man' and is considered the first tool maker (Oldowan culture).

- Geographic distribution → Discovery

↳ Leaky found fossils of H. Habilis at Olduvai gorge, Tanzania (Eastern Africa) in 1961.

→ Other fossils have been recovered from.

Eastern Africa (Kenya, Tanzania, etc) Ethiopia.

Southern Africa (Sterkfontein Cave etc.)

--- same diagram of Africa as Q.1 ---

• Phylogenetic status

→ ~~Ho~~ H. Habilis is considered an intermediate b/w australopithecines (the first hominin) & the modern homo sapiens.

→ It is one of the earliest species of Homo genus (2 - 1.5 mya - Pleistocene epoch) along with H. rudolfensis & recently discovered H. naledi.

A. Afarensis (4 - 3 mya).

A. Africanus (3 - 2 mya)

A. garhi (2.6 mya)

A. sediba (2 mya)

H. Habilis (2 - 1.5 mya).

H. erectus (1.6 - 0.1 mya)

H. Neanderthalensis

H. sapiens.

Paranthropus robustus [2 - 1 mya]

P. Boisei

extinct

• Characteristics

Physical features

1). skull & brain

↳ Relatively larger brain capacity than australopithecines - 650 - 700 cc.

↳ brain case is rounded & has a more human shape.

↳ Mandible (lower jaw) is less massive.

↳ Anteriorly (downward) positioned foramen magnum indicating bipedal locomotion.

↳ development of cerebral cortex, frontal & parietal lobe.

2) Dentition

↳ Dental arch is parabolic.

↳ reduced molars & premolars indicating their omnivorous diet.



3) Limbs.

↳ relatively longer arms & powerful hands - this hint towards (partial arboreal) life.

↳ arched foot & straightened knees.

• Post cranial features → 1) curves in spinal column

4) Reproductive process.

↳ There must have been broadening of pelvis (short & broad) among females to give birth to ~~larger-sized babies~~.

↳ babies with larger brain.

II Behavioral & cultural features → Lower Paleolithic culture

1) Toolmaking & Oldowan culture :-

↳ H. Habilis is considered the first toolmaker.

Along with fossil evidence, heaps of tools are also found at Oldowan gorge. Hence, this culture is named as Oldowan.

↳ Types of tools. :→ ~~Cutting~~ tools (stone flake)

↳ scraping "

↳ Tools to make other tools (~~hammer stones~~)

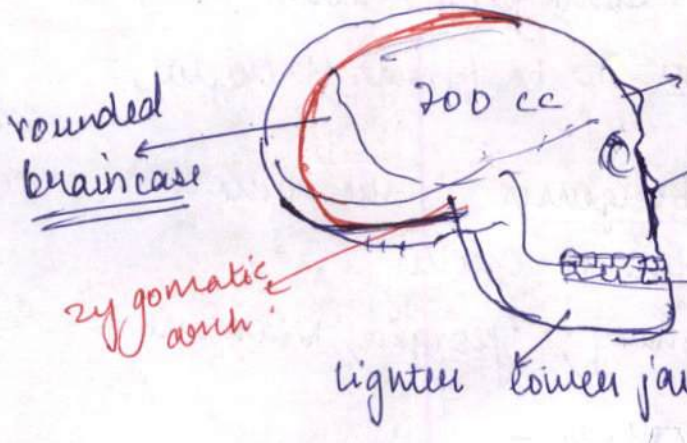
2) Hunting activity & subsistence :- They must have been involved in some hunting & food gathering.

3) H. habilis lived in groups - requirement of their hunting life. - Social system

4) Communication :- Hunting must have necessiated some form of communication & vocalisation. Thus there must have been enlargement of Broca's area.

5) Transmission of culture. :-

Bigger brain size → prolonged infant dependency. (↳ lower gestation period) → easier & greater transmission of learned behaviour.



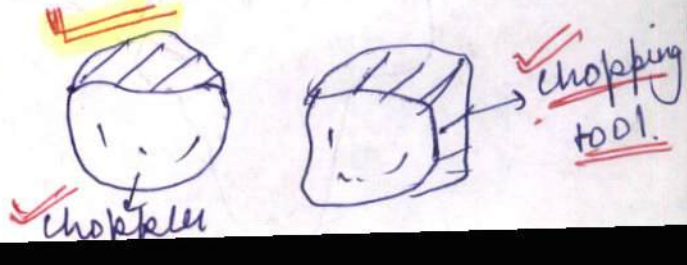
- Conclusion.

H. Habilis is believed to be succeeded by Homo erectus (first hominin species to be widely distributed in the old world). study of H. habilis provides imp. evolutionary link in bio-cultural development of man.

Recent discovery of skull of Dragon Man from China has further added another dimension

→ 1) Choppers & Chopping tools.

↳ flakes removed using block on block technique.



Q.6 Describe Homo erectus.

• Intro :- Homo erectus is the first hominin species to be widely distributed in the Old world. It occured between 1.6 - 0.12 mya. (Pleistocene) It is associated with a larger brain size of 890 - 1040 cc and considered the first one to use fire.

→ Discovery - by E. Dubois in 1891 at Java - cranium & femur.

• Types & geographical distribution

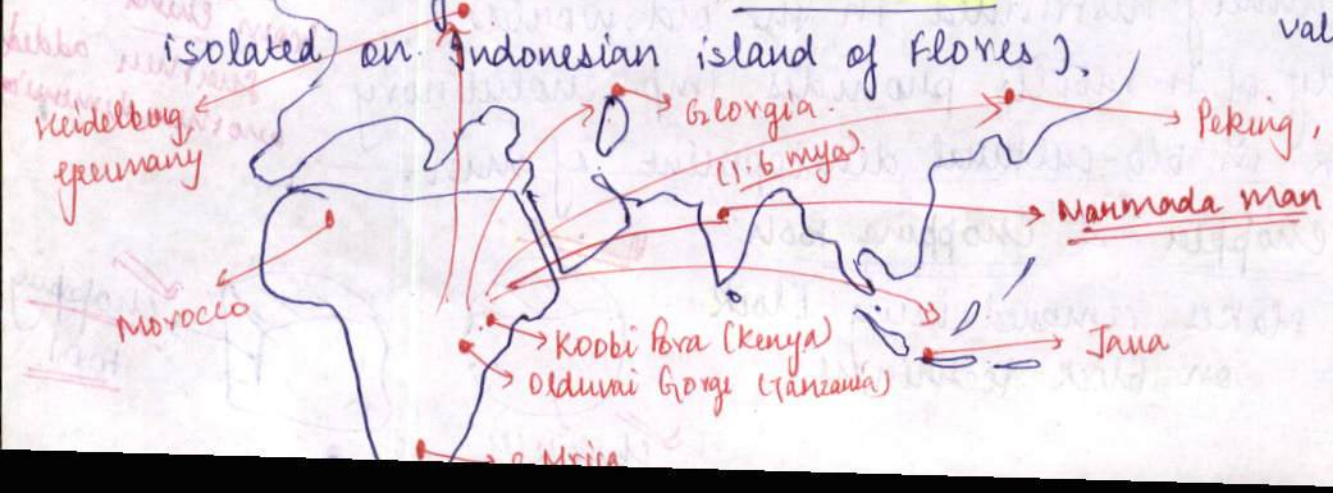
→ Fossils have been found from 3 broad areas :-

1). Africa :- Eastern Africa (Olduvai gorge, Tanzania; Kenya; Ethiopia etc.) & southern Africa.
↳ African H. erectus is sometimes referred to as H. ergaster. Some people also regard Paranthropus to be African H. erectus

2) Europe :- Homo Heidelbergensis is the name given to European H. erectus
↳ Heidelberg, Germany; Georgia; Near East

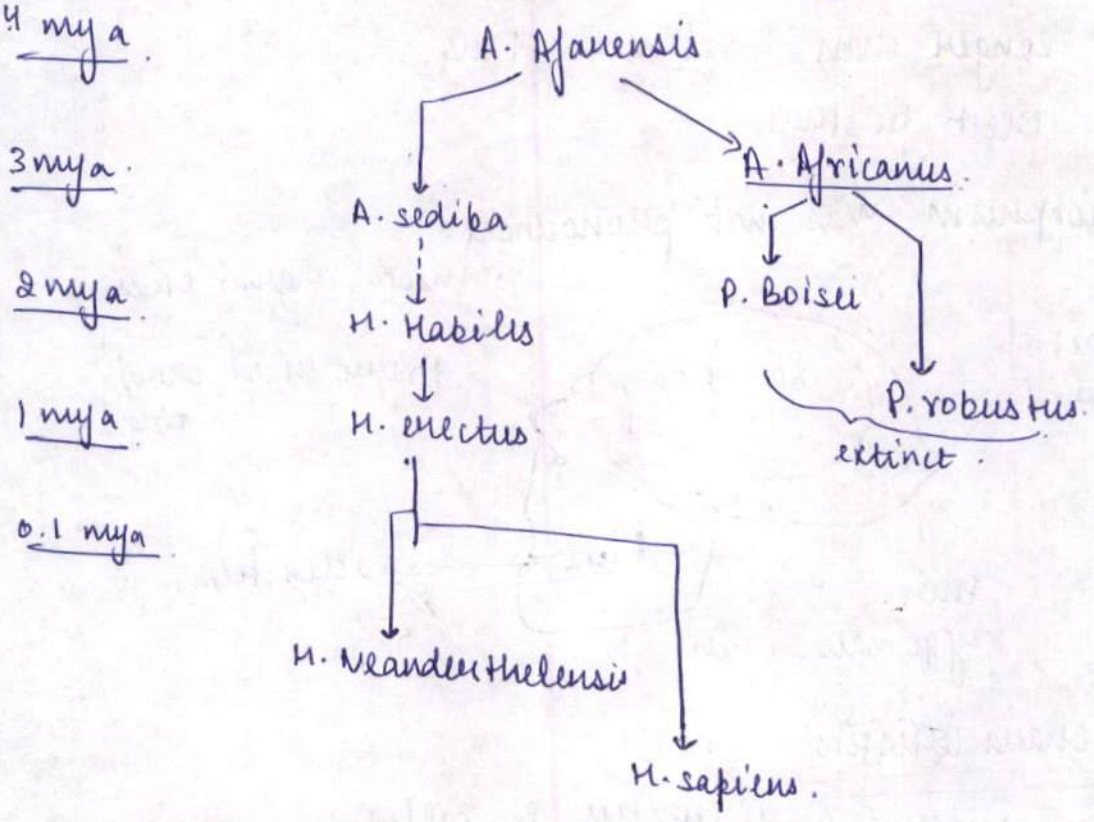
3) Asia :- There are 2 main types :-
3.1) Java Man :- Java Island, S-E Asia
3.2) Peking Man :- Peking, China
↳ Another dwarf variant is H. Floriensis (lived isolated on Indonesian island of Flores).

• Narmada Man :- Narmada valley, India.



• Phylogenetic status

→ It is believed that H. erectus originated in Africa & then radiated to Asia & Europe.
→ It adapted to different ecological niches through both biological & cultural (use of fire) evolution.
→ It is considered an intermediate species b/w early Homo habilis and modern Homo sapiens.
→ While others believe that H. erectus is not directly ancestral to modern sapiens
– theory that H. Heidelbergensis evolved into H. Neanderthalensis in Europe.



• Characteristics

I Physical characteristics

1. Stature :- They had a comparatively similar built to modern sapiens.
Average height of 5'– 5'6" & avg weight of 50–70 kg.

2) Skull & brain

↳ larger cranial capacity :- 800 – 1200 cc

↳ Sagittal crest is absent but prominent brow ridges.

↳ Zygomatic arch is thin like in H. sapiens.

↳ more anterior placement of foramen magnum indicating erect posture.

↳ well developed parietal & frontal lobe.

3) Dentition.

↳ Jaw is larger & massive as compared to (Mandible); absence of chin. (simian feature) modern H. sapiens

↳ Dental arch is more parabolic. modern → flattened nose.

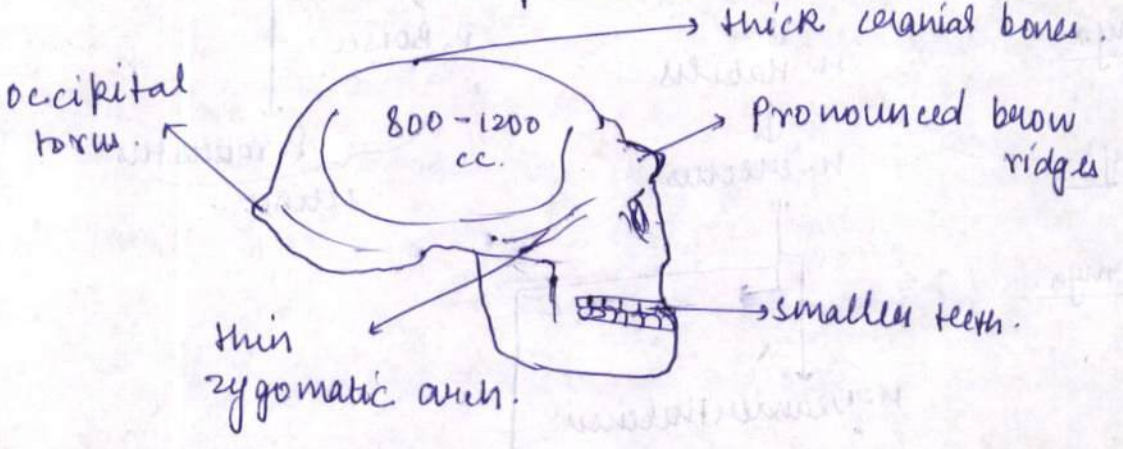
↳ Teeth are of ordinary size like man.

Canines are non-projecting.

4) Post-cranial features

↳ hind limbs longer than forelimbs; thus helping in erect posture.

↳ Sexual dimorphism was not pronounced.



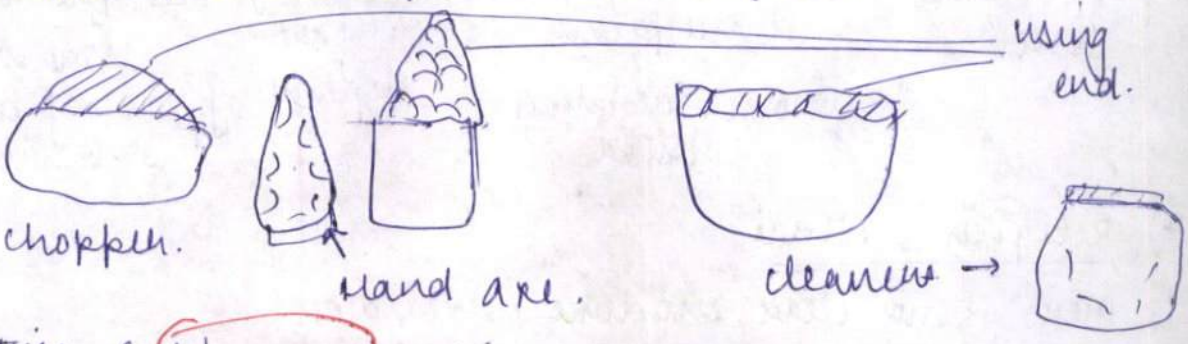
II Cultural characteristics

→ The stone tool culture of H. erectus is called lower palaeolithic or Acheulian culture.

1) Tool making :- They used larger tools created according to standardised shapes or designs.

↳ Types of tools used by them were –

large choppers, hammers, hand axes & flakes.



2) Hunting & big game eating :- H. erectus used to hunt big game such as elephants, wild boxes etc. with the help of fire & advanced tools.

↳ fossils of H. Heidelbergensis found along. imp. with animal fossils of elephant, bison, wild boar etc.

3) Use of fire :- They are regarded as 1st species to practice controlled use of fire. Fire was used for warmth, protection & hunting. ↳ evidence of charred animal bones from Swartkrans (South Africa) 1mya

4) Language & communication :- H. erectus must have developed some type of symbolic language. This was a result of increased brain capabilities as well as cultural requirements (big game hunting & group cooperation).

5) Social life :- They lived in small groups at favourable campsites. Male-Male cooperation is unique feature of H. erectus.

6) Transmission of learned behaviour

Larger brain size → broadening of female pelvis & shorter gestation period → prolonged infant dependency → greater transmission of learned behaviours.

7) Religion & ritual

↳ There is no clear evidence of religion on burials. However, remains of red ochre has been found on many sites.

↳ Red ochre is usually associated with ritualistic activities.

↳ some scholars also suggest practice of cannibalism among H. erectus.

• Conclusion

Thus, H. erectus marks the first wave of migration of homo from Africa to the entire Old world. This stage is the most prominent phase of bio-cultural evolution of man.

Recent discovery of skull of Dragon man from China has added another dimension.

Q.7 Differentiate b/w Java man & Peking man.

• Intro :- H. erectus is the first hominin species to be widely distributed in the old world. The Asian H. erectus are referred to as Java man & Peking man. They existed b/w 1.6 – 0.12 mya (Pleistocene period).

• Geographical distribution.

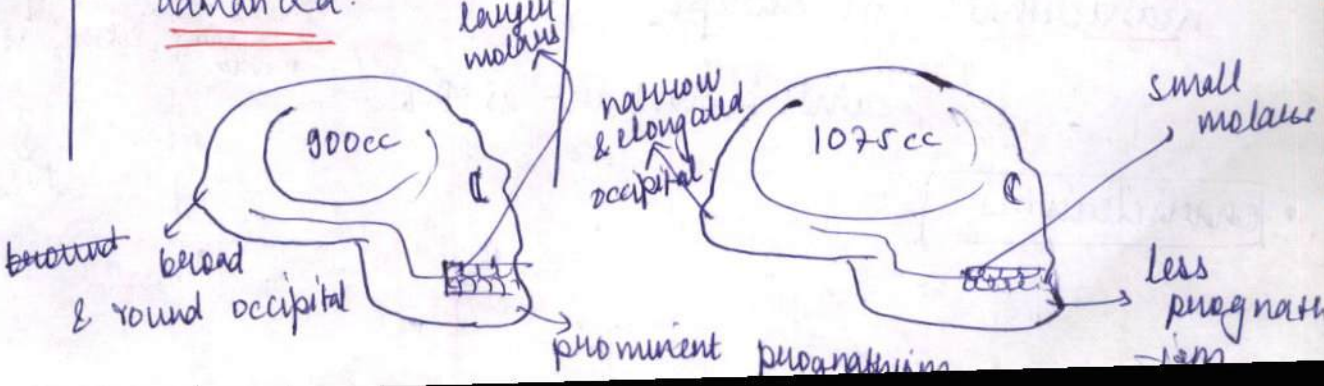
1) Homo erectus javanicus :- Java islands, Indonesia

2) Homo erectus pekinensis :- Peking, China

--- draw map from Q.6 ---

• Difference.

Features	Java man (by E. Dubois in 1891 - femur & cranium)	Peking man (by D. Black b/w 1921-27 from china - few teeth, skulls)
① Stature	① Java man is somewhat taller & heavier (5 1/2 ft & 70 kgs)	① He was comparatively shorter & lighter (5 ft & 50 kgs)
② Cranial capacity	② less than peking man, around 800-1000 cc.	② Greater cranial capacity :- average of 1075 cc.
③ Skull	→ Skull is smaller. → Occipital region is broad & rounded → Cranial bones comparatively less thick.	③ → Skull is larger. → Occipital region is narrow & elongated. → More thick cranial bones
④ Facial features	④ Prognathism more marked. → Heavy & continuous brow ridges. → Nose is broader & flattened	④ → Face is less prognathous. → Brow ridges are heavy but separated from forehead → Nose is less broad & flattened as compared to Java man.
⑤ Jaw	⑤ → Lower jaw is much larger & heavy	⑤ → It is lighter than Java man
⑥ Dentition	⑥ → Teeth are larger with large molars. → Diastema present in upper dental arch.	⑥ → Small teeth & smaller molars. → Diastema is absent.
⑦ Toolmaking	⑦ Tools were less advanced.	⑦ → Tools were more advanced



• Similarities

--- · point of Q.6 (remaining ones) - - -

• Conclusion

- - - - · same as Q.6 - - -

Q.8 Describe Homo Heidelbergensis.

• Intro :- Homo Heidelbergensis is regarded as a transitional or archaic sapiens. Some also consider it as European Homo erectus as its fossils were found from Mauer near Heidelberg in germany. The age is estimated to be 0.35 - 0.45 mya.

• Geographic distribution

→ H. Heidelbergensis



Discovery :- Otto Schoetensack found a mandible from Mauer, Heidelberg, Germany in 1908. Called in Mauer Jaw.

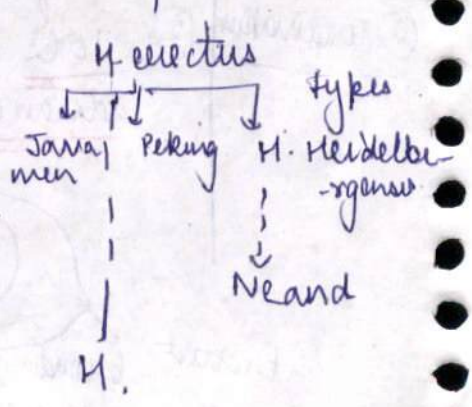
• Phylogenetic status

→ H. erectus moved from Africa to Europe.

→ Due to forced periodic mixing & isolation in the pleistocene epoch as a result of glaciation & interglaciation, they evolved differently according to their ecological niche. (imp.)

→ H. Heidelbergensis are also regarded as a transitional species b/w H. erectus & neanderthals in Europe

- - - - same flowchart as Q.6 - - -



• Characteristics

1) Skull & brain

↳ Cranial capacity = 1200 - 1300 cc.

↳ Skull lacks sagittal ~~crest~~ keel & occipital torus.

↳ Separated brow ridge present.

↳ More developed parietal & frontal lobe than H. erectus.

2) Jaw :- Jaw is large & massive (though less than other H. erectus)

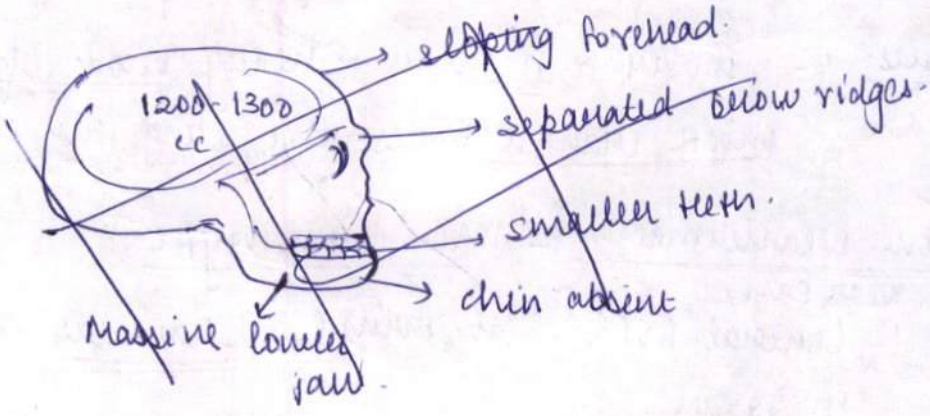
↳ Absence of chin.

3). Dentition :- Dental arch is parabolic

↳ Teeth are smaller as compared to other H. erectus

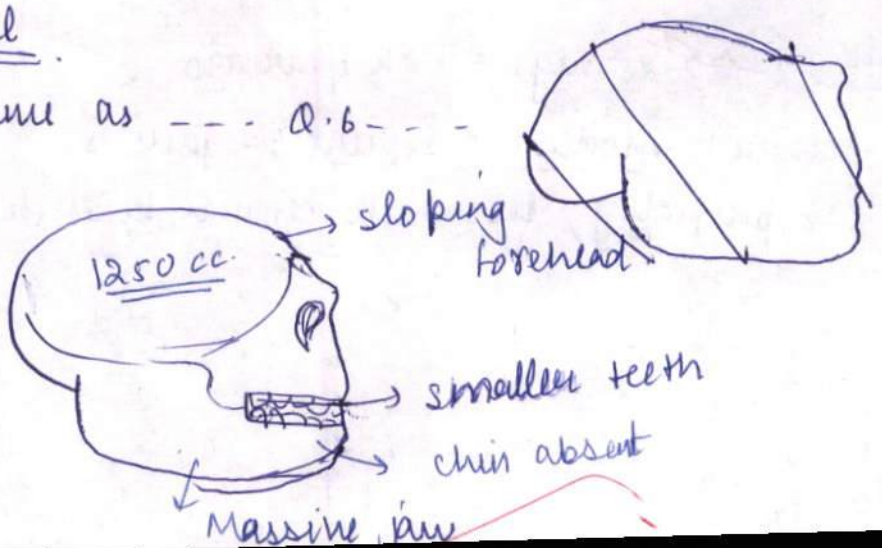
↳ Dental series is continuous without diastema.

4). It has a more robust skeleton.



II Cultural

---- same as --- Q.6 ---



Q. 9 Neanderthals.

• Intro :- Neanderthals is a stage intermediate b/w Homo erectus and modern Homo sapiens. The fossil evidence has been found from Europe & indicates that they lived b/w 0.25 mya - 40,000 yrs ago.

• Discovery - In 1856, from Neander Valley, Dusseldorf, Germany by subsequently, William King named them H. neanderthalensis, after the valley.

• Neanderthals type & geographical distribution

→ fossils were first discovered from Neanderthal valley in Germany, hence the name.

→ They were spread across Europe (France, Germany etc.) Near East, Central Asia, Northern Africa.

→ Types :-

1) Classical Neanderthals :- La chapelle aux saints type

↳ Region :- western Europe - La chapelle, France etc.

↳ Time period :- 75,000 - 40,000 years ago

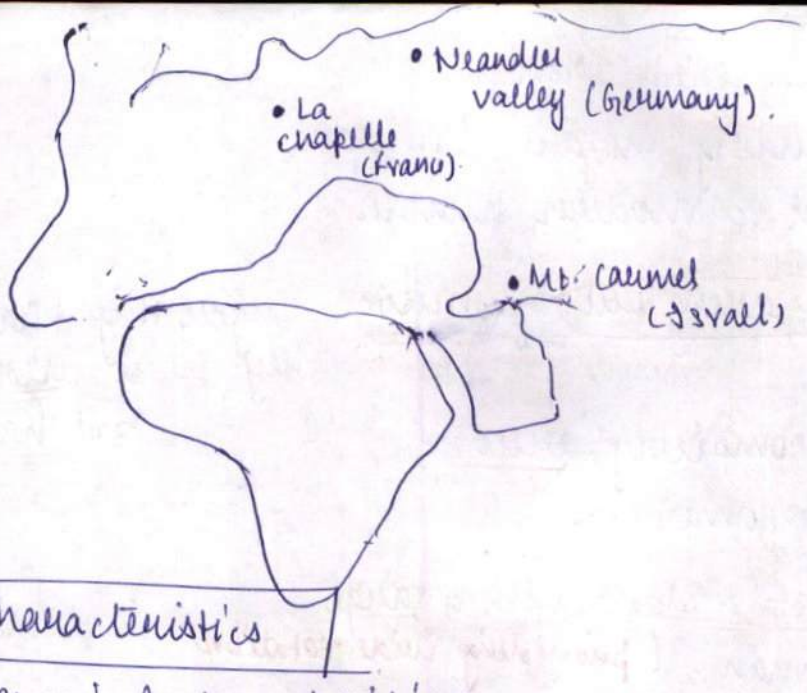
↳ Features :- closer to H. erectus → heavy brow ridges, thick cranial bones, projecting jaw etc.

2) Progressive Neanderthals :- Mt. Carmel type

↳ Region :- Near East, Central Asia - Mt. Carmel & Shanidar in Israel.

↳ Time period :- 0.25 mya - 50K year ago

↳ Features :- closer to modern H. sapiens :- jaw is not projecting, less thick cranial bones etc.



- Characteristics

I Physical characteristics

1) Neanderthals had specialised for coldest climate in Europe. Thus, in accordance with allen's & bergmann's rule, they had a robust skeleton with well developed musculature and short but stouter limbs

2). Skull & brain

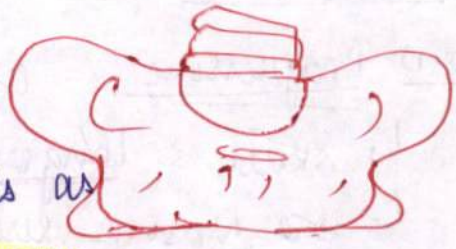
→ 2.1) Progressive :- Cranial capacity of 1400 cc.
- ↳ skull is longer & less broad than classical.
- ↳ Nose is less broad
- ↳ Maxilla is less protruding; chin is not well developed.

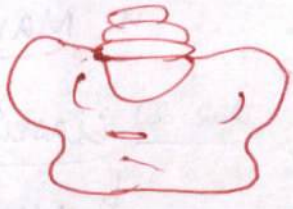
→ 2.2) Classical :- Cranial capacity of 1600 cc
- ↳ skull is large & broad
- ↳ Receding forehead & protruding occipital region.
- ↳ Nose is broad
- ↳ Maxilla projects outward in a muzzle like fashion.; chin is absent

2) Dentition :- Parabolic dental arch
↳ small teeth including molars & incisors; thus more closer to modern human beings.
↳ wearing out of incisors suggesting that they were used as 3rd hand.

3) Limbs
↳ Neanderthals were completely erect & capable of bipedal locomotion.
↳ humerus was short & stout with a large head like modern man. (providing wide rotation)
↳ Development of muscle around scapula :- aiding in throwing activities.
↳ Large & robust fingers ; however they were comparatively shorter.
↳ Fingers terminated in thick pads - increased grasping strength.

4) Vertebral column & pelvis
↳ short & stout vertebral column
↳ Widen pelvic cavity in neanderthals as compared to modern man. Thus, longer gestation period of around 11-12 months.





II. Cultural features
→ culture of Neanderthals is called Middle Paleolithic or Mousterian culture.
stone

1) Tool-making :- Tools such as hand axes & flake tools ('point') were used.
↳ Tools were used for large no. of purposes - for hunting, as containers etc.


Point


Side-scrapper


Borer

2). Hunting & rock shelters :- Neanderthals practiced hunting & lived in small groups often residing at the mouths of the caves.

3) Language :- They must have evolved some type of symbolic language for communication. However, pharynx was poorly developed.

4) Clothing :- They might have used fur for clothes (cold climate). Presence of bone needle at Combe Grenal, France supports the tailoring theory.

5). Religion & ritual :- Evidence of ritualistic burning with animals found at Mt. Carmel (Israel).

↳ Presence of family cemetries, burial offering.

↳ Bear cult was another ritualistic practice.

↳ Thus, some sort of religion might have appeared to keep the society in harmony.

Pollens at Shanidar 1
↳ offering of flowers.

6) Transmission of learned behaviour was less than in modern man :- Because of broader pelvis of neanderthal females ; thus longer gestation period & decreased infant dependency.

→ social cooperation & advancements

7) Neanderthal's philosophy :- They might be aware of interdependence of individual & society as well as dignity of individual.

↳ Eg:- La chapelle aux saints man had severe arthritis & Shanidar I had

undergone surgical operation. Both of these must have survived till maturity with help from society.

- **Phylogenetic Status**

→ Neanderthals must have evolved from European Homo erectus or Homo Heidelbergensis.

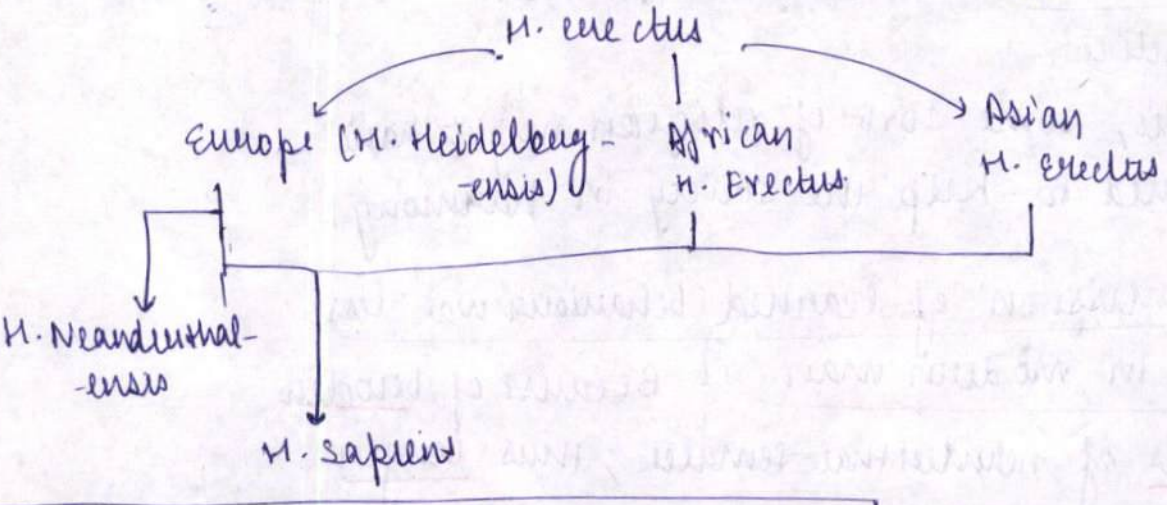
→ They adapted to the colder environment of Europe & became extinct about 30,000 years ago.

→ Modern humans, though contain 2-6% of neanderthal DNA (nuclear DNA), they were **not** direct ancestor of H. sapiens.

↳ Presence of 2% DNA is due to interbreeding.

↳ Inheritance of this neanderthal DNA helped in building of modern human immune system.

↳ Eg:→ Human Leucocyte Antigen (HLA) etc.



- **Theories of extinction of neanderthals**

1). Physical extermination by modern man who had better technology.

2) Over specialisation theory :- Neanderthals were even specialised for cold climate &

became extinct as the climate started warming.

3) Competitive exclusion :- Neanderthals might have not sustained in changing ecological condⁿ. while competing with modern man for resources.

4) Assimilation theory :- Neanderthals were completely assimilated by the dominant sapiens group through interbreeding

• Conclusion

Thus, neanderthals represent an important stage in the evolution of modern man. The presence of neanderthal DNA in nuclear & mt DNA of modern man provides evidence for assimilation theory. However, all the above factors must have occured in tandem and led to extinction of neanderthals.

Q-10 Difference b/w classical & progressive man.

• Discovery :- in 1908 - cave in Correze (France), by 3 priests

in 1931-32 2 sites in Mt. Carmel (Israel)

Classical man → closer to H. erectus	Progressive man → closer to modern H. sapiens
1) Location :- La Chapelle Aux saints, France; western Europe.	1) :- Mt. Carmel, Shanidar (Israel) (Iraq)
2) Time - 75K-40Kya; they evolved from progressive neanderthals in Europe & adapted for colder climate	2) Time :- 0.25mya - 50Kya.

3) Cranial capacity - 1600 cc.

4) Skull ~~has~~ is large & broad

5) heavy & prominent brow ridges

6) Forehead receding

7) Occipital region protruding

8) Upper jaw - maxilla projecting in a muzzle like fashion.

9) Nose is broad & enlarged

10) Orbits less round.

11) skull surface more rough suggesting better development of attachment surfaces.

12) Chin absent

13) They have shorter ht & more stout body built.

14) shorter but stouter limbs.

3) 1400 cc.

4) skull is long & narrow.

5) Brow-ridges are reduced.

6) Forehead less receding

7) → "

8) → "

adaptation to colder environment

longer passage & more surface area for warming the inhaled air.

9) → "

10) more round orbits

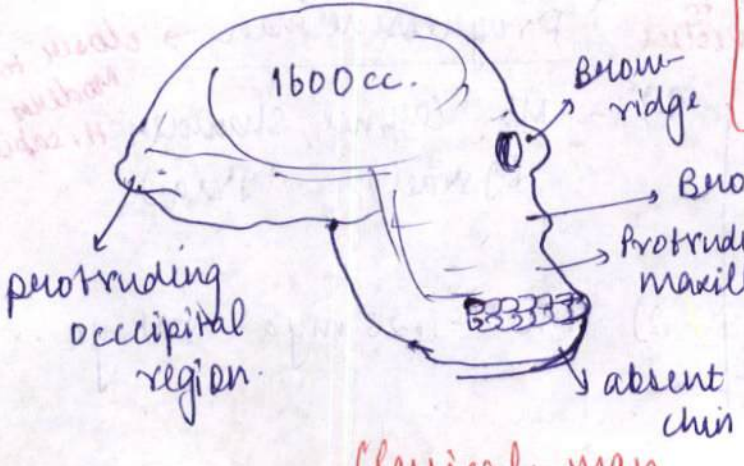
11) → "

12) Chin is developed.

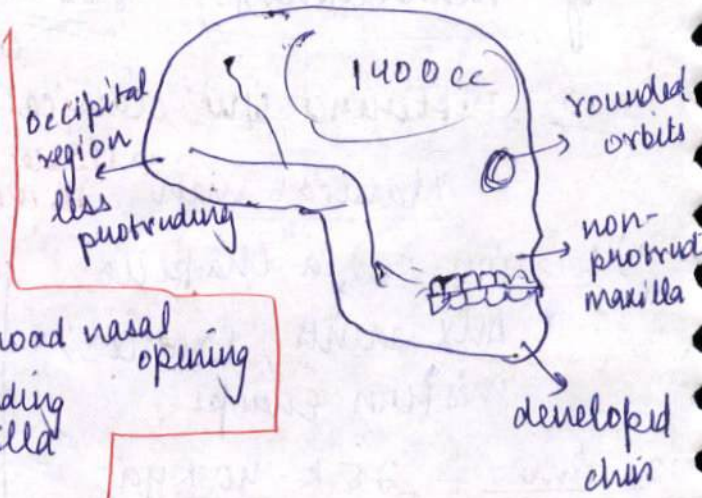
13) Height is ~~longer~~ longer than La-Chapelle man.

14) Medium length limbs.

Q. 17 ~~Rhodesian man~~ ?.



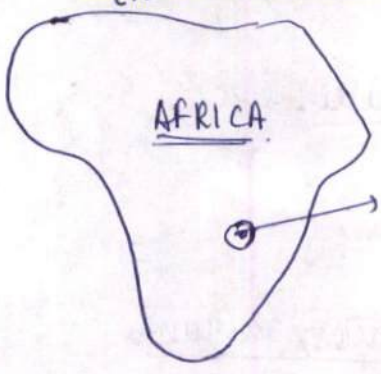
Classical man



Progressive man

Q.11 Rhodesian man ? / Broken Hill Man.

• Intro :- Rhodesian man is considered an intermediate stage between neanderthals & modern man. The fossils were discovered from Broken hill mine, Rhodesia, Africa and are approximately 0.2 my old. (middle Pleistocene) → eg of Archaic sapiens from Africa.



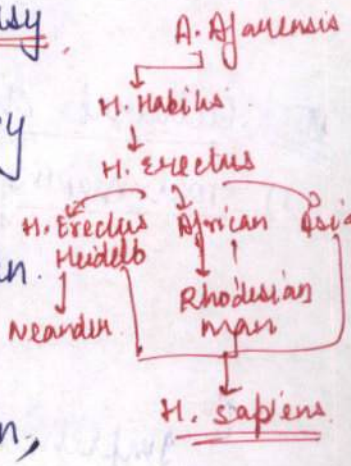
• Discovery - in 1921, Arthur Smith Woodward; skull fossil from Broken Hills, Zambia/ (Rhodesia)

• Phylogenetic status

→ Rhodesian man exhibits features of H. erectus, neanderthal & sapiens at the same time. Hence, its phylogenetic status has been matter of controversy.

(1) Evolution from African H. erectus :- One theory suggests than rhodesian man evolved from African H. erectus & evolved into modern man.

(2) African variant of Neanderthal :- Due to similarities b/w neanderthal & rhodesian man, it is assumed that it bifurcated from (especially Progressive type). Neanderthal & evolved to become modern man.



• Characteristics

I Physical features

1) Skull & brain

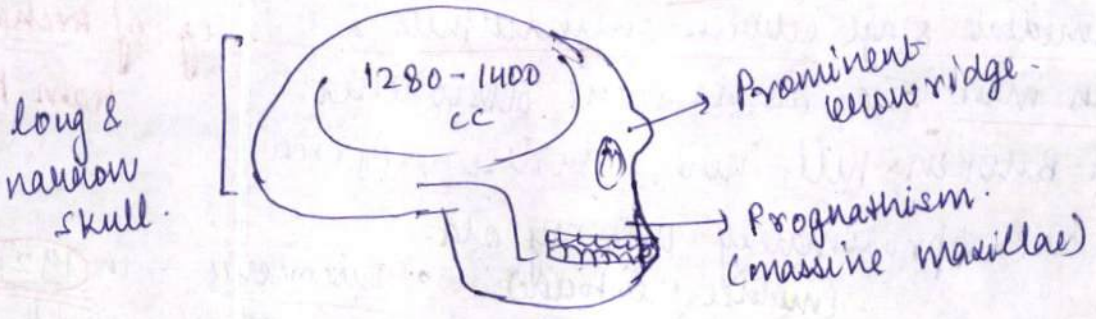
↳ Cranial capacity of 1280 - 1400 cc.

↳ skull is long & narrow.

↳ enormous & prominent brow ridges (like an ape) → (simian feature)

↳ receding forehead.

↳ Face is prognathic (protruding) in a muzzle like fashion; massive maxillae.



(2) Dentition :→ teeth are of smaller size like that of modern man.
↳ canines are non-projecting

(3) Post-cranial features :→ ~~Legs~~ limbs, sacrum & pelvis are human like.
↳ Joints are robust & massive ; Large head of humerus enabling wide rotation.
↳ Bipedal locomotion :- anteriorly placed foramen magnum

III Cultural char. → middle paleolithic

1) Tool-making :- Tools made of stone and bones were used. stone & bone implements were found along with fossil evidence.
↳ Implements show similarity to those used by modern bushmen. However, evidence is not sufficient.

2) They lived in small nomadic group & engaged in hunting.

3) symbolic language & communication must be there to enhance cooperation.

4) They made use of fire

• Conclusion

Thus, rhodesian man forms an intermediate b/w neanderthals & modern H. sapiens. The unique features of rhodesian man can be attributed to forced mixing & isolation due to glaciation & interglaciation periods during late pleistocene.

Q.12 Describe modern Homo sapiens - (cromagnon, Grimaldi & chancelede).

• Homo sapiens or wise man :- only extant specie.

• Intro :- Cromagnon, Grimaldi & Chancelede man are the subspecies of European early modern humans. Their fossils date around 30-40 thousand years ago. [They became extinct by 10,000 years ago]. Although, earliest of such fossils belong to Africa around 0.1 mya from where they spread to Europe and other parts of the world.

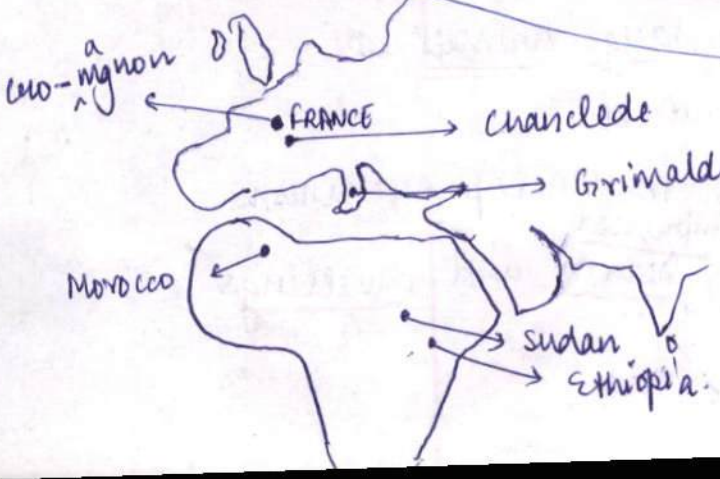
→ last live
→ late Pleistocene.

• Geographical distribution.

1) Cromagnon :- Cromagnon cave in France. - in 1868 by Lartet :-
Omo-Kibish (Ethiopia), Sudan, Morocco - Africa.
5 skeletons in cromagnon cave

2) Grimaldi - Mediterranean coast, Italy. → in 1901

3) Chancelede - France. → in 1888; male skeleton buried in a flexed pose - knees touching jaw



• Characteristics

I. Cro-magnon.

→ Physical features

0) Stature :- Tall individuals with developed musculature with ht of 180 cm (5'10")

1). Skull & brain

↳ Cranial capacity = 1600 cc

↳ Skull is dolicocephalic - long skull but short in breadth.

↳ small browridges.

↳ skull is pentagonal in outline due to marked parietal tuberosities

2) Face is broad, short & flat. (i.e. not in harmony with skull)

3) Eye orbits are rectangular

4) Nose :- long & narrow.

5) Jaw :- Marked prognathism with distinct chin

6) Dentition :- small incisors, & molars

7) Limbs :→ lower leg & forearm longer than femur & upper arm; thus effective bipedal walking

Harpoon. Arrowhead

Blade Burin

→ Cultural features :- belonged to Aurignacian culture of upper paleolithic.

1). Tools :- Advanced stone & bone tools, ~~consisting of bow & arrow, spear, saws, scrapers, Axes with handles etc.~~ → ivory points, burin, blade, arrow head etc.

2) Hunting :- They hunted large animals like mammoth, cave bear. etc.

↳ This enabled them to develop mechanisms for food storage, improved hearth and dwellings for their stay.

3) Cave paintings :- These paintings showcase cro-magnon man's belief system regarding hunting, transition practices etc.
Eg:- Altamira in Spain
↳ Rock sculptures & venus figurines have also been found.

4) Ritual & religion :- Burials with associated goods have been found. This showcases their belief in social classes & ~~ritualistic~~ after life, &

5) Socialisation :- Pelvis of cro-magnon females indicate birth of less mature babies. Thus, longer period of socialisation & greater transmission of learned behaviours.

6) Language & communication :- Development of Broca's area indicated use of some sort of simple language for communication & group cooperation.

II. Grimaldi

→ Physical features :- well developed negroid features

1). Skull & brain
↳ Cranial capacity :- 1250-1450 cc.
↳ Skull is more long & narrow than cromagnon (hyper-dolico-cephalic)
↳ Parietal tuberosities is absent; thus no pentagonal outline of skull but elliptical contour is there.
↳ Bulging forehead.

2) Face :- short with triangular outline, narrow below cheek bones.
↳ similar to negroids.



3) Eye orbits are rectangular

4) Nose :- depressed at the root, nasal aperture is broad.

5) Jaw :- lower jaw is strong & broad.
↳ poorly developed chin.

6) Dentition :- Teeths were larger than in cromagnon.

7) Limbs :- Hind limbs were very longer than forelimbs - efficient bipedalism
↳ lower leg & forearms longer than femur & humerus.

→ Cultural features :- belonged to Aurignacian culture (like cromagnon).

----same as cro-magnon ----

III Chancelede :- shorter than cromagnon.

→ Physical features :- close resemblance to modern day Eskimos

1) Skull & brain
↳ Cranial capacity = 1500-1700 cc
↳ skull is dolicocephalic - long & narrow
↳ well developed parietal tuberosities (similar to cro-magnon)
↳ More developed ~~parietal +~~ sagittal crest (∵ powerful jaw or masticatory apparatus)
& cheek bones (poor in negroids / grimaldi)

2) Face :- long & broad in harmony with skull.

3) Orbits are quadrilateral in shape.

4) Nose :- large & long & narrow.

5) Jaw :- strong lower jaw & powerful masticatory apparatus
↳ well developed chin.

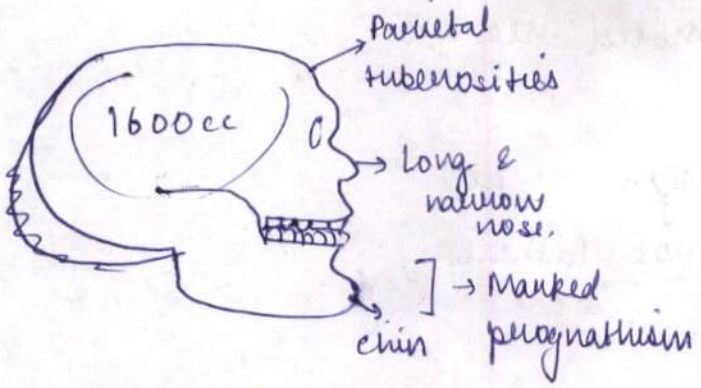
6) Dentition :- small sized teeth.

7) limbs :- shorter but stouter limbs;
forelimbs comparatively longer than hindlimbs

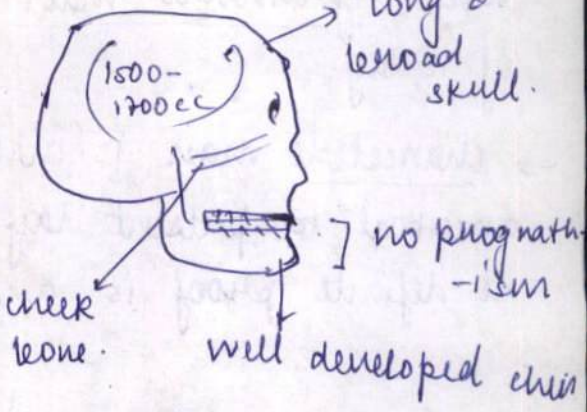
→ Cultural features :- belonged to Magdalenian culture which succeeded aurignacian & solutrean cultures in some part of Europe.

→ large proportion of bone tools as compared to stone tools

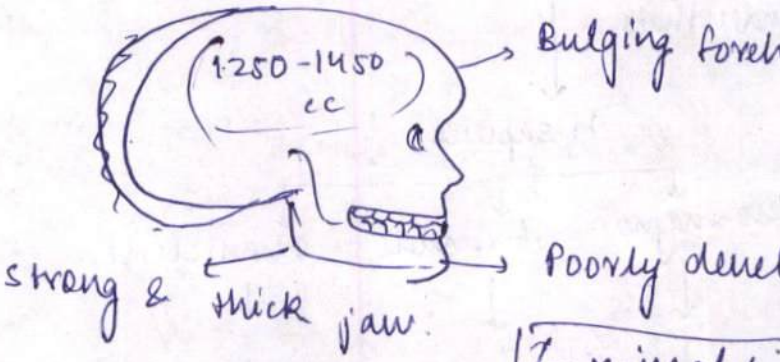
---- same as cro-magnon ----.



Cro-magnon



Chancelade man.



Grimaldi

- **Phylogenetic status**

→ Evolutionary linkages are not clear; though it is proposed that modern human sapiens first emerged in Africa 0.1 mya. (1 Lakh years ago)

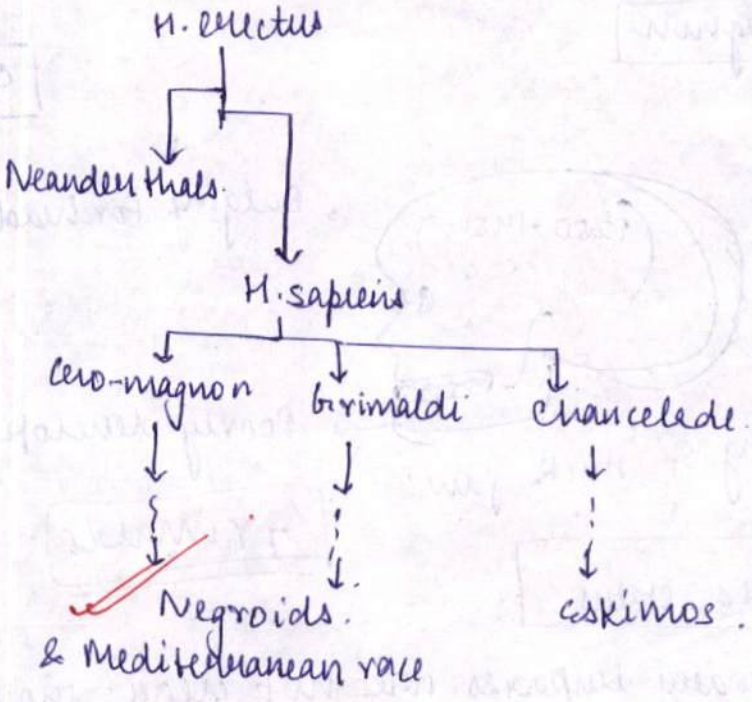
→ From there, they spread to other parts of the world including Europe.

→ Here, these modern H. sapiens replaced the archaic sapiens (including neanderthals) & developed slightly different cran due to their separate ecological niches.

→ These gradually got assimilated into the present population that exists today.

→ It is assumed that, cro-magnon had diluted negroid characteristics as they have undergone sufficient hybridisation; while grimaldi man resembled negroid of today

→ chancelade man is also thought to be ancestral to present day eskimos. Although, no definite proof is available.



- Conclusion

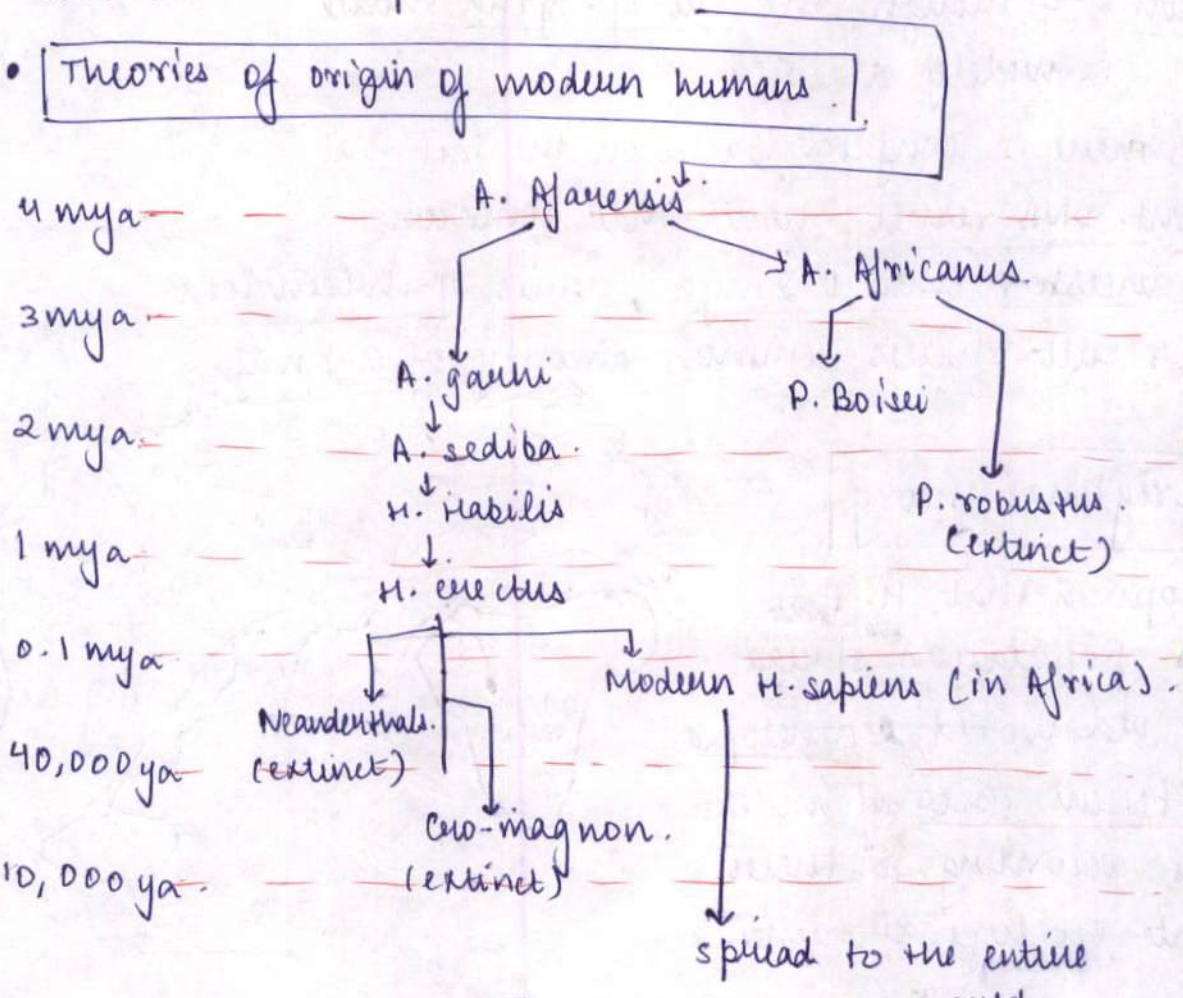
Thus, these sapien sub-~~stb~~species were gradually absorbed into the European population that came later. Some characteristics might still be retained in particular ecological niches due to natural selection.

Skull of Dragon man from China, said to be contemporary of Neanderthals & H. sapiens.

Q.13 Discribe Hominin evolution / emergence of modern humans.

- Intro:- Hominoid diverged into two families - Pongids & Hominins. The first hominins Australopithecines appeared 4 mya during Plio-Pleistocene epoch. Subsequently, the modern H. sapiens evolved in Africa 0.1 mya and spread to the entire world replacing archaic Homo species.

- **Theories of origin of modern humans**



1) **Single origin theory / Total replacement theory**

↳ It indicates that modern humans first emerged in Africa 0.1-0.2 mya.

↳ From there, they moved to the Near East, then Europe & Asia and finally Australia & America.

↳ Due to the cultural & biological advantage, these modern sapiens replaced archaic species

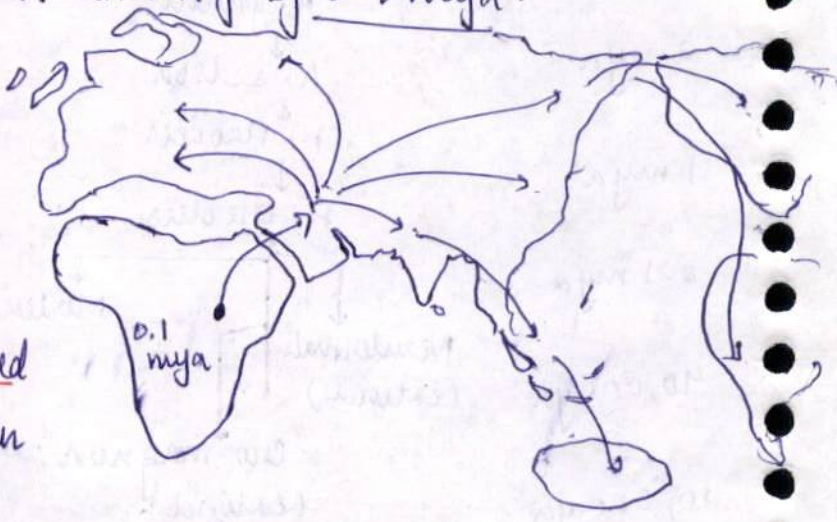
of homo including Neanderthals, Denisovans etc.

→ Evidence in support :- Analysis of mitochondrial DNA & y-chromosome of human population indicates their common ancestor living in Africa around 0.1-0.2 mya.

↳ This gave birth to mitochondrial eve & y-chromosome adam hypothesis

↳ Criticism :- Though, the out-of-Africa model is widely accepted.

↳ There is conflict based on the fact that mt. DNA result shows that common ancestor lived 0.2 mya, while y-chromosome result shows common ancestry of 0.1 mya.



② Multiregional theory

→ It proposed that H. erectus population that spread into the old world (1-1.6 mya) developed into different races of modern Humans according to their different ecological niches

→ Archaic Homo species and Neanderthals represent transitional stages in the development of modern sapiens

→ Evidence :- 1) Continuity in fossil evidence from different parts of the world

2) Eg :- Peking man (H. erectus from China) had broader faces with move horizontal cheekbones. Same feature can also be seen in modern Chinese population.

→ Criticism :- 1) DNA analysis show common ancestry around 0.1 mya that evolved in Africa.

2) Moreover, continuity in traits is not found in all parts & is limited to some regions.

(3) Assimilation theory

↳ It is most widely accepted.

↳ It states that while human originated in modern Africa 0.1 mya & spread to the entire world replacing Neanderthals & archaic homo, there must have been some kind of interbreeding b/w modern H. sapiens & local populations encountered by it.

↳ Thus, in course of time, the genome of archaic homo like Neanderthals got completely assimilated within modern H. sapiens.

↳ Evidence :→ Nuclear DNA evidence shows that ~~we~~ ~~have~~ we contain 2-6% of Neanderthal DNA.

↳ This has helped in building human immune response, eg - Human Leukocyte Antigens (HLA) inherited from Neanderthals.

↳ Criticism :- 1). The hybrids may not be viable and didn't survive and even if they did, they would have been sterile.

2) However, some female hybrids might have survived & successfully reproduced.

- Conclusion

Thus, the popular view is that modern sapiens emerged out of Africa & spread to the entire world replacing archaic homo species. However, during this some interbreeding might have also occured.

Dragon man skull

Q.14 Human evolution in India?

→ Meagre fossil evidence.

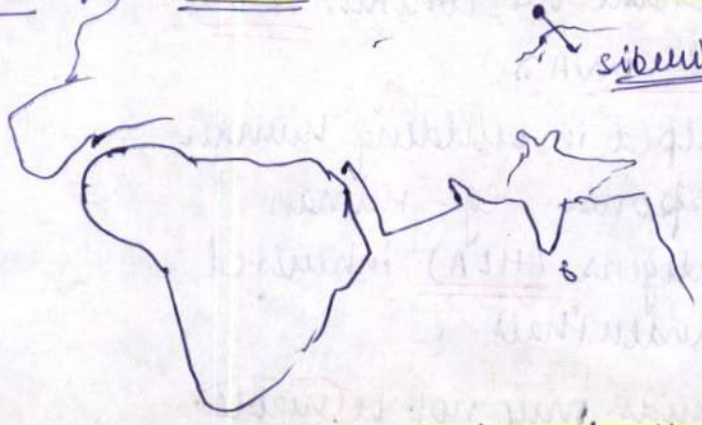
1) Sinapithecus & Ramapithecus.] → from Sivalik hills (8 - 13 mya).

2) H. erectus Narmadensis → Narmada Valley
↓ high cranial capacity (1150 - 1420 cc)
1 - 0.1 mya

- Denisovans.

→ contemporary to Neanderthals & modern sapiens (0.1 mya - 40,000 ya)

→ region: - Siberia (Denisova cave, Altai region, Siberia).



→ more closely related to Neanderthals than modern humans.

→ separated from our lineage a little early than neanderthals.

→ Middle - Paleolithic style tools.

→ must have interbred with Neanderthals. (Denny - child). & even modern sapiens acc. to DNA evidence.

* Template :- 1) Intro.

2) Why pedigree analysis :→ } 3 limitations of direct experimentation in man.

Body ← [3) Principles ; type,
4). methodology etc.

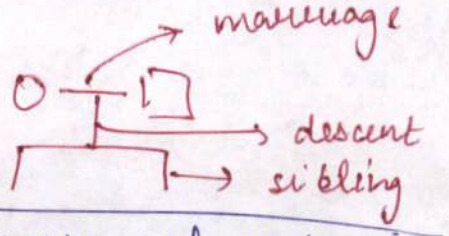
5) Significance / Application.

6) Limitation

7) conclusion.

▨ → affected with trait.

⊘ → deceased.



• Methodology of pedigree :- 1) Pedigree charts are formed using symbols & lines. Symbols represent family members (○ = female ; □ - male) while lines represent relationship b/w them.

2) Data is collected from existing family members and presented in the pedigree chart, thus making it easier to visualise the transmission of traits.

Unit-9.1 Human Genetics.

Q.1 What is pedigree ~~applications~~ analysis?

- **Intro :-** Pedigree analysis refers to studying the pattern of inheritance of traits across several generations within a family.
A pedigree chart is formed with the help of symbols and lines, thus making it easier to visualise the transmission of traits between family members.

- **Significance of pedigree analysis**

- **Principles of pedigree analysis**

→ It is based on the following Mendelian principles :-

1) Law of dominance and recessive genes.
2) Law of segregation.
3) Law of independent assortment
4) Law of equivalence.

→ Pedigrees are mostly based on phenotype, and not genotype.

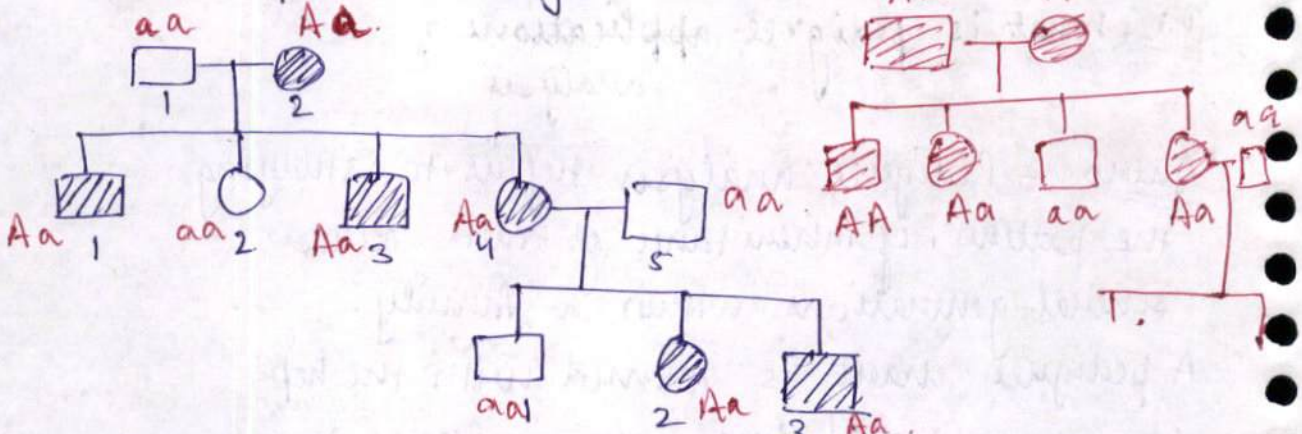
→ One can also determine following things through pedigree analysis ; whether a trait is.

1) Autosomal or sex linked
2) Dominant or recessive.

- **Types of pedigrees**

1) **Autosomal dominant** :- Trait can appear in both sexes with equal frequency, without skipping generations.

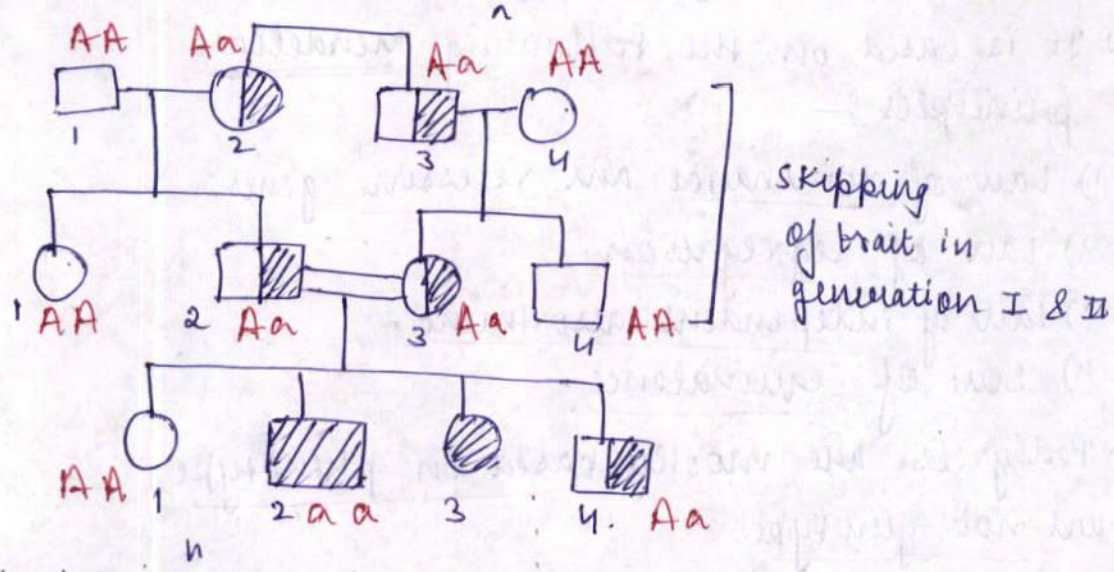
↳ Eg:- Myotonic dystrophy, Huntington's disease, Achondroplastic dwarfism etc.



2) Autosomal recessive

↳ Traits can be present in both sexes with equal frequency. However, due to its recessive nature, it can skip generations and reappear in next generation.

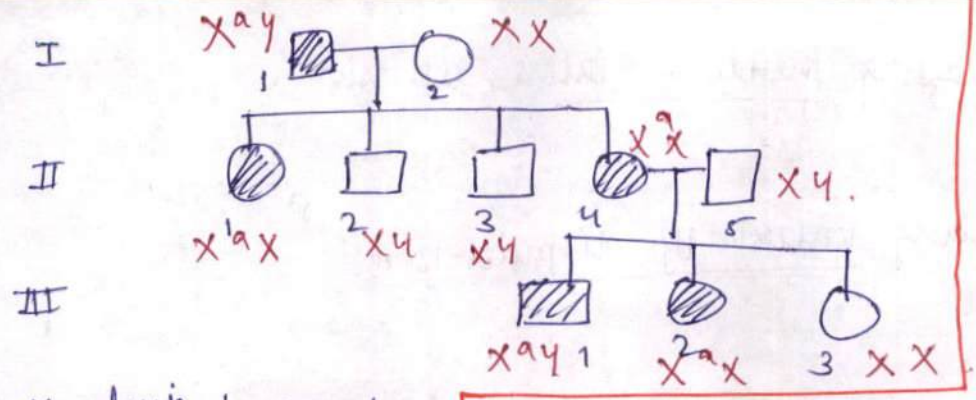
↳ Eg:- Cystic fibrosis, albinism, sickle cell anaemia etc.



3) X-linked dominant :- It will be appear in each generation (dominant). However, it has a sex bias :- ① it transmitted through father - appears only in daughters.

↳ ② It transmitted through mother - can appear in both sons & daughters

↳ Eg:- Vit-D resistant rickets, blood group Xg etc.

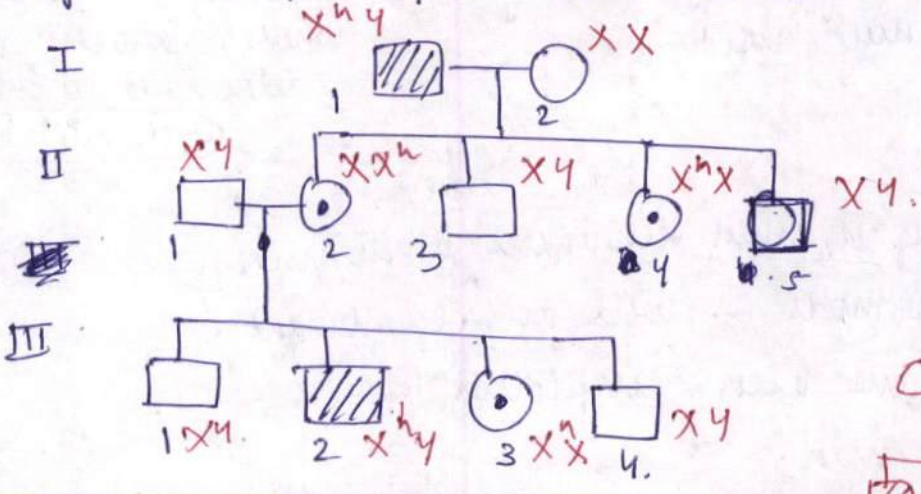


• sex-limited inheritance :- autosomal traits; genes present in both sexes but expressed in only 1
↳ Eg :- Baldness
↳ Beard in males.

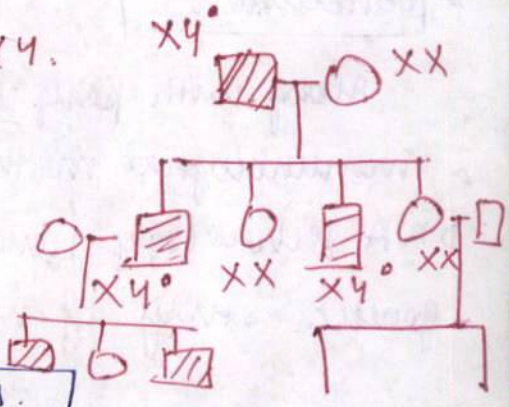
ii) X-linked recessive.

↳ Males are often affected by it while females act as carriers. Skipping of generation can also take place — criss cross inheritance.

↳ Eg :- Haemophilia, color blindness etc.



iii) Y-linked
↳ Holandric
↳ from father to sons only.
↳ Eg :- Hairy ears, webbed toes



• Significance & applications of pedigrees.

1). Useful in studying inheritance of genetic disorders since direct experimentation cannot be performed on man due to :-

↳ a) only 2-3 generations of man can be observed in a lifetime ; not sufficient

↳ b) limited no. of offspring.

↳ c) ethical reasons :- ~~man cannot be interfered & observed for experimentation.~~ controlled breeding not possible in man.

2) Useful tool in genetic counselling as it helps in avoiding incidence of diseases

3) Helps in studying Mendelian laws, allelism & linkage.

4) Helps in settling paternity disputes to a certain degree.

• **Limitations.**

1) Not useful in tracing traits which are not influenced by genes or which depend upon interaction b/w genes & surrounding environment.

2) Ethical concern regarding privacy, confidentiality and future use. consent

3) useful only in those cases where character is determined by only single allele pair.

• **Conclusion**

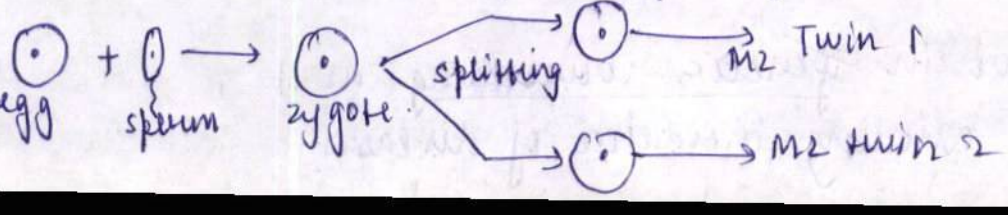
Along with pedigree, other techniques like biochemical, & immunological methods as well as recombinant DNA technology have been employed in genetic study of man.

Q.2 Describe twin studies

• Intro :- Twins studies are conducted on identical (MZ) or fraternal (DZ) twins to determine the influence of genetic & environmental factors on different phenotypic traits & disorders.

• **2 types of twins.**

1) Monozygotic or identical twins :- These are formed due to splitting of single zygote.

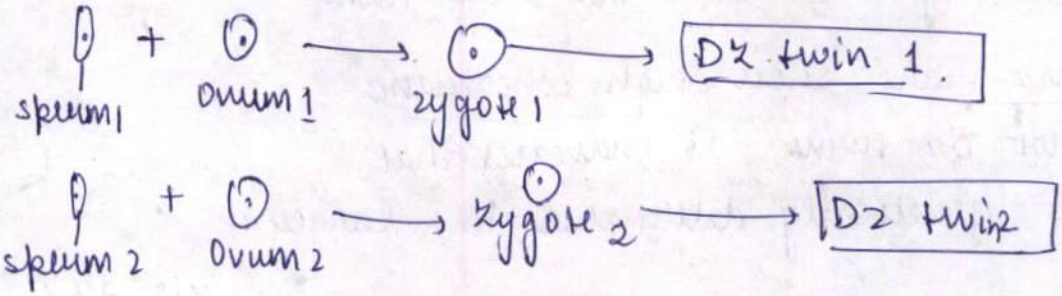


(i) These are genetically identical except some somatic mutations.

(ii) They are of the same sex.

(iii) No effect of mother's age on probability of birth of MZ twins.

2) Dizygotic or fraternal twins :- Result from fertilisation of 2 ova by 2 different sperms at the same time



(i) No more genetic similarity than ordinary siblings.

(ii) They can either be of same or different sex.

(iii) More frequent in older mothers & certain ethnic groups (Eg :- Africans).

• Significance of twin studies → settle 'nature v/s nurture' debate -

1) Helps in determining whether a particular trait is genetically inherited or environmentally influenced.

↳ Since direct experimentation cannot be conducted on man because of :-

(i) long lifespan of man

(ii) limited no. of offsprings

(iii) ethical reason :- ~~man~~ controlled breeding is not possible in man.

2) Helps in understanding role of genes & environment on complex diseases like obesity, depression, cardiovascular diseases

&

• Methodology

I. Concordance - Discordance study by comparing pair of DZ & MZ twins

→ Both twins have/or don't have a trait
→ only 1 twin possess the trait

↳ Extent of concordance (presence of trait) is noted in both MZ & DZ twins in both the twins

↳ If both show high concordance :- the trait must be be influenced by environmental factors. (for discrete traits.)

↳ Eg :- Concordance rate for sitting up is high for both MZ & DZ twins.

↳ If only MZ twins show high concordance rate & not DZ twins, it indicates that the trait is genetically determined to a larger extent.

↳ Eg :- Concordance rate of eye color, (99.6%. v/s 28%.)
hair color is higher in MZ twins. (89% v/s 22%).

II. Rearing studies :-
Concordance & discordance study on MZ twins reared together & reared apart.

↳ used to find out heritability of continuous characters like height, intelligence etc.

↳ If concordance rate is high in both cases when MZ twins are reared together & reared apart :- then heritability is high or trait is genetically determined.

↳ If concordance rate is higher in case of MZ twins reared together :- then environmental influence is the vital force.

• Limitations of twin studies

1) Provides no information regarding nature, location & behaviour of genes. Similarly, no recognition

given to different components of environment- physical, chemical or biological.

(2) The assumption that MZ twins are completely identical is erroneous. as differ in size, vigour etc. in many case.

(3) Certain characteristics like IQ etc. are not exclusively influenced by genes or environment but by complex interaction b/w them.

(4) ~~Eto~~ The intra-uterine environment is not influence of taken into account. Difference in here can lead to low concordance rate among MZ twin.

(5) Inter-population variations are not accounted.

(6) Questioning the extrapolation of rare twin studies to entire population.

(7) Unethical - keeping twins apart can impact them psychologically. Eg:- The documentary :- 3 Identical Strangers.

- **Conclusion**

Twin studies remain a useful tool in genetic study of man. Its limitations can be overcome by combining the results obtained from other methods like foster child studies, co-twin method etc. ~~to~~

Q. 3 Describe foster child method.

- Intro :- foster child method complements twin studies in determining the influence of heredity & environment on the development of traits. It tries to settle down the age-long nature - nurture debate.

→ Foster child :- A child who is neither the biological child nor is legally adopted.

• **Why foster child studies in genetic study of man**

↳ Direct experimentation cannot be performed on man due to → (1) It's limited but longer life span
↳ (2) Less no. of offsprings
↳ (3) Ethical reason :- controlled breeding isn't possible in man.

↳ Hence, indirect techniques like foster child method are used.

• **Underlying Principle**

→ Methodology :

1) Groups of children are selected at random and placed in different homes, classified as - good, average & poor.

2) Since, children are randomly selected, it is assumed that genetic component of a trait, say intelligence is equally distributed among them.

3) After some time, their intelligence levels are tested.

4) Result :- Usually, children placed in good homes have better intelligence scores than others ✓

5) Inference :- Intelligence is not entirely genetically determined & has an environment factor. ✓

→ **Case studies**

1) Chicago study :-

Children placed in	Good homes	Avg homes	Poor homes
Avg. IQ scores.	112	105.	96.

decreasing with decrease in environment quality.

2) Minnesota study

↳ children of managerial class placed in labour class homes & vice-versa.

↳ Result :- Though IQ of labour class children rised when they were put in managerial class homes, it was still less than children of managerial class.

↳ Inference :- This indicates influence of heredity along with environment.

- **Significance.**

1) Used to determine the genetic & environmental component in the development of a particular trait.

2) Effective tool in genetic study of man along with twin method.

- **Limitations.**

1) The method is not free from biases - children might not be selected at random.

2) If children are placed in foster homes in later years they are likely to be already influenced by environment of their original homes (eg - in Minnesota study).

3) If children are selected from different background, difference can be attributed to ethnicity & other factors.

4) unethical

• Conclusion

→ The limitations can be overcome by taking adequate steps to minimise any biases & errors. Thus, it provides further enlightenment on the nature-nurture debate.

Q. 4 Co-twin method?

• Intro :- Co-twin method is used in genetic study of man. It helps in determining the influence of heredity & environment in the development of a particular trait.

→ Here, a pair of twins in taken, one of them is subjected to training & other changes, while its co-twin is kept unaffected. in a controlled environment. Both of them are compared at the end.

• Types of twins.

1) Monozygotic / identical twins :- single zygote splits to form 2 offsprings

↳ They have same genetic components except some somatic mutations.

2) Dizygotic / fraternal twins :- 2 different zygotes formed from the start due to fertilisation of 2 ovum with 2 sperms.

↳ They are no more genetically similar than ordinary siblings.

• Principles

1) A MZ or DZ twin & its co-twin are investigated & compared by subjecting them to different

environment conditions.

2). The difference b/w twin & co-twin method is that even when twins are reared apart in the former case, the environment provided to them is not strategically designed.

3) whereas, in latter, the environment is controlled. M2 & D2 are

4) for eg:- One of the twins is provided training to improve their intelligence level, while their co-twins are not.

5) Result :- In both the cases (M2 & D2); the co-twin that was provided training performs better than the other.

6) Thus, influence of environment can be determined in the development of intelligence trait.

- **Significance.**

1) separating influence of heredity & environment in development of a trait.

2) Effective tool for genetic study of man. (especially mental traits) as direct experimentation is not possible in man (long lifespan, limited offsprings etc)

3). Helps in study of mendelian laws of inheritance in man.

- **limitations**

Point ①, ③ & ⑥ from Q. 2.

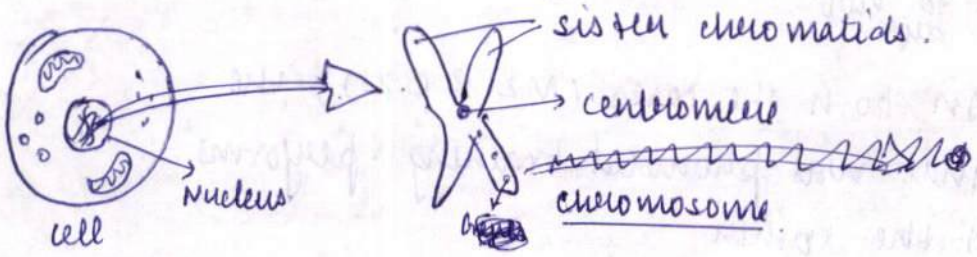
- **Conclusion**

--- same as Q. 3 ---

Q.5 Describe cytogenetic method / chromosomal analysis.

• Intro :- Cytogenetics (chromosomal analysis) is a branch of genetics that is concerned with structural & functional studies of the chromosomes.

→ chromosome :- These are microscopic filamentous structure present within the nucleus (thread-like bodies) of a cell. They contain an individual's genetic material in the form of genes.



→ chromosomes always occur in pair. Each of the pair is inherited from father & mother.

→ Total chromosomes = 22 pair of autosomes + 1 pair of sex chromosomes

= 46.

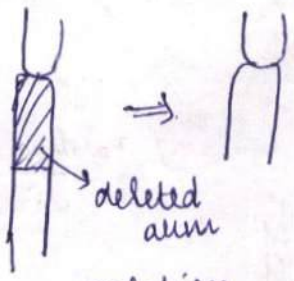
• Underlying Principle

1) Objective :- It involves analysing the number & general structure of all 46 chromosomes to detect any abberations.
↳ It is also called Karyotype analysis

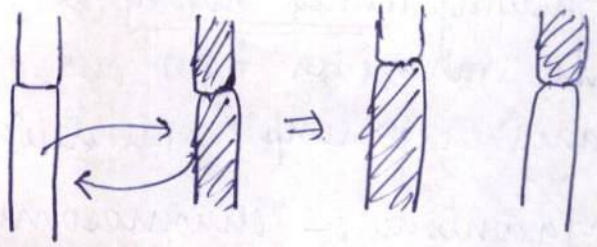
2) Numerical chromosomal analysis :- It refers to increase or decrease in no. of chromosomes from the usual 46
↳ Eg :- → 21 trisomy or down syndrome.
↳ Klenifelters syndrome (XXY) etc.

3) Structural chromosomal analysis :-

Analysing the chromosomes for translocation, inversion, duplication, deletion etc.



Deletion



Translocation

- **Methodology**

I → Cells are taken from tissues that are actively dividing (eg - Bone Marrow cells)

→ These are then arrested at metaphase stage.

II to observe the chromosomes clearly. (using colchicine) III.

↓ → separation of chromosomes.

IV staining different parts of chromosome for better analysis ~~& precisely locating the gene~~

↓

V Microphotographs. → VI cutting out individual chromosomes from microphotographs.

→ Types of staining :-

1) Q-Banding
2) G-banding
3) C-Banding
4) R-banding.

VII Analysing them for any abberations.

→ Other methods :-

Flow Cytometry :- Fluorescent activated cell sorting.

2) Somatic cell Hybridisation

:- Hybrid of somatic cells (eg - Mouse & human) can be produced. Then, separating human chromosome when these hybrid cells divide.

- **Significance**

1) Medicine :- 1) Identification of many congenital diseases related to chromosomal abberations. Eg :- Turners syndrome etc.

2) Identifying genetic problems related to infertility, stillbirth or neonatal deaths.

II studying family history as chromosomes are transmitted from one generation to another in simple Mendelian fashion.

III Taxonomy :- chromosomal analysis of different species can help in establishing their evolutionary linkage.
(Eg) :- chromosome 2 in humans - chromosome 12 & 13 of apes.

IV Inter-generational
2 Intra-generational variations.

V Paternity disputes forensics.

- **Limitations**

1) It is effective only in determining influence of genetic factors & not environmental factors.

2) some traits are a resultant of interaction b/w genes & environment, hence, such cases cannot be solely analysed using cytogenetics.

3) Ethical concerns regarding privacy, consent & future use of personal data.

- **Conclusion**

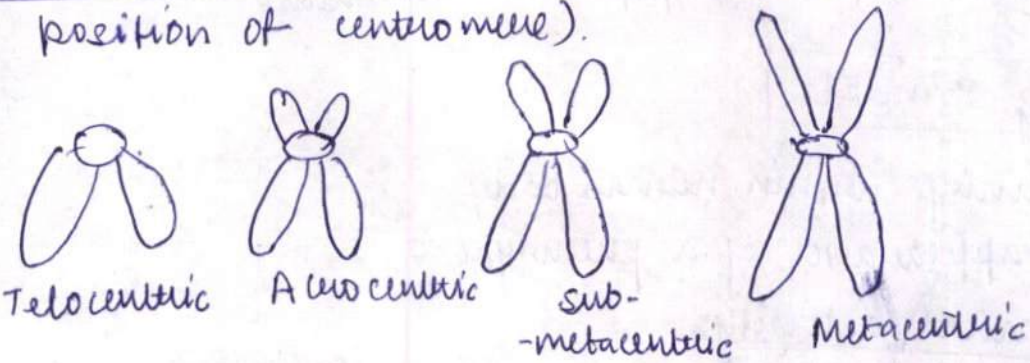
Thus, modern techniques like cytogenetics & karyotype analysis help in identifying underlying genetic causes for various disorders. It can provide a more holistic picture when combined with biochemical & immunological methods.

Q.6 Describe karyotype analysis.

- Intro :- karyotype method refers to analysing the number & structure of chromosomes within the nucleus of a cell to identify for any aberrations.

→ chromosome :- --- same as Q.5 ---

- Types of chromosomes (on the basis of position of centromere).



- Principles of karyotyping

→ Analysing the chromosomes for the following features :→ (1) size of chromosomes
↳ (2) shape of chromosomes
↳ (3) position of centromeres
↳ (4) Length of arms.

(5) Numerical analysis :- --- [same as Q.5]

(6) Structural analysis :- ---

- Methodology
- Significance
- Limitations
- Conclusions

} same as Q.5.

Q.7 Biochemical method.

- Intro:- Biochemical method involves the study of chemical compounds & reactions which occur in living organisms. These involve study of proteins, carbohydrates, nucleic acid (DNA), enzymes, hormones etc.
  ↳ AE Garrod - pioneer
- → It helps in understanding human genetics as well as inter or intra population' variation.

- **Underlying Principle**

→ Every activity within human body including appearance of a phenotype is a biochemical activity.

→ Chromosomes contain genes which ~~have~~ carry the form. the DNA material

DNA → (transcription) RNA → (translation) protein

→ Thus, expression of protein is responsible for many visible changes in human body.

→ Through biochemical method, we separate the desired proteins, nucleic acid etc. from the cell

- **Methodology**

I Separation & identification of protein, DNA material etc.
↓
Sequencing of DNA (ATGC bases in DNA)
or
sequencing of amino acids within protein
↓ by comparing it
Analysing the data with standard level.

↓

Any excess or shortage of the same could point to inherited health problems.

II Techniques for separation of Proteins

1). Gel-filtration :- separates larger proteins from smaller ones on the basis of size & molecular weight.

2). Ion-exchange chromatography :- separation of proteins on the basis of charge.

3) Affinity chromatography :- Proteins are separated by binding with specific ligands.

4) Electrophoresis :- Proteins are put in an electric field & separated on the basis of charge & molecular weight.

• Significance & Use

1). Useful in detecting inherited genetic disorders & health problems. Eg :- Galactosemia, Cystinuria, Gout etc.

2) Effective tool in study of human genetics.
- helps in understanding intra & inter population variation based on difference in biochemical constitution.
  - Eg :- Excess Melanin in people living in equatorial countries.

3). Helps in ascertaining metabolism and physiological capacity within individuals. family history.

4) Biochemical analysis of different species can help in establishing their evolutionary linkage.

5) Applications such as - DNA fingerprinting, settling paternity disputes, forensics & criminal biology etc

6) Diagnosis of genetic disorders in foetus.

- **Limitations**

---- same as Q.5 ---

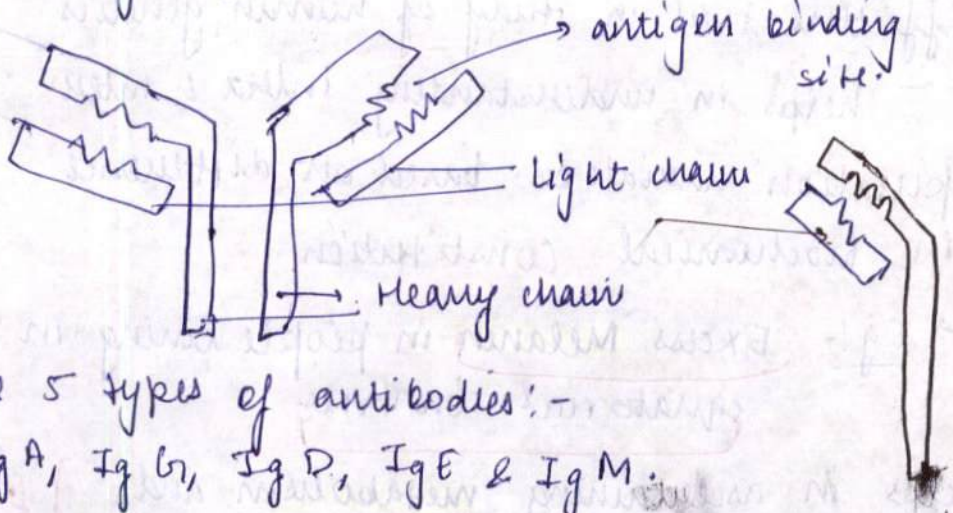
- **Conclusion**

--- same as Q.5 ---

Q.6. Explain the immunological method?

- Intro :- Immunological method is employed in study of human genetics and is based on antigen-antibody reaction. Each individual has an immune system (lymphocytes). Hence, different with slight variations antibodies are released by each individual's immune system in response to antigens.

- Antibody :- Each antibody is made of two heavy & two light protein chains



→ There are 5 types of antibodies :-
IgA, IgG, IgD, IgE & IgM.

- **Basic Underlying Principle**

1) Antibodies to particular antigens occur

in all individuals but genetically variant type occurs.
↳ This is due to difference in amino acid composition of different chains
↳ This is genetically determined

2) These variations in the antibodies help in immunologic study of man (how genes help in development of variable immunity within people)

↳ Eg: 1) Detection of infectious diseases that can spread easily in a population as inhabitants lack antibody against it (eg - covid-19 disease etc.).

2) Inter & intra population variation in immunity etc.

• Methodology

Antigens are injected into humans

↓

Developed antibodies are separated & purified (using techniques like - immunoelectrophoresis).

↓

Analysis of variation in antibodies owing to genetic factors.

Injection of these antibodies into another animal, eg rabbit (here; they will act as antigens)

↓

Extraction of anti-sera containing antibodies against human antibody

↓

reaction of blood samples of different individuals with anti-sera

↓

Analysis of difference in extent of reaction.

• Significance & Application

1) Used in blood group determination, Rh factor compatibility, organ transplants etc. → HLA incompatibility.
   - ↳ A blood group → anti-B antibody
   - ↳ B " " → anti-A "
   - ↳ O " " → both anti-A & anti-B antibody
   - ↳ AB " " → no antibody.

2). Help in ~~detection~~ detection & timely treatment of emerging infectious diseases (like covid-19, dengue etc)
   - ↳ Also help in development of vaccines & medicines against them.

3) Detection of immuno-deficiency diseases which are hereditary in nature. Eg:- IgA deficiency etc.
   - ↳ Detection of hereditary auto-immune diseases. Eg:- Rheumatoid arthritis

4) Help in understanding diversity in immune responses of individuals belonging to different regions, ethnicity etc.
   - ↳ Eg:- B-blood group dominant in South Asian regions.

5) Anti-sera can be used in establishing evolutionary linkage b/w different species (eg:- humans & chimpanzees etc)

6) Paternity, forensics etc.

- **Limitations**

①, ②, ③ – same as Q.5 – – – ④ Growing concern surrounding resistance to antibodies by pathogens due to fast-paced mutation.

- **Conclusion**

Immunological method holds great

significance in contemporary times when the entire world is facing & recovering from covid-19 pandemic. Better R&D and capacity building measures (eg- Genome sequencing labs for emerging variants) can only secure human population from future pandemics/ epidemics.

Q.9 DNA technology / recombinant DNA technology.

- Intro :- rDNA technology involves introduction of desired gene into the DNA of another ~~species~~ organism.

It is also referred to as genetic engineering, gene cloning etc.

→ Tools required in rDNA technology

- Plasmid vector.
- Restriction enzymes
- ligases
- host organisms.

- **Underlying Principle**

→ It is based up on ~~the principle that~~ underlying structural & functional similarities ~~of~~ in DNA among all biological beings.

- Structural similarity

Nucleotide Bases (A, T/U, G, C) → Codons → Genes → DNA.

- Functional similarity :- (1) Replication of DNA

→ (2) This DNA is translated into protein which causes observable phenotypic expressions. [synthesis of protein?]

DNA → RNA → protein

- **Methodology**

1) Isolation of DNA fragment (1) using restriction endonucleases (2) cutting → molecular scissor.

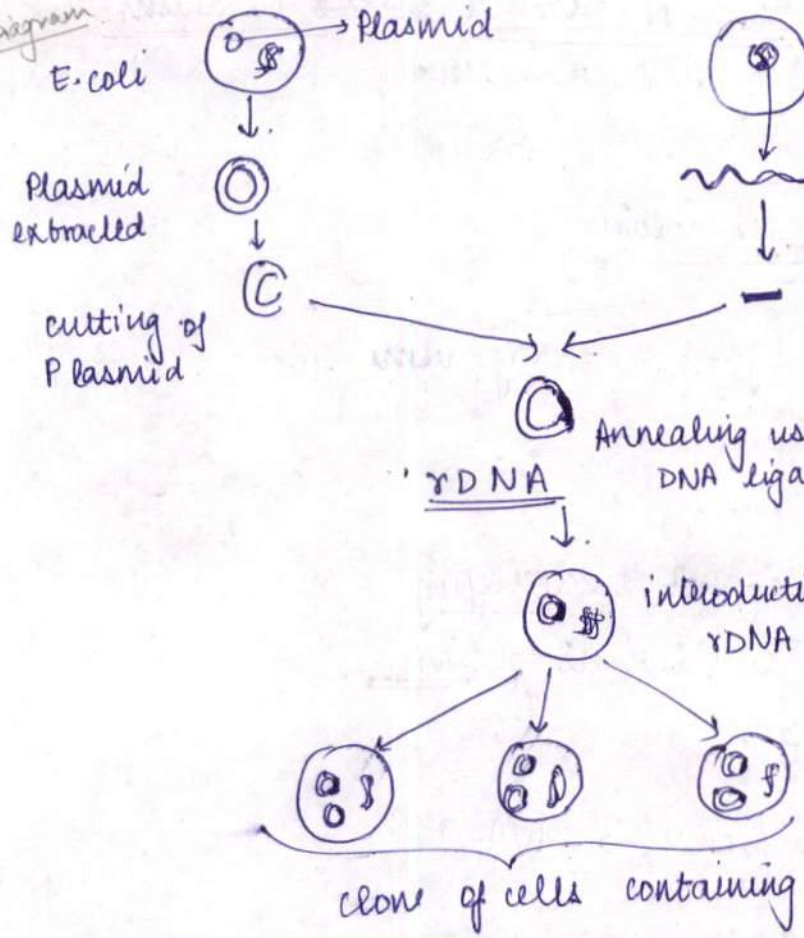
2) Insertion of these DNA fragments into suitable vectors; eg - plasmid. ∴ joined using DNA ligase → (3) Amplification using PCR.

3) Introduction of DNA into host organism (like E. coli).

4) Cloning of host organism to create multiple copies of desired DNA.

5) Isolation of clones containing specific DNA / gene product

Diagram



(8) Downstream Processing → before releasing product for final marketing

↳ It involves separation & purification, clinical trials & quality tests.

• Significance & Applications

1) It helps in diagnosis, treatment & prevention of many diseases.
↳ Eg :→ Diagnosis of genetic disorders in foetus

2) Diagnosis :- Using DNA probes, we can identify diseases which are difficult to detect otherwise
↳ Eg :- Sickle cell anaemia, kala-azar etc.

3) Treatment :- Gene therapy, that is, replacing incorrect genes by correct ones has been used to cure diseases like cystic fibrosis, ADA deficiency syndrome etc.

↳ Monoclonal antibodies have been used to treat covid-19, HIV, ebola etc.

4) Prevention :- rDNA technology has been used in synthesis of vaccines. → P-fizer.

↳ Eg:- vaccines for covid-19, Hepatitis B etc.

5) rDNA technology has been used in commercial production of essential hormones and enzymes like

↳ Insulin - Diabetes ; Growth hormone - Dwarfism.

6) It has been used to grow GM crops which are resistant to pathogens & extreme weather conditions.

↳ Eg:- Bt cotton ; GM rubbish in Assam - cold resistant

Advantage

1) less time consuming than traditional methods.
2) Can benefit a large no. of people since large quantity can be produced is smaller time.
3) Technology is not complex.
4) Can be instrumental in curing many genetic disorders in the future

Disadvantages

1) It may introduce potential harmful organisms in the ecosystem.

↳ Eg:- Emergence of covid-19 from wuhan lab. Theory of

2) Possible harmful genetic effects of GM crops
↳ allergic, toxic, Anti-biotic resistance
↳ Eg:- BT brinjal.

3) Risk of immune system response against vaccines & gene therapy; thus reducing their efficiency → reduced genetic diversity in env. - extinctions of certain species

4) Ethical concerns :- rDNA technology can bring unwarranted changes in foetal DNA which is unethical on many grounds. } designer baby

• **Conclusion**

rDNA technology holds great promise for future. However, ethical concerns surrounding it should be addressed as any development that disturbs the man-ecology balance is undesirable. } Crispr-Cas9, CAR-T

Q.10 Describe the various methods used in genetic study of man.

• Intro :- Human genetics is concerned with scientific study of variation among human beings due to genetic and environmental factors. It is based on the principle of inheritance of genes from one generation to another.

• Reason :- why direct experimentation is not suitable for genetic study of man

1) Long life-cycle of man makes it impossible to observe large no. of generations simultaneously.

2) Limited no. of offsprings and family size.

3) Ethical reasons :- Controlled breeding is ~~both~~ difficult, illegal and unethical in men.

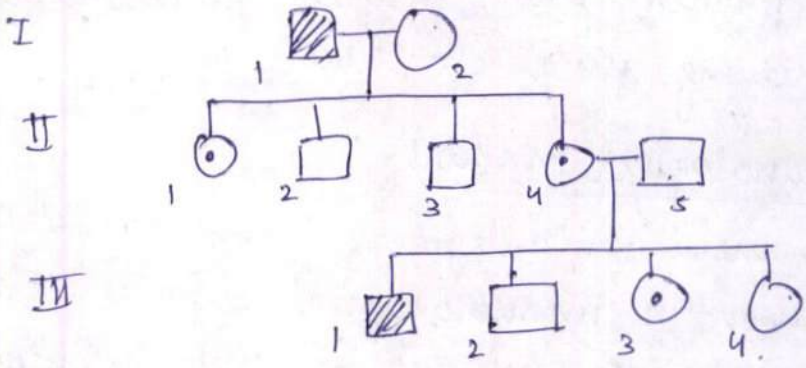
→ Therefore, we use 'indirect methods' to study human genetics. These are :-

1) Pedigree Analysis :- Pedigree charts are formed with the help of symbols & lines using data collected from family members.

→ It helps in easy ~~visualisation~~ visualisation of transmission of traits & genetic disorders from one generation to another

↳ Eg :- disorders like Haemophilia, color blindness, sickle cell anaemia etc.

Pedigree chart for haemophilia. (x linked recessive)



2) Twin study & co-twin study

↳ These are conducted on identical (MZ) & fraternal (DZ) twins to determine the influence of genetic & environmental factors in development of traits like IQ, height etc.

↳ Methods used involve concordance - discordance studies, rearing studies

↳ In co-twin method, one of the co-twin is trained in a controlled environment while the other is not

3) foster child method :- It analyses effect of heredity & environment on phenotypic traits by placing children in 3 different homes - good, average and poor homes.

4) cytogenetic & karyotype analysis

→ It refers to scientific study of number & structure of chromosomes to detect for any aberrations.

→ Numerical aberrations :- 21 trisomy (Downs syndrome), Klienfelters syndrome (XXY) etc.

→ structural aberrations :- due to translocation, inversion, duplication, deletion etc.

5) Biochemical method

→ It involves extracting biochemical molecules like protein, DNA, enzymes, hormones etc. and studying their structure.

DNA → RNA → Protein → phenotypic expression in form of traits

6) Immunological method

→ It is based on antigen-antibody reaction.

→ Variation in immunological response is found within a population due to genetic difference.

→ It is instrumental in detection & timely treatment of infectious diseases (covid-19, dengue etc.) & immuno-deficiency diseases (like IgA deficiency etc.)

7) rDNA technology.

→ It involves insertion of desired gene into the DNA of another organism using tools like plasmid vector, restriction endonuclease, ligase etc.

→ Applications :- Gene therapy, DNA probe, Monoclonal antibodies, vaccines, GM crops etc.

- **Significance of these methods.**

1) Help in understanding influence of genetic & environmental factors in development of traits.

2). Better understanding of diversity & variation in human population.

3) Timely treatment & diagnosis of genetic disorders.

4) Taxonomy :- such analysis also helps in establishing evolutionary linkage b/w different species. Eg- Anti-sera.

5) Used in DNA fingerprinting, forensic biology, paternity, settlement etc.
dispute

- **Limitations.**

1). Most methods only account for genetic or environment factors in isolation; their interaction with each other is not considered.

2). Possible introduction of harmful genes & pathogens in environment.

3) Extrapolating results from limited studies to entire population is also questioned.

4) Ethical concerns :- Privacy, consent & future use of personal data.

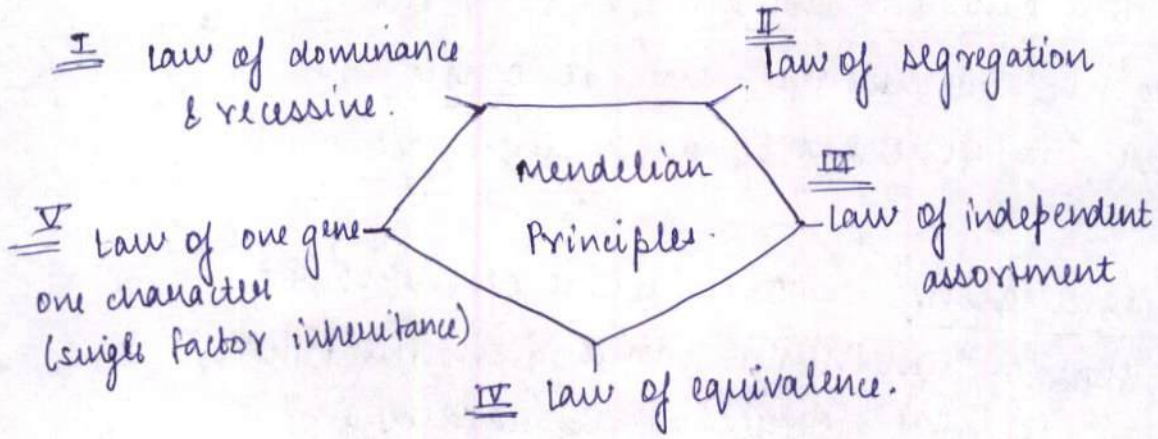
- **Conclusion**

These methods have revolutionised the field of human genetics and find applications in contemporary world - development of vaccines or tracing new variant of covid-19 etc. However, concerns ~~re~~ surrounding these methods should also be addressed.

Unit - 9.2

Q.1 Discuss the Mendelian principle & their relevance in man-family study.

- **Intro** :- Gregor Mendel conducted hybridisation experiments on pea plant in 1860s. These experiments allowed him to come out with certain laws of inheritance. These laws hold great relevance in genetic study of man; however they are not absolute. (Eg - ABO blood grouping)



- **Mendel's experiments**

I. **Monohybrid cross** :- character - height
alleles - Tall (T); dwarf (t)

a) TT (Tall) × tt (short).

Gametes :- T T t t

F_1 : Tt Tt Tt Tt] heterozygous tall.

b) Tt × Tt

Gametes :- T t T t

F_2 :- TT Tt Tt tt

Phenotypic ratio :- Tall : Dwarf = 3 : 1

Genotypic ratio :- TT : Tt : tt = 2 : 1

→ Laws :- 1) Law of dominance ~~& recessive~~ :-
Allele which expresses itself in both homozygous & heterozygous conditions is dominant (eg - 'T'), while the one which expresses itself only in homozygous condition is recessive (eg - 't')

2) Law of segregation :- when germ cells (gamete) are formed, two factors (gene) segregate such that each germ cell receives only one of the two factors.

3) Law of one gene one character :- It refers to Monogenic inheritance, that is single character is governed by only single factor (gene).

4) Law of equivalence :- Irrespective of the source of allele, that is, whether it comes from the father or mother, it will express itself equally in both the cases.

II Dihybrid cross

a) YYRR (Yellow-Round seeds) × yyrr (green-wrinkled seeds)

Gametes :- (YR) (yr)

F1 :- YyRr (Heterozygous yellow-round seeds)

b). Cross-between YyRr will result in offsprings with phenotypic ratio :-

- Yellow-Round : Yellow-Wrinkled : Green-Round : Green-Wrinkled = 9:3:3:1

→ Law :- 1) Law of independent assortment :-

Whenever two or more pairs of contrasting characters are brought together in a ~~popul~~ hybrid, the factors (genes) of different pairs segregate independently of each-other.

• Mendelian Inheritance in humans

1) ABO blood grouping :- 3 different alleles - I^A, I^B, I^O.

↳ Blood group is determined by 2 alleles.

Genotype	Phenotype
$I^A I^A$ or $I^A I^O$	A group.
$I^B I^B$ or $I^B I^O$	B "
$I^A I^B$	AB " [co-dominance]
$I^O I^O$	O "

Parents :- $I^A I^O$ X $I^B I^O$.

Gametes :- I^A I^O I^B I^O

F_1 :- $I^A I^B$ (AB.) $I^A I^O$ (A) $I^B I^O$ (B) $I^O I^O$ (O.)

2). Rolling tongue longitudinally :- This ~~ability~~ is inherited as a dominant trait

3) Tasting Phenylthiocarbamide (PTC) :-

Allele ~~for~~ tasting is dominant.

4) Autosomal dominant traits (expressed in both homozygotes & heterozygotes having that allele).

Eg:- Tongue rolling, Tasting PTC, widow's peak, dimple, Free-ear lobe, Achondroplasia. (short limbed dwarfism).

3) Autosomal recessive traits

Eg:- Cystic fibrosis, sickle cell anaemia, albinism, Phenylketonuria etc.

4) sex-linked recessive traits

Eg:- Haemophilia, Red & green color blindness

$X X^h$ — Carrier female

$X Y$ — Normal male

Gametes :- (X) (X^h) (X) (Y)

F1 :- XX | XY | X^hX | X^hY

XX — Normal female

XY — Normal male

X^hX — carrier female

X^hY — haemophilic male.

5) Sex-linked dominant

Eg:- Vit. D resistant rickets, Xg blood group.

• Applications.

1) Genetic Counselling & Pedigree analysis :-

→ Pedigree charts are formed to detect transmission of traits & genetic disorders from one generation to another.

→ Accordingly, parents can take a decision to reduce chances of hereditary diseases within their child.

2) Medico-legal applications :- ABO blood grouping can be used in settling paternity disputes upto a certain degree.

3) Medical applications :- determining histocompatibility;

Erythroblastosis fetalis :- mother Rh^- & Rh^+ father

↳ Early detection can ensure timely measure.

4) Hybrid varieties of cereals, fruits, vegetables etc.
:- more disease resistant, resistant to extreme weather, high yield etc.

Limitations.

1) Incomplete dominance :- The heterozygote condition is intermediate between dominant and recessive alleles.
↳ Eg:- In snapdragon, heterozygotes have Pink flowers (intermediate b/w red & white) / skin color in humans

2) Co-dominance :- Both the alleles exhibit themselves in heterozygous condition. Eg:- $I^A I^B$ = AB group.

3) Polygenic trait :- characters which are governed by more than one gene. don't follow Mendelian laws.
↳ Eg:- skin color, height etc.

4) Environmental effect :- Phenotype in humans, in many cases depend on environment also.
↳ Eg:- stress & diet affecting diabetes mellitus, hypertension etc. in addn to genetic factors.

5) Pleiotropy :- when one gene governs more than one character.
↳ Eg:- Sickle cell anaemia. heterozygotes have partially sickle celled RBCs & show resistance to Malaria.

6) Sex linkage :- Violates Mendel's (law of equivalence.)

7) Linkage of alleles :- In some cases, certain alleles remain linked even during segregation.

This violates law of independent assortment.

- **Conclusion**

Thus, except the law of segregation, all Mendelian laws have some exceptions in case of humans & other species. Still, they are instrumental in improving ~~human~~ public health & food security.

trait is present within family, but there's no consistent pattern.

slightly different :- It refers to traits that are determined by the combined effect of genetic inheritance, inheritance of environment & other factors.

Q.2 Polygenic inheritance in man. / 'Multifactor inheritance'

- **Intro** :- Polygenic inheritance refers to those characters which are governed by more than one pair of alleles at several loci. Thus, the trait is determined by cumulative (or additive effect of multiple genes) effect of multiple factors - multiple genes & environmental factors.

Defy mendelian laws.

↳ The study of such complex traits is dealt by Quantitative genetics.

Nilson Ehle and Fishers studied pioneered in this domain.

- **Basic Underlying Principles**

1) Role of multiple factors (Multifactor inheritance)

:- Traits are not determined by single factor (in Mendelian inheritance) but multiple alleles at different loci, ~~as well as environmental factors~~.

↳ They all have an additive effect on the trait.

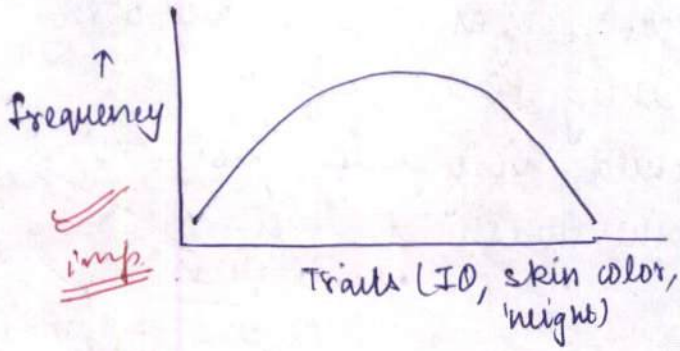
↳ Eg:- intelligence, body weight, height etc.

2) Intermediate traits :- In polygenic inheritance,

traits are not sharply marked into two extremes; but there is continuous variation b/w the two extremes resulting in many intermediate types.

↳ Eg:- Skin color.

(3) Normal distribution curve :- People having extreme traits are lower in frequency, whereas large no. of people have mean characteristics



imp

(4) Polygene threshold :- In some cases, character is expressed only when cumulative sum of polygenic genes cross a critical threshold level.

↳ Eg:- Eye color. — both parents with blue eye color can have brown eyed child if threshold for blue eyes is not crossed.

(5) Environmental Influence

• Examples of polygenic inheritance in humans

1) Skin pigmentation :- It is governed by more than one gene located on separate chromosomes.

↳ A cross between a pure blooded black (AA BB) and pure white (aa bb) can lead to offsprings having wide range of intermediate skin color.

2) Height :- It is also determined by multiple genes as well as environmental factors.

↳ Hybrid vigour is also shown sometimes :- heterozygote child is taller than both parents.

3) Other traits which are influenced by polygenes and environmental factors are :-
Intelligence, body weight, hair color etc.

↳ Disorders :- Diabetes mellitus, hypertension, Depression etc.

(4) Eye color :- It is a polygenic trait that shows threshold effect.

↳ sometimes, brown eyed children are born to parents having blue eyes. This is because, in child polygenic alleles might have crossed the threshold level.

understanding inter & intra-population variability ✓

• Applications : ✓ Better, focused screening of high risk people for early detection of diseases like cancer, hypertension etc.

✓ Effect of environment could be leveraged to suppress genetic diseases. Eg :- good diet, less stress can reduce risk of hypertension in spite of family history.

• Conclusion.

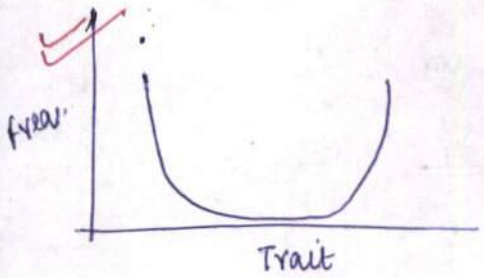
Polygenic inheritance is thus non-mendelian in nature. Most of the characteristics in humans are determined by polygenes barring a few cases where mendelian laws are applicable.

Q3 Differentiate b/w single factor & multifactor inheritance.

Single factor (Monogenic)	Multifactor (Polygenic)
(1) Only one pair of allele governs a trait. → one gene - one character	(1) More than one pair of allele at different loci determine a trait
(2) It is in conformity with Mendelian laws.	(2) Not in conformity with Mendelian laws ↳ Proved later by Nilsson Ehle & Fisher.

③ Only two extreme characteristics are expressed in the population.
↳ Eg:- either you can roll a tongue/ ~~or~~ taste PTC or not.

④ Frequency of people having extreme characteristics is high.



⑤ Influence of environment is often neglected.
↳ Eg:- Blood group type, Haemophilia

⑥ Though, it is ~~also~~ found in human beings, it is only upto a limited extent.
↳ More common in less complex plant & animal species.

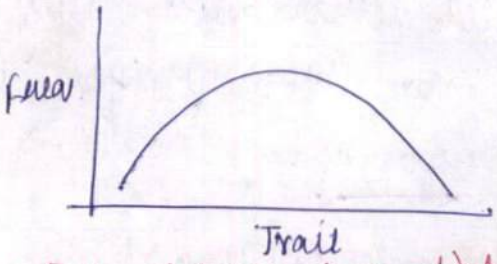
⑦ Result or trait of offsprings can be accurately determined

⑧ Traits transmitted are simpler & discrete.

⑨ Eg:- ABO blood grouping, tongue rolling, widow's peak etc.

③ Continuous variation b/w two extremes result in many in intermediate types. ↳ skin color.

④ Frequency of people having extreme characteristics is low, while, people having frequency of mean characteristics is high.



↑ Eg:- Hypertension, diabetes,

⑤ Environmental influence in determination of traits is taken into account.

⑥ Majority of traits in human beings are polygenic in nature.
→ Also found in some less complex species like drosophila

⑦ Such accuracy is not possible due to large no. of variations.

⑧ Traits transmitted are complex & continuous.

⑨ Eg:- eye color, skin pigmentation, height etc.

Q.4. what are lethal & sub-lethal genes? / categorise genes that impact human survival.

• Intro :- Certain genes can kill its possessor and hence impact human survival. These are called lethal genes. They can be categorised ~~on~~ into different types based on lethality & zygosity.

II • Categories of lethal genes.

I. Based on lethality.

1) semi-lethal :- If the gene kills the possessor after attainment of reproductive age., it is called semi-lethal.
↳ Hence, these can be passed onto the next generation.
↳ Eg:- Huntington's disease, sickle cell anaemia, Thalassemia. etc.

2) sub-lethal :- If the death of individual possessing the gene occurs in infancy or early childhood before the attainment of reproductive age, it is called sub-lethal.
↳ Eg:- Epiloia, Haemophilia.

II Depending on zygosity.

1). Dominant lethal genes :- It can cause death both in homozygosity & heterozygosity.

↳ Eg:- Epiloia, Huntington's disease.

2) Recessive lethal :- The gene can kill the possessor only in homozygous condition.

↳ Eg:- Thalassemia, haemophilia etc.

I. • Basic Principle of lethality

1) Mutation :- Lethal genes are a result of mutation of normal genotype.

Harmful nature :-

2) Interference :- They may sometimes ~~interfere~~ interfere with normal development & cause death of the individual.

3) High frequency circulation in population :- Despite their unfavourable effects, lethal genes defy natural selection & are found in high frequency.

rejection by

→ Two theories to explain this

3.1 School of Dobjhansky :- Recessive lethal genes in heterozygous conditions sometimes provide advantage.

↳ Eg:- sickle cell anaemia heterozygotes ($Hb^A Hb^S$) have resistance against malaria.

3.2) School of Muller :- Artifical reduction of natural selection due to intervention of medical sciences & socio-cultural practices.

↳ Eg:- Phenylketonuria affected person can lead a full life if fed on phenylalanine free diet.

Human Practices to counter lethal genes

1) Eugenics :- Inheritance of better genes is encouraged & inheritance of lethal genes is discouraged.
   - Eg:- Sperm-banks and selective mating through pedigree analysis etc.

2) Euphenics :- It comes into play after lethal genes have been transmitted to an individual & steps should be taken to minimise its harmful effects.
   - Eg:- 1) Gene therapy (replace defective gene by functional gene)
     2) Artificial synthesis of medicines, hormones (insulin), enzymes etc.

3) Euthenics :- Improve the quality of environment to enhance the expression of better genes & reduce harmful effects of lethal genes.
   - Eg:- 1) Phenylalanine free diet for phenylketonuria affected person.
     2) Navodaya schools for better development of intelligent students.

- Conclusion :

Thus, lethal & sub-lethal genes impact human survival. While majority of them are eliminated in course of evolution by natural selection, some still persist in high frequency due to their selective advantage & medical interventions.

Unit-9.3

Q.1 Explain genetic polymorphism & its relationship with selection.

- **Intro** :- Genetic polymorphism is defined as occurrence of more than one (form) of allele of a gene in a population such that, frequency should be greater than 1%. That is, the various of each allele forms of gene are maintained by some sort of selection & not by recurrent mutation.

- **Basic Principles** :
  1. multiple distinct phenotypes. (eg) -
  2. Discreet & discontinuous phenotypes
  3. source → Mutation, recomb., migration etc
  4. Action of natural selection → change in gene freq.

1) **Several distinct forms of a gene** :- Existence of more than one type of a particular gene resulting in more than one phenotypes.
   - Eg :- ABO blood grouping :- 3 alleles of a single gene (I^A, I^B, I^O) giving 4 different phenotypes (A, B, O & AB blood group)

2) **Discrete & discontinuous traits** :- Polymorphic traits show several discrete & discontinuous phenotypes.
   - Eg :- Tongue roller or non-roller, PTC tasters or non-tasters etc.

3) controlled by one gene / **Monogenic** :- Polymorphic traits are discrete and hence controlled by only one gene. Mendelian laws are applicable.

4) **Natural selection** :- It acts over mutation & Due to some advantage, selection sustains multiple forms of a gene resulting in polymorphism.

(4) source of polymorphism :- Primary source is mutation along with migration, genetic recombination.

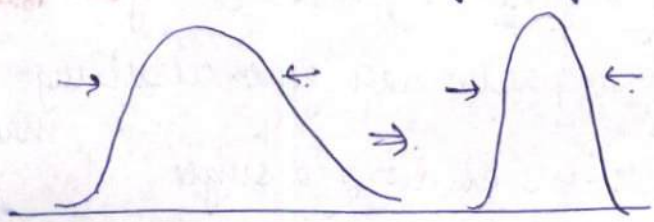
• Relationship b/w genetic polymorphism & selection

1) Monomorphism & (stabilising selection).

1.1) It refers to presence of only one form of a gene or phenotype within a population. (Eg):- neonatal mortality

1.2) It is a result of stabilising selection when individuals having extreme traits get eliminated while those with average traits are favoured.

1.3) Result is occurrence of only one type of phenotype or fewer phenotypes



Eg:- & discrete sexes (male or female) are favoured by stabilising selection.

2) Transient polymorphism & directional selection

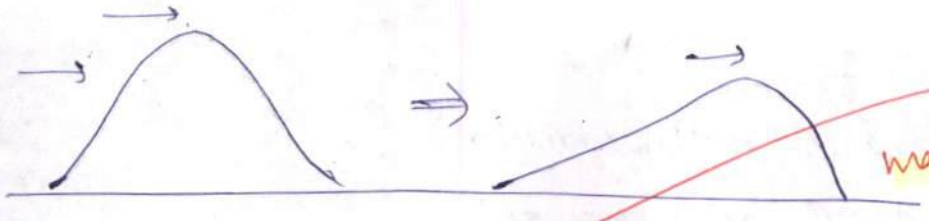
2.1) It represents changing environmental condn due to which one of the alleles of the gene pool is replacing others.

2.2) Hence, it favors individuals which can survive in changed environment and average individuals are eliminated.

2.3) Transient polymorphism is ultimately replaced by monomorphism.

Eg:- (1) Drug resistant bacterias (by Kettlewell)

(2) Melanic moths in England :- black colored moths replaced white ones when environment became polluted due to industrialisation as the former could camouflage better.



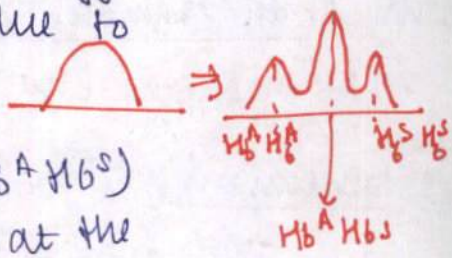
def^{n} :- 2 versions of a gene are maintained in a population because indiv. carrying both has better chance of survival than those who have copies of either version alone

(3) Balanced polymorphism & balanced selection.

3.1) It refers to a situation with multiple forms of a gene such that a balance is seen in their occurrence. (Harmful alleles are also allowed to circulate because.
↳ Heterozygote superiority
↳ Medical intervention.

3.2) This is due to presence of variety of ~~enviro~~ habitats. Therefore, multiple genotypes evolve to enhance survival.

3.3) In such situations, superiority of heterozygotes is seen over both types of homozygotes due to the selective advantage they enjoy.

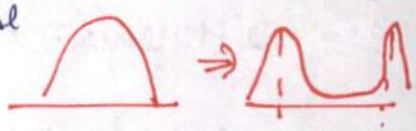


Eg:- 1) Sickle cell anaemia heterozygotes ($H_b^A H_b^S$) don't develop fatal case of disease but at the same time are resistant to malaria.

2) Thalassemia.

(4) Disruptive selection

- favours extremes ; results into polymorphism



* Advantages of polymorphism

1). Presence of several forms of a gene reduces the chances of extinction of a species in case of abrupt environmental change.

2). Variety of traits of a single character prevents overcrowding & competition within a single ecological niche.

↳ Individuals could adapt to different habitats, thus minimising competition.

• Applications / Examples.

1) ABO Blood grouping :- Multiple alleles of a single gene determines blood group.

2) Haemoglobin variants :- HbA, HbC, HbE, HbS etc. Some of these variants like sickle cell haemoglobin (HbS) provide selective advantage over normal haemoglobin

3) Genetic variability of Major histocompatibility complex :- No 2 individuals except identical twins possess the same antigens.

4) other examples include :- Lactose intolerance / tolerance; Rh grouping (+ve or -ve) etc.

• Conclusion.

Thus, genetic polymorphism is desirable to adapt to changing environment. Balanced polymorphism is the most widespread type as it has developed after being acted upon by selection for a long time.

Q.2 Differentiate b/w Monomorphic & Polymorphic traits

Polymorphic	Monomorphic
(1) Controlled by single gene but there exists several forms of that gene.	(1) controlled by many genes. Multiple forms of a gene are not found.
(2) Results in discrete & discontinuous traits / phenotypes.	(2) Graded & continuous traits / phenotypes.
(3) Mendelian inheritance applicable	(3) → " not applicable.
(4) Expression of phenotype less modified by environment	(4) Greatly influenced by environment.

④ Result of balanced selection or disruptive selection.

⑤ Eg:- ABO etc.

⑤ Result of stabilising selection & directional

⑥ Eg:- Height, weight etc.

Q.2 Explain Mendelian population.

• Intro:- Dobzhansky defined Mendelian population in his 'Genetics & the origin of species' (1951) as "A reproductive community of sexual & cross-fertilising individuals which share a common gene pool'. Eg:- A biological species including the whole of mankind.

• Why is it called Mendelian population

b. Because characters are transmitted in a Mendelian fashion from one generation to the next generation in such a population. (Law of D & R traits; Law of segregation etc.)

• Features. a) Group of individuals capable of successful reproduction through interbreeding

1) Mating between individuals occurs at random with everyone having an equal chance.

2) There is continuity of characters within the population as they are transmitted across generations.

3) Common gene pool shared by all individuals because of interbreeding.

4) In case of Mendelian population which is in equilibrium (absence of migration, mutation, selective mating etc); the resultant genotype & phenotype frequencies are more or less permanently established.

• factors affecting random mating // Mendelian population in humans

1) Geographical barriers
2) Social barriers – class, caste, religious etc.
3) Linguistic barriers.
4) Economic barriers
5) Educational barriers.

↪ random mating is not possible in human beings due to following socio-cultural barriers :–

→ Distortion in gene pool due to
- Migration.
- mutation
- natural selection induced by change in environment etc.

• Significance. (3 significance).

1) Useful in population genetics study :- genetic differences b/w & within populations.

2) Extending Mendel's laws of inheritance to human.

2 Understanding Mendel's laws of inheritance by extending them to human population.

3) wide-scale study of genotypic & phenotypic composition of for.

3) Helps in accounting variation & diversity among human population.

3. Study evolution of mankind in relation with other primates to different factors. mutation migration etc.

• Conclusion.

Thus, Mendelian population is an imp. tool in study of human genetics as well as population genetics.

Q.4 Explain the Hardy-Weinberg law.

• Intro :- British mathematician G. Hardy & German physician W. Weinberg formulated the law in 1908. It states that relative frequencies of various genes and genotypes remain constant from generation to generation in an infinitely large population in absence of migration, selection, mutation or selective mating.

→ Let two alleles of a gene be → A & a.
Frequency of occurrence of A = p.
Frequency " " " a = q.
such that p + q = 1

→ If all the males & females mate randomly their offsprings will be distributed as follows :-

Then ;

Male gametes → / Female gametes ↓	P (A)	q (a)
P (A)	p^2 (AA)	pq (Aa)
q (a)	pq (Aa)	q^2 (aa)

→ AA : Aa : aa
p^2 : 2pq : q^2
= 1 : 2 : 1

$$(p+q)^2 = p^2(AA) + 2pq(Aa) + q^2(aa) = 1$$

→ This is called Hardy-Weinberg equilibrium.
genetic equilibrium.

II • Conditions for Hardy-Weinberg Equilibrium

⇒ Equilibrium can be sustained only when no change in gene frequency occurs.

① Infinitely large population so that changes don't take place by chance.

(2) Random mating among equal no. of individuals of both sexes.

(3) No mutation is taking place.

(4) No selection forces are operative.

(5) Migration is not taking place.

(6) equal fertility of all parents, that is, no differential reproduction.

III. Examples of traits where Hardy-Weinberg law is applicable.

1) PTC tasters / non-tasters :- gene frequency must be constant as mating is random. PTC tasting is usually not the criterion for selection of mate.

2) Tongue rollers / non-rollers.

3) Attached or non-attached ear lobe etc.

include this in ⇓

PTC tasters / widow's peak etc follow H & W principle as random mating takes place; not a criterion for mate selection

IV. Limitations.

1) The ideal population which is at genetic equilibrium ~~is~~ ~~are~~ is rarely found.

2) Thus, it is a mathematical abstraction as no real population fulfills all the necessary conditions.

I. Basic Principles.

1) British Mathematician G. Hardy - - - - - - - in 1908.

2) It states that under random mating, the frequency of heterozygotes in a population will be equal to twice the product of the square root of two homozygotes.

$$f(Aa) = 2\sqrt{p^2}\sqrt{q^2} = 2pq.$$

③ If the gene pool is not initially in equilibrium, after one generation of random mating, genetic equilibrium is established & perpetuated to subsequent generation.

- - - - - Mathematical derivations on previous page - - -

IV | Significance.

1). It is a cornerstone in population genetics, as it mathematically describes the behaviour of genetic traits in a population.

2). It helps in analysing whether a population is evolving or not & at what rate. ⇒ by determining the difference in freq. of an allele at 2 point in time

At T_1; freq of A = r.
T_2; A = s.
Diff = s - r

+ve evolution in favour of A
-ve evolution against A
0 - No change / equilibrium

3). The genetic equilibrium proposed by Hardy & Weinberg also holds significance because
- 3.1) It tends to preserve the gains made in the past & prevent too rapid change
- 3.2) Allows a fair proportion of recessive genes in a population which might become useful in case of environmental change.

4). It helps to calculate specific allele and genotype. Thus, can be used, ~~to regulate~~ genetic disorders. in early detection & diagnosis of

• | Conclusion.

Thus, Hardy - Weinberg principles helps in determining the factors affecting gene frequencies & evolution rate in a population through a mathematic model.

Q.5 Explain mutation. What are the implications of mutation in evolution?

- Intro :- Hugo De Vries first emphasised the importance of mutation in evolution. It refers to abrupt change in genetic material producing an altered gene.

- **Reasons for Mutation**

1) Error in DNA duplication resulting in change in its code.
   ↳ addition, deletion or replacement of a base
   - Transition. (Purine ⇄ Purine ; Pyrimidine ⇄ Pyrimidine).
   - Transversion. (Purine ⇄ Pyrimidine).

2) Chromosomal aberration :- Altering the structure or number of chromosomes.

3) Induced mutation :- Produced through
   → Physical agents like β & γ rays.
   → Chemical agents like - Mustard gas etc.

- **Basic Principles.**

1) Mutations are mostly ~~germinal~~ recessive.
2) They can be neutral while some are lethal.
3) Mutations can be both somatic & germinal. Germinal mutations are inheritable.
4) Mutations can occur at random without any purpose.

• Effects of Mutation

1) Neutral effect :- This occurs when mutation is :-

a) Silent :- change in DNA doesn't cause change in protein.

b) Acceptable missense :- Even when change in protein occurs due to change in DNA, its functionality remains the same.

↳ Eg :- Hb-Hitkari in Japan.

2) Harmful / Lethal :- Some mutations have drastic consequences due to change in protein.

a) Partially acceptable missense :- Eg - sickle cell anaemia is lethal only in homozygous recessive condⁿ; while heterozygotes have selective advantage.

b) Non-acceptable missense :- Extreme case of protein deformation.

c) Reading frame shift Mutation :- It causes change in several proteins due to shifting of reading frame. Hence, it is deadliest of all.

3) Beneficial effect :- Some mutations enhance chances of survival in a changed environment

↳ Eg :- Heterozygote condⁿ of sickle cell anaemia ($Hb^A Hb^S$) in tropical countries is beneficial.

↳ Mutations producing high-yielding, disease resistant varieties of seeds, fruits etc.

• Significance of mutation in Evolution

1). Major source of genetic variation :- Mutation brings about variation in gene pool of a population along with genetic recombination, migration etc.

↓

2) ~~Action~~ Natural selection acts on mutation; if mutation is extremely lethal it will be eliminated; otherwise a fair proportion of mutant recessive genes will be maintained

↳ This is because, the harmful mutant gene maybe beneficial in an alternate physical or cultural environment

↓

3) Change in gene frequency :- Thus, due to combined action of mutation & selection & other forces, frequency of genes & genotypes in a population change

↓

4) Micro-evolution :- Such small changes due to mutation lead to micro-evolution.

↳ Eg :- Cold adaptions in Eskimos

5) Macro evolution :-

↳ Gradualism :- ~~large accum~~ Accumulation of these small mutations over a long period lead to sub-speciation & speciation.

↳ Punctuated equilibrium :- some believe that large scale mutation in bursts cause speciation.

• **Conclusion**

Thus, mutation is the primary cause of genetic variation. Such variation enhances

chances of human survival in a changed bio-cultural environment.

Q.5 Explain the significance of selection/ How 'natural selection' acts on variation?

• Intro :- Darwin gave the concept of natural selection and survival of the fittest in his book 'Origin of species' (1859). ~~It~~ selection refers to a mechanism through which gene pool of a population changes due to reproductive success of a particular genotype over others.

• **Basic Principles**

1) Prerequisite for selection forces to act is existence of genetic variation.

2) Some of these variations are beneficial and others harmful in a particular environment.

3) Due to struggle for existence, harmful variations get eliminated and only those with beneficial variations survive.

↳ Eg:- sickle cell anaemia heterozygotes ($Hb^A Hb^S$) survive in tropical regions due to resistance against malaria.

4) Thus, selection occurs through :-

↳ Differential reproduction & non-random mating

:- fittest individual with beneficial traits leaves more offsprings

↳ capacity of adaptation & pre-adaptation

Variation
↓
struggle for existence
↓
survival of the fittest
↓
differential reproduction
↓
change in gene pool
↓
micro & macro-evolution

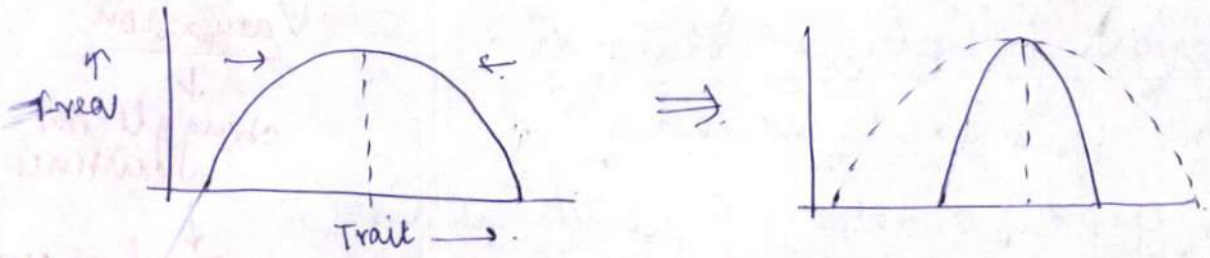
5) This leads to change in gene frequency resulting in organic evolution or speciation.

• Types of selection

1) Stabilising selection :- It removes from the population the extreme forms and favours the mean characteristics.

↳ Thus, population is mostly homogeneous and shows monomorphism.

↳ Eg :- High neonatal mortality in individuals with weights less than or more than the average 4 kg.



2) Directional selection :-

→ Here, selection favours one extreme form over all other varieties and thus change happens in that direction

→ It is also the direction of environmental change as the favoured extreme form is most adaptable in that environment.

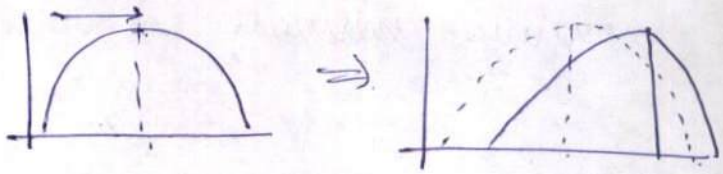
→ It is associated with transient polymorphism that gradually changes into monomorphism

→ Eg :- 1) Melanin moth experiment by Kettlewell
2) Drug resistant bacteria etc.

humans ↳ 1) selection of skin color :- temperate regions - lower melanin
↳ Tropical regions - high melanin

2) Selection of B blood group in oriental region.
often
:- more resistance to diseases in tropical areas.

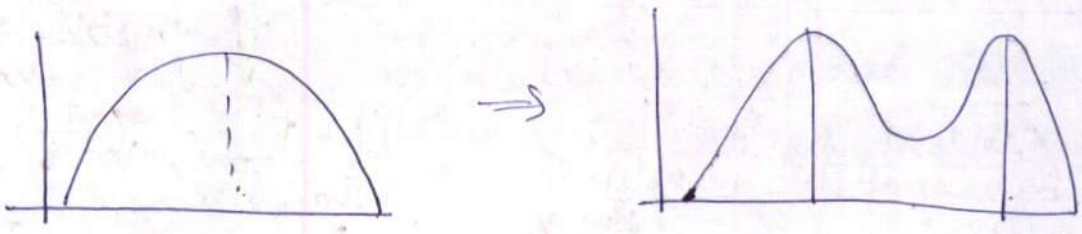
3) selection of long limbs in hot, humid climates etc.



(3) Disruptive selection

:- It favours extreme forms and intermediate forms are at disadvantage. → Polymorphism found in population.

↳ Eg:- ~~Papilio dardanus~~ Papilio dardanus or African swallow tail butterfly, some individuals mimic the distasteful species & get saved.



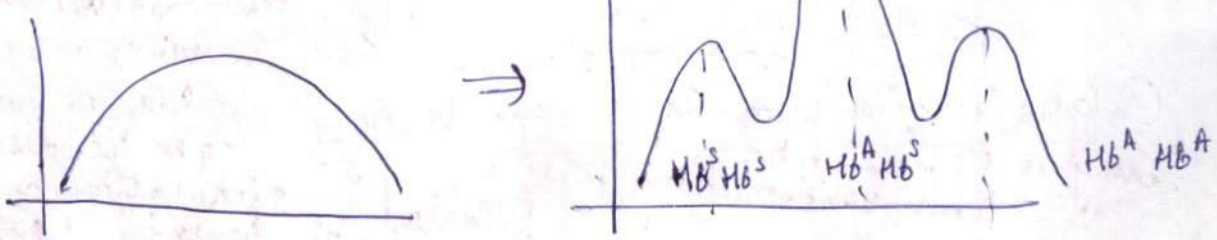
(4) Relaxed selection / balanced selection:

↳ It allows the harmful alleles to circulate in a population because :-

1) when it is in heterozygote state, it provides some advantage — Dobzhansky
↳ Eg:- sickle cell anaemia ($Hb^A Hb^S$)

2) or due to Medical intervention or cultural adaptation. — Muller

↳ Thus, it leads to balanced polymorphism - existence of multiple alleles of a gene in a population.



• Conclusion

Thus, selection along with other factors like mutation, migration, genetic drift etc. cause change in gene frequency resulting in organic evolution or speciation.

Q.7. Genetic drift.

• Intro :- Genetic drift refers to ~~random process that affect~~ sudden change in gene frequencies in a small, relatively isolated population. not attributed to mutation or natural selection.

Sewall - Wright developed a mathematical model to show role of genetic drift in evolution.

• Conditions necessary for genetic drift

↳ 1) small and isolated population.

↳ 2) Random mating

↳ 3) Freq. of at least one allele very low in original population.

$$\left(\frac{L_T}{L_0}\right) = \left(e\right)^{\left(\frac{-T}{2N_e}\right)}$$

T → no. of generations

N_e = population size.

• Causes of genetic drift ⇓ probability of genetic drift as factor of evolution.

1) Founder's effect :- Migration of a section of population to either a geographically isolated barren land or a populated land but they practice endogamy.

↳ Eg :- (a) Population that migrated to N. America through bering strait :- This explains high occurence of O blood group among native americans.

(b) Six fingered dwarfism in old order Amish :- migrated from Germany to US in 18th century (~~Philadelphia~~ Pennsylvania; few original migrants carried; inbreeding; freq. of rare genetic disorder increased sharply; not prevalent in parental population)

(c) Retinitis Pigmentosa in Tristan De Cunha. early 1800s - migrated to form British colony.

(2) Bottleneck effect :- Natural calamity removes a large proportion of original population so that genetic pool of the residual people gains eminence.

↳ Eg :- (a) spread of ITD genes in US
(b) spread of glycogen storage related diseases in SE Asia.

(3) Inbreeding among a small isolated section of population.

(4) All the individuals may not be reproducing. Thus, in a small population, with death of those individuals, there gene would be lost.

(5) Limited no. of offsprings in a small population reduces the chances of transmission of all types of alleles.

→ loss of certain alleles
↓
This also leads to evolution (changed gene freq.)

• Role of Genetic drift in evolution :-

1) Genetic drift along with selection acts on the gene pool to bring about changes in

1) formation of different gene combinations

genetic drift & selection acting on a gene pool.
↓
change in gene frequency
↓
emergence of sub-populations with different genetic combinations.

original population has low freq. of a particular trait
↓
migration of small section & inter-breeding
↓
Disadvantageous recessive genes' freq. increases
↓
change in gene pool
↓
Micro-evolution

2) Success of disadvantageous genes :- Genes which were rejected in a large population, increase in

frequency in a small population due to selective advantage in that environment.

↳ Hence, natural selection also favours that gene in the small population.

- Conclusion

---- on same lines as Q.6 ----

Q.8. Explain the factors affecting gene frequencies.

- Intro :- The genetic equilibrium as proposed by Hardy-Weinberg law ~~can~~ is not found in real populations due to frequent change in distributions of genes in the population. This is termed as change in gene frequency which results in organic evolution.

- Reasons for change in gene frequency.

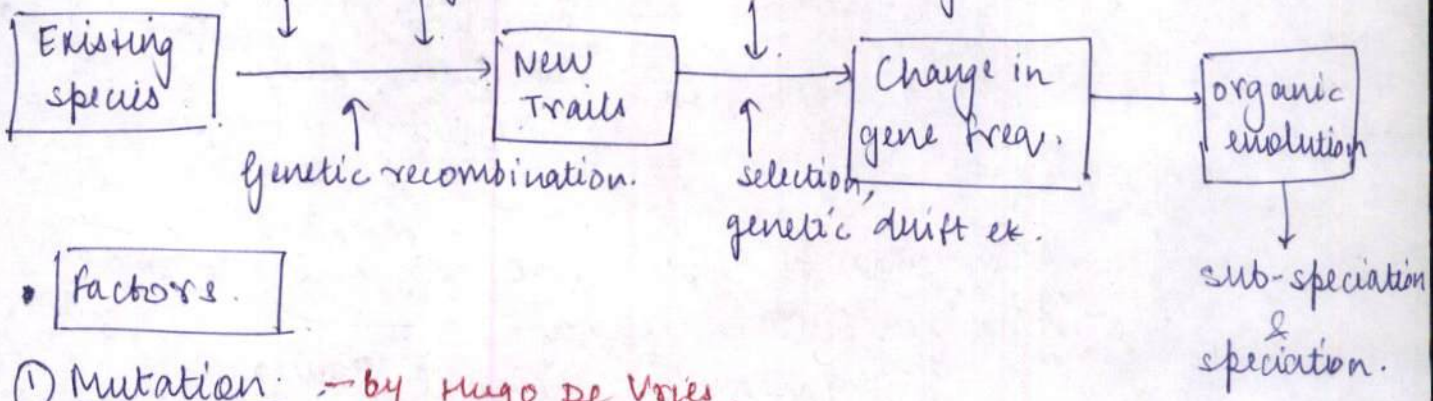
- Intro :- Gene frequency refers to distribution of different forms of a gene in a population. Contrary to the genetic equilibrium as proposed by Hardy-Weinberg law, real populations face change in gene frequency owing to many factors.

→ Genetic variation is the prerequisite for any change in gene frequency. It is caused by → 1) Mutation.
↳ 2) Genetic recombination. (Eg :- hybrid vigour)
↳ 3) Hybridisation.

→ Following factors act on these variations to bring about change in gene frequency :-

Selection — Migration/ Gene flow — Isolation — Genetic drift — Interbreeding

① Mutation ~~not~~ in race formation too imp



• Factors.

① Mutation :- by Hugo De Vries.

↳ It refers to abrupt change in genetic material producing an altered gene.

↳ Cause :- Error during DNA duplication.
↳ Chromosomal aberration.
↳ Induced mutation through physical (β & γ rays) or chemical agents. ×

↳ Feature :- Mutation ~~is~~ can be neutral & beneficial but mostly it is lethal.

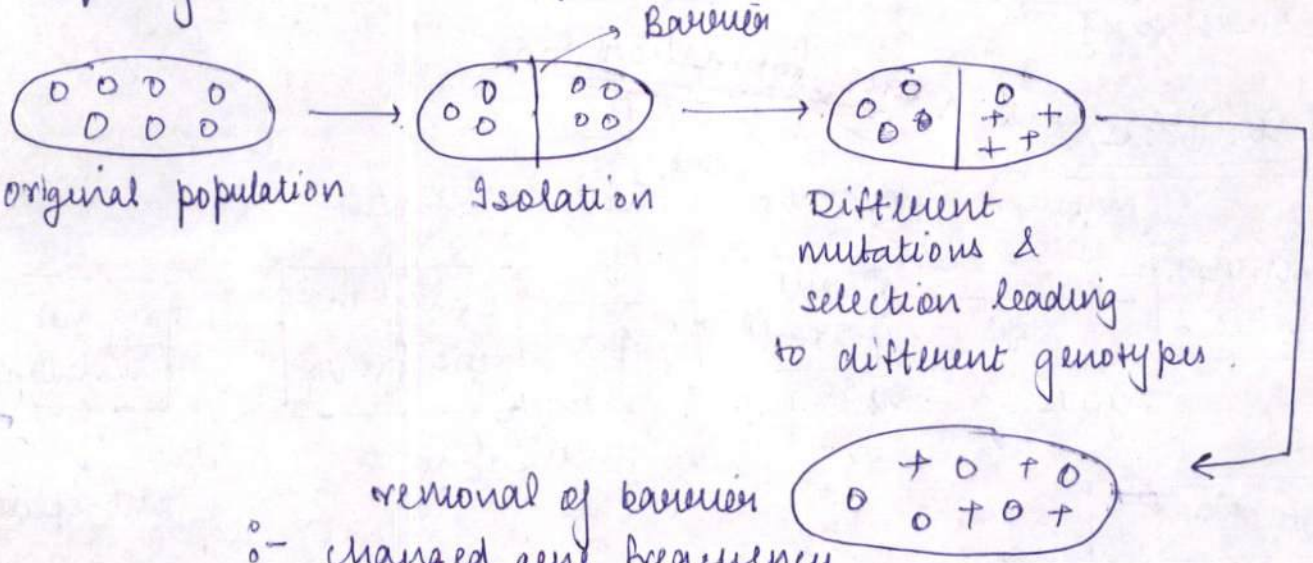
↳ Gradual accumulation of small mutations over a long period cause change in gene frequency & ultimately macroevolution.

↳ Eg of partially acceptable mutation :- Heterozygotes of sickle cell anaemia ($Hb^A Hb^S$)

② Isolation :- It facilitates segregation of a population into smaller units. These units

units don't interbreed due to various geographical, socio-cultural & behavioral barriers.

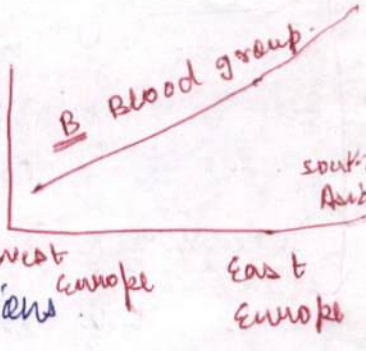
↳ This leads to formation of unique genotypes, facilitating change in gene frequency in different settings.



∴ changed gene frequency as compared to original population.

(3) Migration :- It results in gene flow from one population to another through immigration & emigration.

↳ Thus, new genes are introduced in the original population leading to change in gene frequency.



↳ Effect is more pronounced in small populations with changing environment.

↳ Eg :- Decreasing cline of Type B blood group in Europe from East to West.

(4) selection :- It refers to increase in frequency of particular genes & genotype due to their reproductive success.

↳ Thus, selection occurs in cases of :-

a) Differential reproduction :- fittest individual will produce more offspring.

b) capacity of adaptation & pre-adaptation in response to changing environment.

→ Types of selection → a) stabilising selection.
↳ b) Directional selection
↳ c) Disruptive "
↳ d) Balanced "

(5) Inbreeding :- It can lead to increase in frequency of homozygotes and relative decrease in frequency of heterozygotes
↳ It is also called consanguinity.
↳ Inbreeding can also cause expression of fatal recessive genes.
↳ Eg:- Retinitis Pigmentosa in Tristan de Cunha.

(6) Genetic Drift :- It refers to random change in gene frequencies due to natural calamity, migration or inbreeding in small, relatively isolated population.

→ It refers to random processes that can cause fluctuations in gene frequencies in a small & isolated population.

→ Causes :- 1) Founders effection :- migration of small population to barren land.
2) Bottleneck effect :- natural calamity killing large proportion of population.
3) Limited no. of offsprings etc. that result in loss of certain alleles from a population.

↳ Eg :- 1) Six fingered dwarfism in old order Amish
2) O blood group in native Americans etc.

(7) Hybridisation & ~~genetic recombination~~.

↳ It refers to interbreeding between two unrelated sub-species ~~inb~~; thus introducing new genes and changing the original gene frequency.

- **Significance of changes in gene frequency**

1) It causes organic evolution which might result in sub-speciation & speciation.
2) ~~The~~ Enhanced chances of survival. if any change in environment takes place due to presence of fair proportion of recessive genes.
3) Helps in understanding genetic & phenotypic variations among & within populations.
   ↳ Eg:- High freq. of Type B blood in oriental region. → provide greater resistance to tropical disease.
4) By keeping a tab on changes in gene frequency; ~~of~~ genetic disorders could be diagnosed & treated in a time-bound manner.

↳ It can also prevent transmission of genetic disorders to progeny :- eg- by discouraging ~~inbreeding~~ inbreeding.

- **Conclusion**

Thus, all these factors combinedly act to facilitate evolution and creation of new species & sub-species. Most of the change in gene frequency is unintentional & outside human control, thus ~~evolution~~. it supports gradualistic theory of macro evolution.

Q.9 What are the genetic effect of consanguineous & cousin marriages.

• Intro :- Consanguineous marriages are marriages b/w related individuals who have common ancestors. Inbreeding is observed in such marriages. NFHS-4 - 14% marriages in India are consanguineous marriages with majority being held in south India

→ Types of marriages

Consanguineous (inbreeding)
- ↳ Parallel cousin
- ↳ cross cousin
- ↳ Uncle-neice marriage.

Non-Consanguineous
→ outbreeding ; b/w unrelated individuals.

→ Regions of practice :- 1) Ashanti of Ghana, Trobriand islanders, Bedouin of Arabia (Parallel cousin)

2) India :- Todas of Nilgiri, Gonds (South Kautuva), other communities primarily in southern states of Tamil Nadu, Andhra Pradesh, Kerala etc.

Basu & Rizvi - more popular in S. states ; 37% in TN alone.

• Effect of consanguineous marriages on gene pool.

→ Effect varies with degree of consanguinity

→ In most societies, incest taboo is observed between :- a) father & daughter
b) Mother & son
c) brother & sister.

include in intro

→ However, cousin marriages are fairly popular.

→ Genes shared by 1st cousins = $1/2 \times \frac{1}{2} \times 1/2$

$= 1/8.$

Thus, there are one in 8 chances that they carry similar genes.

① Expression of large no. of recessive genes in the offspring :- Consanguineous marriages have greater chances of producing offsprings with homozygous recessive traits.

↳ In some cases, this leads to expression of recessive genetic disorders.

Eg:- ① Inheritance of six-fingers dwarfism by Old order Amish. (moon children).
② Inheritance of Albinism, Alkaptonuria, Tay-Sachs disease etc.
③ Retinitis pigmentosa in Tristan da Cunha.

Points - ① same
② Birth defects ↳ still birth, IMR: infant death ↳ population reduction
Basu & Roy ↳ Indian Muslims ↓ highest: mortality rate under 21 yrs among 1st cousin marriage.
③ Inbreeding depression ↳ IQ; behavioral & psychiatric disorders.
④ Loss of diversity.

② Inbreeding depression :- It refers to Deterioration of many important qualities due to inbreeding
↳ Eg:- reduced fertility, IQ, increased infant mortality etc.
↳ Eg:- Great Andamanese - sharp decline in population

④ Loss of diversity :- In the long run, recessive alleles are eliminated from the gene pool leading → to loss of diversity.
↳ This can prove detrimental in case of environment change
↳ Eg:- Resistance against Malaria of sickle cell anaemia heterozygotes ($Hb^A Hb^A$)

2014 study - Koda, Paliyan tribes of Kerala saw reducing populations due to inbreeding

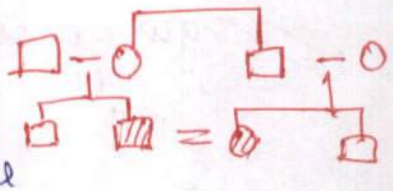
③ ~~In the long run~~ :- In populations where consanguineous marriages are a tradition for thousands of years, the incidence of recessive diseases are less.
↳ In the course of time; heterozygotes are eliminated ~~through selection~~ as well as, ~~no~~ recessive homozygotes are also eliminated as they might die at young age.

few Adv. too
1) Dominant homozygotes
2) Strengthens family ties
3) scarce resources conserv-ation.
Eg:- Bedouins

↳ Thus, there is an ↑se in proportion of dominant homozygotes ∴ ↳ offsprings with highly desirable traits.

- Comparing consanguineous and non-consanguineous marriages

↳ Eg:- Charles Darwin's parents were cousins.



I) In the short term.

↳ Consanguineous marriages lead to inbreeding depression and inheritance of recessive genetic disorders.

↳ Non-consanguineous marriages showcase hybrid vigour, that is, the heterozygotes ~~have~~ show increase in desirable traits as compared to the parents.

Format → Intro (diag / NFHS / Eg) → Harmful effect ↳ (4) points → Few Adv ↳ (3) pt. → Conclude

II) In the long run:

↳ The net result in both cases is same due to elimination of recessive homozygotes.

↳ only difference is - in consanguineous marriage, the frequency of recessive alleles would be very low.

While in non-consanguineous, recessive alleles would be present in fair proportion but they are masked by dominant alleles.

- Conclusion:

→ cultural relativism practice

→ Thus, ~~inbreeding is largely harmful~~. However, there are cases of good genes being transmitted too (eg - Charles Darwin). Socio-cultural norms are responsible for controlling the cases of inbreeding to reduce their harmful effects.

Q.10 Genetic load?

- Intro :- Genetic load is directly proportional to the number of harmful alleles in a population. It is defined as the extent to which a population departs from a perfect genetic constitution.

initially coined by Haldane as 'cost of natural selection'; Muller termed it 'genetic load' in 1950.

genetic Load (L) = 1 (fitness of perfect genotype) − W (fitness of current genetic pool).

- **Sources of genetic Load** — Mutation, Genetic drift, Inbreeding / Consanguinity, selection, migration (Gene flow)

1) Mutation :- Mutation results in development of altered genes.

1.1) higher the mutation rate; higher will be the number of recessive harmful genes and higher will be the genetic load.

1.2) lower the mutation rate; lower will be the genetic load.

(2) selection can only increase or decrease the frequency of genes in the population, it has no role in the formation of genetic load.

mention it disturbs Hardy-Weinberg Equilibrium

- **Harmful effects of genetic load**

1) Genetic diseases :- Population having high occurence of recessive harmful genes and hence high genetic load may be more susceptible to genetic disorders and death.

b Eg :- ~~Diseases like~~ Thalasemia, Haemophilia etc.

2) Decreased reproductive fitness :- Larger deviation from perfect genotype results in reduced reproductive ability of optimum genotype.

↳ This results in greater no. of individuals having less desirable traits.

Positive effects of genetic load.

1) Increased chances of survival in changed environment :- As fitness of particular genotype changes with change in environment

2) Protection from extinction :- Population with small genetic load may become extinct in rapidly changing environment. ↳ Eg :- $Hb^A Hb^S$

3) Carrying capacity of environment and self thinning :- Population with small genetic load may face high competition in an ecological niche as every individual is equally fit. → keeps population growth in check by reducing competition within and b/w species.

↳ whereas, in case of large genetic load, selection eliminates weaker individuals to increase the chances of survival of the rest.

conclusion.

Thus, contrary to the earlier belief, high genetic load is not all too harmful. It may decrease fitness of some individuals but increase the overall fitness & chances of survival of the entire population.

Unit - 9.4

Q.1 Describe chromosomal aberrations. - structural & numerical aberrations.

- **Intro :-** Chromosomes are microscopic thread like bodies present within the nucleus of a cell which carry genetic material. Any change in the structure or number of chromosomes from the normal is called chromosomal aberration. comes under the field of cytogenetics

→ **No. of human chromosomes :-** Diploid no. of chromosomes (2n) = 46 (XX or XY).

- Chromosomal aberrations
  - Structural aberrations
    - Change in gene composition (unbalanced)
      - Deletion
      - Duplication
    - Change in gene arrangement (Balanced)
      - Inversion
      - Translocation
  - Numerical aberrations
    - Euploidy
      - Triploid (3n)
      - Tetraploid (4n)
      - etc.
    - Aneuploidy
      - Monosomy (2n-1)
      - Trisomy (2n+1)
      - etc.

- **Structural aberrations.**

→ It involves change in chromosome structure through addition, deletion or rearrangement.

⇒ It can be broadly classified into :-

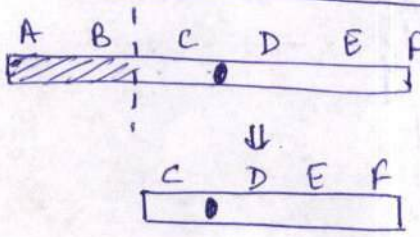
1) **Unbalanced structural change** :- net loss or gain of chromosomal segments ; greater chance of abnormal phenotypes.
2) **Balanced structural change** :- no net loss or gain of chromosmal segments ; only rearrangement takes place. ; chance of abnormal phenotypes is less.

↳ Types

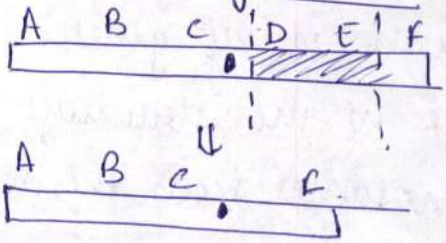
1) **Deletion** :- loss of a chromosomal segment.

↳ This leads to loss of genes. Loss of genome can be sublethal or lethal.

1.1) Terminal deletion



1.2 Intercalary deletion



↳ Disorders :- a). Cri-du-chat syndrome :- deletion on the short arm of chromosome 5.

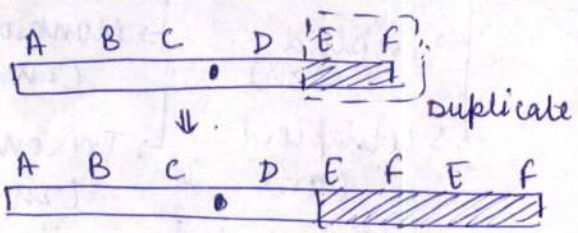
b) Philadelphia 22 :- deletion in chromosome 22.

2) **Duplication**.

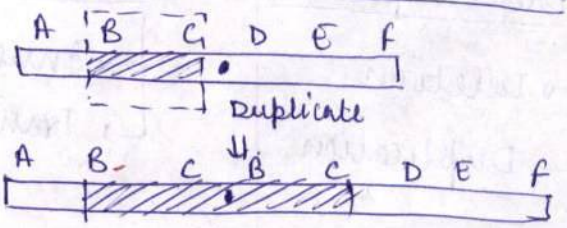
↳ Presence of an additional chromosomal segment due to error in homologous recombination.

↳ Hence, extra copies of genes are present leading to formation of excess protein.

2.1) Terminal duplication.



2.2) Intercalary duplication



↳ Disorders :- a) Charcot-Marie-Tooth disorder

:- duplication in short arm of chromosome 17.

↳ Motor & sensory neuropathy.

b) Pallister killian syndrome :- extra segments of chromosome 12.

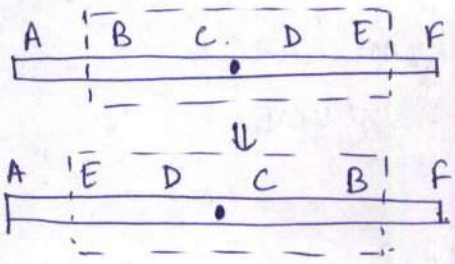
3) **Inversion**.

↳ It refers to orientation of a segment of chromosome in reverse direction.

↳ This causes change in order of genes; no loss or excess of genetic material

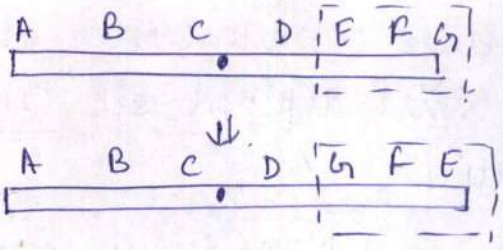
↳ 2 types based on position of centromere :-

3.1) Pericentric.



Inverted segment contains centromere

3.2) Paracentric



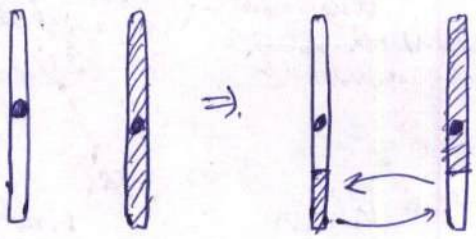
↳ since, it is balanced structural change; except in rare cases, individuals don't show abnormal phenotype.

4) Translocation.

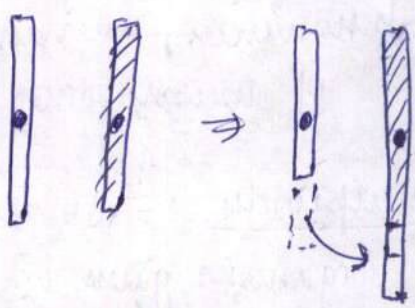
↳ It involves exchange of ~~chromosomal~~ segments between two non-homologous chromosome.

↳ There is no loss or excess of genetic material.

4.1) Reciprocal translocation.



4.2) Non-reciprocal translocation



↳ Disorders :→ Down Syndrome :-

translocation b/w chromosome 14 & 21.

↳ Translocation b/w chromosome 11 & 22 is fairly common.

↳ Usually, individual showing balanced structural change (inversion or translocation) don't show any abnormal phenotypes themselves.

↳ However, there is possibility that abnormality

will appear in their progeny / offsprings due to disturbance during meiotic segregation.

- **Numerical aberrations**.

↳ A change in number of chromosomes from the normal diploid set (2n) is called numerical aberrations.

↳ causes :- 1) Non-disjunction of chromosomes during meiosis.

2) Translocation induced disturbance during meiotic segregation.

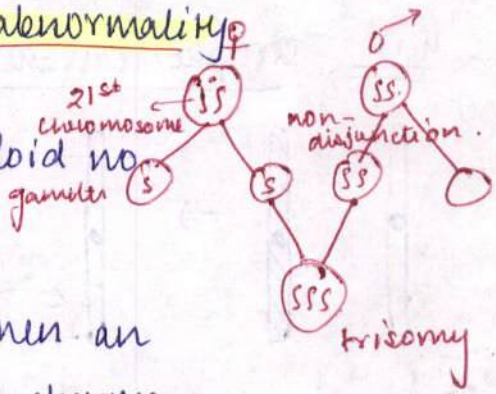
→ 2 types :-

I. Euploidy :- when an organism gains or loses one or more entire set of chromosomes.

↳ Eg :- → ~~Ha~~ Triploid (3n)
↳ Tetraploid (4n)
↳ Polyploid (5n, 6n - - - etc.)

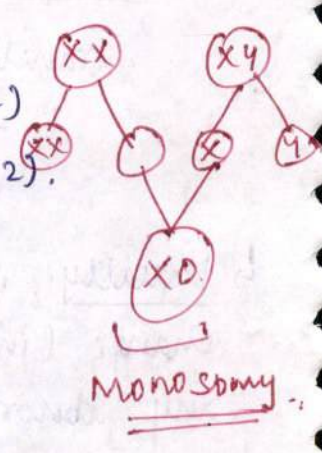
↳ Euploidy conditions normally do not exist in humans because the extent of abnormality is too large to sustain life.

↳ However, human gametes have haploid no of chromosomes (n).



II. Aneuploidy :- It refers to condition when an organism gains or loses one or more chromosomes and not the entire set.

↳ Eg :- Monosomy (2n-1) ; Nullisomy (2n-2)
↳ Trisomy (2n+1) ; Tetrasomy (2n+2).



↳ **Genetic disorders** :-

a) Down syndrome :- Trisomy 21.
b) Patau's syndrome :- Trisomy 13
c) Edward's syndrome :- " 18.

d) Klinefelter's syndrome :- Trisomy of sex chromosomes :- XXY.

e) Turner's syndrome :- Monosomy of sex chromosome [45 (X)].

• Control & prevention

- There are no suitable cure for diseases caused by ~~genetic~~ chromosomal aberrations.
- However, their occurence could be prevented through :-

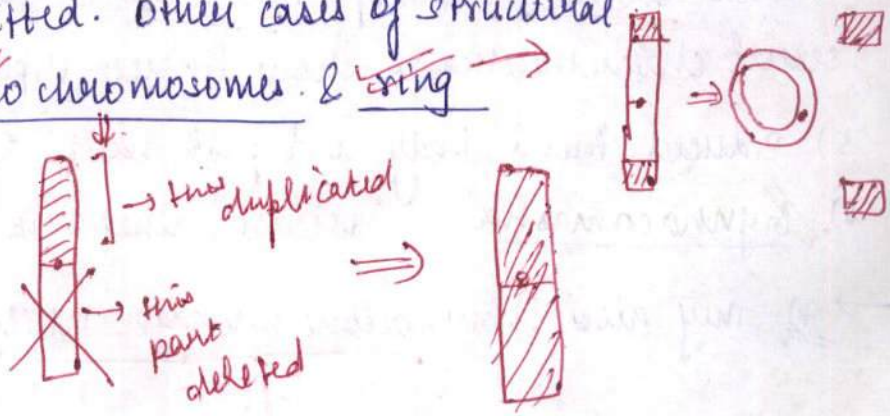
(i) Genetic counselling :- Identifying whether a person has some kind of chromosomal abernation that can be transmitted to the offspring.

(ii) Cytogenetic or karyotype analysis :- This can be done during foetal stage by taking samples of amniotic fluid and accordingly termination of pregnancy could be suggested.

(iii) Biochemical analysis can also be used during foetal stage.

• Conclusion.

Due to lethal nature of chromosomal abernations, the individuals usually die before attaining reproductive age in most cases. Therefore, they are not transmitted. Other cases of structural abernations include iso chromosomes & ring chromosomes.



Q.2 Klinefelter's syndrome.

- **Intro** :- It refers to trisomy of sex chromosome such that there is an additional X chromosome in males (XXY) causing abnormal sexual development. They have normal life expectancy.

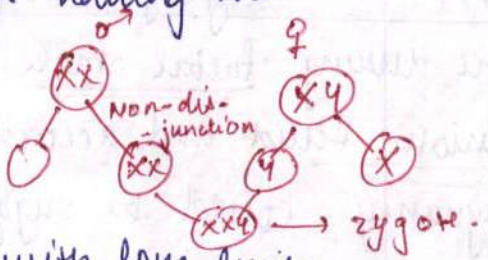
→ It was first described by Harvey Klinefelter in 1942.

- **Source of extra X chromosome (s)**

↳ It arises due to non-disjunction during meiosis. → The extra X chromosome can be either of maternal or paternal origin, but mostly its the former.

↳ As a result, the female gamete containing two XX rather than one, ~~fertilisis~~ gets fertilised by the sperm (Y).

↳ This results into ~~the~~ zygote having the karyotype, 47, XXY.



- **Features**

1). They are outwardly males, with long limbs.

2). They show hypogonadism; hence infertility.

3) Testes are infantile, characterised by azoospermia. (failure to produce sperms).

→ Secondary sexual characteristics

4). Due to presence of barr bodies (extra X) these males do not develop masculine secondary sexual characteristics & show female-type features.

5) Reduced facial, body and pubic hair.

6) Gynnacomastia :- breast development

→ 7). They also show below average intelligence

- **Types of klinefelters syndrome.**

1) Klinefelters syndrome I (47, XXY).

↳ Hypogonadism, mental disability etc.

2) Klinefelters syndrome II (48, XXXY)

↳ increased physical and mental disability

↳ They also show prognathism.

3) Klinefelters syndrome III (49, XXXXY)

↳ More marked and extreme mental & physical retardation.

↳ More marked prognathism.

- **Frequency & associated genetics**

↳ Frequency is around 1 in 1000 live births

↳ Frequency also increases with increase in maternal age as non-disjunction is more common then.

↳ Normally, it is not transmitted to next generation due to associated sterility.

- **control & prevention.**

---- same as 0.1 ---

- **Conclusion**

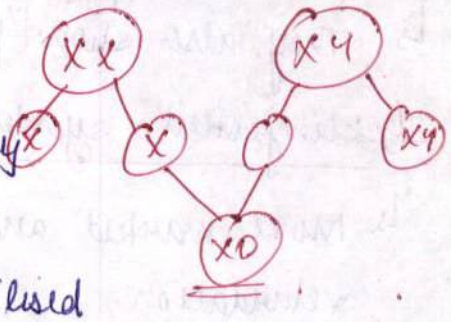
There are other syndromes due to numerical sex-chromosomal aberrations too. All of them cannot be cured, but we as a society can provide them a normal life through greater sensitisation and removal of prejudices.

Q.3 Turners syndrome.

- Intro :- It refers to partial or complete absence of one x chromosome in females resulting in the karyotype - 45, XO. It is associated with abnormal sexual development in such females.

- Causes.

1) Non-disjunction during meiosis, mostly the source of origin is paternal.
   ↳ As a result, when ovum (X) is fertilised by a sperm containing no sex chromosome, zygote having karyotype - 45, XO is formed.



2) Other causes include mosaicism, deletions, isochromosome etc.

- Features.

1) Hypogonadism - poor ovary development.
2) Sterility due to inability to produce gametes
3) Amenorrhea - absence of menstruation.
4) Short stature and outwardly female.
5) Reduced development of female secondary sexual characteristics.
6) Shield-like chest & minimal breast development.
7) Webbed neck; cubitus valgus
8) Heart malformation & greater risk of heart ailments
9) Intelligence level is average and mental retardation is uncommon; mild form of mental disability can be found in some cases.

- **Frequency & associated genetics**

→ Frequency is 1 in 2500 live birth; lower than Klinefelters syndrome.

→ No relation to maternal age as source of disjunction is usually the father.

→ Though, only one X chromosome is active even in normal female; there is a small subset of genes on barr body (inactive X chromosome) which are required for development of normal sexual characters

→ Hence, in case of Turner's syndrome, there is absence of normal female sexual development

- **Cure & prevention**

→ No suitable cure as such, however therapy with estrogen can allow adults to develop secondary sexual characteristics and lead a normal life (though sterile).

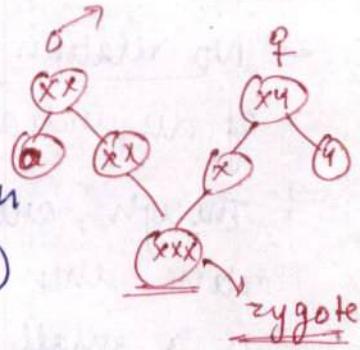
→ --- same as Q.1 for prevention ---

- **Conclusion**

---- on same lines as Q.2 ---

Q.4 Super-female (XXX).

- Trisomy of sex-chromosomes; karyotype -47, XXX
- They are normal living females and may also give birth to normal children.



→ Causes :- disjunction during gamete formation (origin can be both maternal or paternal)

→ Features :- 1) These are normal female females; many show few or no symptoms at all.

2). Flaccid muscles.

3) Tall stature

4) Kidney abnormalities & seizures in some cases.

5). Delayed development of speech & language skills as well as motor skills

6). Mental retardation & learning disability.

→ Frequency :→ 1/1000 live births

↳ increased with ↑se in maternal age.

↳ chances not transmitted.

→ Treatment & prevention.

↳ No permanent cure, learning disability can be countered through ↑sed assistance & counselling

↳ Genetic counselling & karyotype analysis. - Diagnosis.

→ Conclusion

↳ on same lines as Q.2 - - -

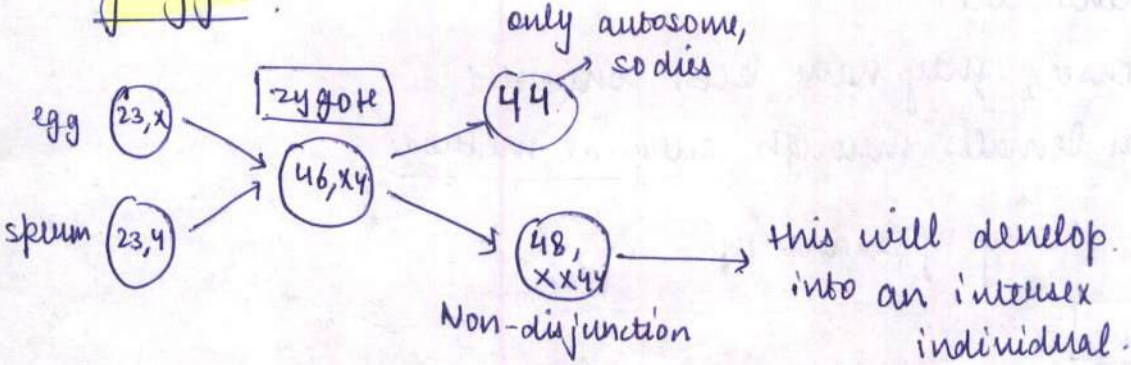
9.5 Intersex / Mosaics.

• **Intro** :- Intersex or mosaics refer to individuals whose sexual anatomy doesn't entirely fall into the 'male' or 'female' category.

→ **Cause** :→ 1) Intersex usually have people more than one cell line with different genotypes.

2) That is, while some cell have normal number of chromosomes, others have losses or gains

3) It is caused due to non-disjunction of chromosome during early mitotic division of zygote.



• **Features**.

1) They have both male & female characteristics

2) They might be more masculine or more feminine depending on what is their predominant genotype - XX or XY.

↳ This can be analysed through presence or absence of barr bodies.

3) Male Pseudohermaphrodite :- undescended testes, small penis

↳ rudimentary vagina, presence of breasts.

(5) Female pseudo hermaphrodites :→ underdeveloped ovaries; infantile uterus & vagina
↳ rudimentary penis; little breast development.

(3) Intersex may be of two types :-

3.1) Gynandromorph / Hermaphrodite.

3.2) Pseudohermaphrodite :- partly male & partly female.

(6) They also secrete both male & female hormones.

- **Frequency** :- 1 in 1000-1500 live births
- **Treatment & prevention**

→ No permanent cure

→ In some cases, they have been converted to males or females through surgical methods.

→ Diagnosis - Karyotype analysis.

- **Conclusion**

- - - - same as Q.2 - - -

Q.6 Other disorders due to sex chromosome abnormalities.

1). Fragile X syndrome.

→ Genetic composition is normal :- 46, XY or 46, XX.

→ caused by :- change in gene FMR1 located on X-chromosome; usually inheritable.

→ Both male & female can be affected but males have greater symptoms because they have only 1X.

→ Feature :- 1) large head & ears.
2) prominent chin
3) larger testes in males.
4) Mental ~~rtd~~ retardation; delayed learning.

→ Treatment :- counselling etc.

2) Chimera :- Individual possess more than one type of cell lines due to development from two or more zygotes.
↳ The phenotypic variations or abnormalities are subtle.
↳ If zygotes were of opposite sex; it may result into intersex having both male & female sex organs.

→ Thus, they have have cells with different genotypes & DNA sequence.

↳ Occurence :- 1) During in-vitro fertilisation.
2) DZ twins of opposite sex :- female zygote may receive testosterone from male embryo.
3) People undergoing organ transplantation.

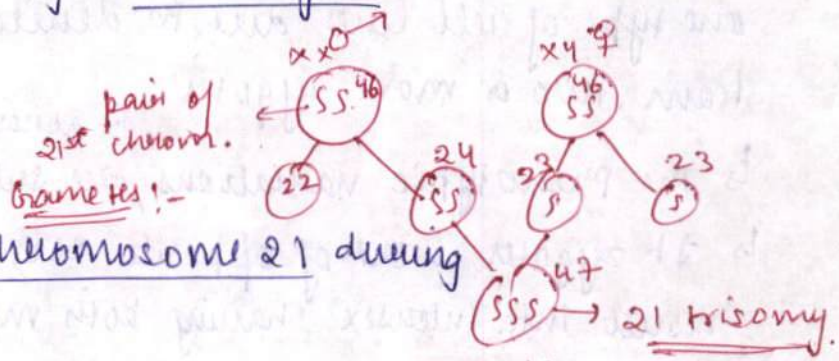
3) XX males.
→ Genotype = 46, XX;
→ Cause :- Accidental crossing over → some male determinants transferred from short arm of Y to X during paternal meiosis.
→ Feature :- 1) testicular development
2) masculine secondary sexual characteristics
3) azoospermia; sterile
4) avg. intelligence

Q.7 Down syndrome.

- **Intro** :- Down syndrome is characterised by 21 trisomy, that is presence of an extra 21 chromosome making the karyotype - 47, XX/XY + 21. It is also called 'Mongolian idiocy' due to pseudo resemblance with mongolian features.

→ It was first described by John Langdon Down in 1866.

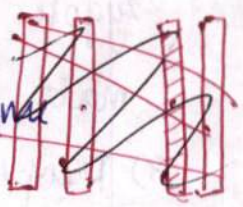
- **Cause**



(1) Non-disjunction of chromosome 21 during gamete formation.

↳ Though source of disjunction could be both maternal or paternal, in most cases it is maternal.

(2) Translocation :- It is caused due to translocation b/w or fusion of chromosome 14 and 21.



↳ Thus, there are 2 normal chromosomes 21, 1 normal chromosome 14 & 1 large chromosome formed due to 14-21 translocation.

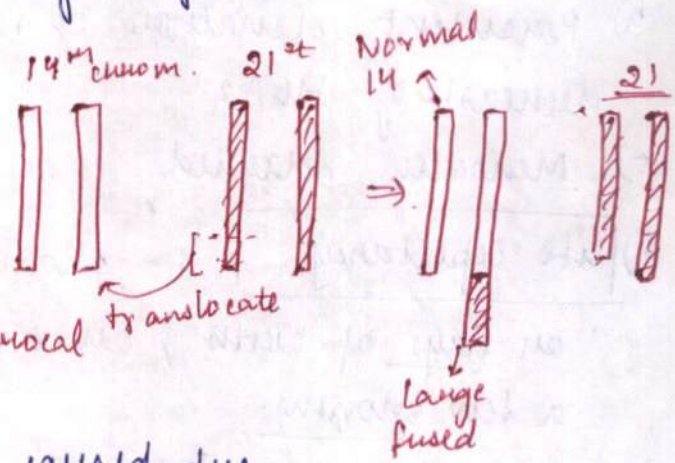


- **Features** Pseudo-Mongoloid features :-

1) Flat face, round head and epicanthic fold of the eyes
2) Short stature
3) Short and stubby hands with simian crease.
4) Protruding furrowed tongue.
5) Severely low BP at the time of birth.
6) Hypotonia - poor muscle ~~tone~~ tone

7). Mental retardation and developmental disabilities. 8) congenital heart deformities

- **Frequency** :→ 1 in 700 live births.
  - ↳ Non-disjunction since is associated more with maternal gametes, its possibility ↑es with ↑ing maternal age.
  - ↳ **Life expectancy** :- Nearly 50% of the patient are dead by the end of 1st year.
    - ↳ Few survive longer.



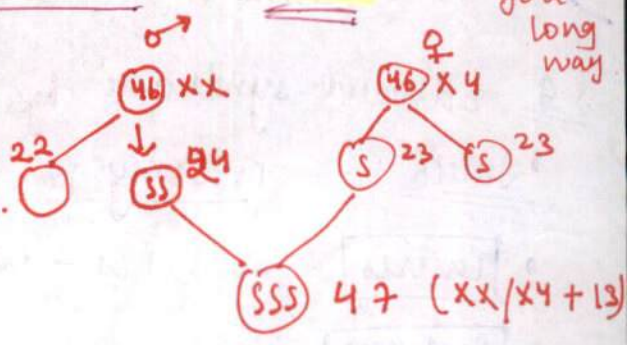
- **Treatment & prevention**
  - Diagnosis — 1) cytogenetic & karyotype analysis
    - ... same as Q.1
    - 2) Genetic counselling
- **Conclusion.** 3) Learning assistance & counselling.

Downsyndrome is thus caused due to autosomal aberration in chromosome 21. It is more tolerated due to chromosome 21 having small amount of gene rich region, engaged in synthetic activity.

Case study :- Zainika Jagasia, a 19 yo girl with down syndrome has become a successful baker and model despite her disorder. Thus, showing right societal attitude can go a long way.

Q.8 Patau syndrome. by Klaus Patau in 1960

- Intro :- Trisomy 13.
- **Cause** :- 1) Non-disjunction
  - 2) Translocation. → Diagram



- **Features**
  1). Deformed hand & feet; more than 5 fingers
  2) flexion & overlapping of fingers

(3) Hair lip & cleft palate
(4) sloping forehead & deformed appearance of face.

→ Health & life expectancy

1) eye defects
2) congenital heart malformation.
3) Neutrophils showing sessile projections in the nuclei.
4) Persistent elevation of HbF and significant decrease of HbA2.
5) Mentally retarded
6) **Life expectancy** :- short; die within hours or days of birth; or may survive upto a few months.

- **Frequency** :- 1 in 2200 live births
  ↳ Moderate effect of maternal age.
- **Treatment & Prevention**

--- same as Q1 ---

- **Conclusion**

--- same as Q. 7 ---

Q.9 Edward syndrome. by John H. Edwards in 1960

- Intro :- Trisomy 18.
- **Causes** :- 1) Non-disjunction 2) ~~Malfunction~~ Translocation.
- **Features** :-
  1) small triangular ~~face~~ mouth.
  2) flexed hand & fingers
     ↓
     bent or tight.

3) Malformation of intestine
4) Arches on 6 or more fingers fingerprints
5) abnormal occiput (back of the head)
6) low-set and malformed ears.
7) Congenital heart defects.
8) Mentally retarded.
9) **life expectancy** :- few hours or days to few months ; females survive better than males.

- **Frequency** :- **1 in 4500** live births
  - is more uncommon.
  - moderate maternal age effect; not as great as down's syndrome.

---- Rest same as Q. 7 ----

Q.10 Cri-du-chat syndrome. - by Lejeune in 1963

- Intro :- Cri-du-chat is characterised by deletion of part of short arm of chromosome 5. Thus, it is a type of structural aberration. It literally means cry of cat.



- **Cause** :- 1) Deletion :- loss of chromosomal segment leading to loss of genes.
  - short arm (p) of chromosome 5
  - This can be due to error during crossing over.
  2) Balanced translocation in parents might lead to offsprings that might have deleted or duplicated chromosomal segments.

• **Feature**

1) Peculiar weak cry which closely resembles meowing of cat.
2) Baby is weak & small.
3) Microcephaly - exceptionally small head.; small jaw.
4) Outward & downwardly slanting palpebral fissures of the eye.
5) wide-spaced eyes.
6) Mental retardation.; slow development of skills
7) **Life expectancy** :- only few survive while most die within few months or years.

• **Treatment & prevention**

------ same as Q.7 ----

• **Conclusion**

--- Q.7 ---

• **Fuequency** :- 1 in 25,000 live births.

↳ incidence is seen more in females despite it being autosomal

Q.11 what is genetic imprinting

• Intro :- Genetic imprinting ~~is a condition~~ refers to a mechanism where male and female parents stamp their genes with their marking, so that ~~they~~ genes from 2 sources behave differently in the offspring despite controlling the same character.

→ **Exception to Mendel's law of equivalence**

↳ Genetic imprinting gives importance to source of genes.

↳ while Mendel's law of equivalence suggested that behaviour of genes doesn't depend on whether it comes

from the father or mother.
↳ Hence, it's an exception to law of equivalence.

• Cause and Mechanism of Genetic imprinting

1) Methylation :- There is differential DNA methylation in females and males.
↳ DNA on genes coming from mother is usually more methylated than gene coming from father.
↳ Greater is the degree of methylation, lesser is the chances of its earlier expression.

2) Mechanism :- During gamete formation, both the parents stamp their genes differently.
↳ when zygote is formed through fertilisation, the genes will carry the marking indicating their source of origin.

• Characteristics of genome imprinting

1) Genes which are ~~imprint~~ imprinted express differently
:- Difference can be in → magnitude of expression.
↳ timing of expression.
↳ behavioral difference - whether it has enhancing effect or retarding effect.

2) It is erasable :- An offspring might receive genes having maternal & paternal marking. But such marking gets erased when offspring forms its own gametes which carry his own new stamp.

3) Most commonly found in mammals & flowering plants which directly nourish their embryo.

4) It is species-specific, i.e., genes which are imprinted in one species may not be imprinted in other.

5) It is not a rule and is found only in some of the male and female genes.

• Genetic imprinting in human diseases

↳ It is commonly observed that some traits / diseases despite being autosomal express differently in males & females. This is due to genetic imprinting

① Huntington Chorea :- Autosomal dominant disease.
↳ Time of initation of symptoms & severity of disease will be different depending on whether the genes are paternal or maternal

② Angelman syndrome :- maternal copy of chromosome 15 is marked differently.

③ Prader-Willi syndrome :- Paternal copy of chromosome 15 is marked differently.

④ Other diseases :- embryonic tumors, cancer, Fragile X syndrome etc.

• Theories of Genetic imprinting

1) Adaptive nutrition theory :- It suggests that genetic imprinting evolved due to conflicting demands of nutrition of paternal & maternal genes
↳ Paternal genes get imprinted to obtain more and more nutrition for the embryo ; while reverse is true for maternal genes.

paternal genes imp. for development of placental tissue thus,

(2) Prevention of parthenogenesis theory

↳ Parthenogenesis can eliminate male genes & hence genetic variability from population.
↳ Hence, imprinting evolved to prevent that.

- **Significance**

1) Helps in identifying source of allele.
2) This can further help in understanding the extent of severity due to imprinted gene & take adequate measures.
3). More understanding regarding different expression of diseases in different sexes.
↳ This can aid in genetic counselling

- **Conclusion**

Thus, genetic imprinting is necessary for nourishment of embryo, genetic variability & enhanced chances of survival of the species.

Q12 Genetic screening.

- Intro :- Genetic screening refers to the process of testing an individual or a population for genetic diseases in order to prevent transmission of such defective genes to the next generation.

→ It ~~is a~~ along with genetic counselling is an important part of public health programs in developed countries.

• Types of screening

1) Mass screening :- screening for the whole population.

2) High risk/ selective screening :- screening of people belonging to high risk group.

3) Individual screening :- This includes the person himself, any of his relatives or the foetus

Eg:- case study :-

↳ Recently, importance of foetal screening is amplified after London court admitted a case concerning a patient of spina bifida whose birth could have been prevented if correct counselling was given at foetal stage was given to her mother.

→ won legal battle (Evie Toombes)

sued doctor - mother's if she would have advised correct supplements; her disorder could have been prevented.

• Methodology of screening

→ Various tools used in genetic screening :-

1) Pedigree analysis
2) Cytogenetic & karyotype analysis
   ↳ Eg:- Down's Syndrome.
3) Using genetic markers and genetic probes.
   ↳ Eg:- Detection of sickle cell anaemia.
4) Prenatal diagnosis
5) Biochemical & immunological analysis.

→ Criteria for screening test

① Test must be acceptable to people.
② It must be repeatable for ensuring greater reliability & precision.

3) It should be cost effective.

4) It should be accurate

5) Other criterias like safety & ease of administration should also be given due consideration.

- **Significance**

1) Prescriptive screening :- Helps in detecting unrecognised genetic diseases ~~in the family tree~~ in an individual.

Ls Eg:- Cancer, Phenylketonuria. (US & Canada)

2) Prospective screening :- early diagnosis of genetic disease within the family line. Hence proper treatment & genetic counselling could be seeked to reduce the incidence or transmission of such diseases.

3. Individuals can make informed medical & lifestyle decisions.

4) Reduced risk of developing a particular disease (eg - cancer) through early measures.

- **Limitations**

5) Costly

1) Issues of privacy, confidentiality & future use of data.

2) Psychological stress to an individual who was not previously aware of an Ised risk of developing a disease

3) Failure to differentiate b/w neutral mutations & a disease state in some cases.

4) Low social & behavioral acceptance of test results.

- **Conclusion**

Thus, genetic screening has immense potential in improving public health. More so, after recent advancements in molecular biology & rDNA technology.

Q.13 Genetic counselling.

- Intro :- Genetic counselling is the process of advising affected or at risk individuals & families about the genetic disorders to help them understand & better adapt to the medical, psychological & familial implications.

→ case study :- Spina Bifida

- **Process of genetic counselling**

Genetic screening using tools like pedigree analysis, karyotype, biochemical analysis

↓

Diagnosis of genetic diseases or defective gene

↓

Recurrent risk estimation of diseases in next generation.

↓ with

Communicating and advising the individual or family (discuss the options).

↓

Preventive measures or treatment if available

- **Tools & methodology for diagnosis**

1) Pedigree analysis :- analysing family history and inheritance pattern of various genetic diseases; identifying carrier of the disease.

2) Cytogenetic or karyotype analysis :- This could even be done in foetal stage through amniocentesis to identify for some diseases like - Down's syndrome etc.

3) Biochemical analysis :- can be used to detect sickle cell anaemia etc.

- **Basic principles**

1) Increase a family's understanding of their genetic condition.

2) Discuss available options regarding preventive measures or possible treatments to minimise the risk of disease development.
   - Eg:- Termination of pregnancy in case of serious chromosomal aberration etc

3) Keep careful record of the individual's family history.

4) Help the individual & family to better cope medically, psychologically & economically.

5) Avoidance of value judgement by the counsellor.

6) Allowing the family involved to take the final decision.

- **Significance**

1) Prospective counselling :- identify defective genes

through diagnosis and suggest measures to prevent expression of genetic disorder within the progeny - medical & ~~env. of~~ lifestyle change options
↳ Eg :- BP.

2) Retrospective counselling :- identify hereditary disorders within a family line and suggest appropriate measures to prevent its occurrence.
↳ identification of carriers. Eg :- Haemophilia, color blindness
Timely
3) Treatment of certain disorders through socio-cultural & environmental interventions
↳ Eg :- Phenyalanine free diet for people suffering from phenylketonuria.

• Limitations.

①, ②, ③ & ④ of Q.12 ---
↓
low social & behavioural acceptance of advice rendered.
↳ Eg :- Counsellor cannot & should not advice women to marry; ultimate decision is of the individual.

• Conclusion.

---- same as Q.12 ---

Q.14 Human DNA profiling / DNA fingerprinting

• Intro :- It is a process of identifying an individual through his unique DNA fragments → set of
~~characteristics~~. It founds applications in criminal investigations, ~~paternal~~ parentage disputes etc.

→ The technique was first developed by Alec Jeffreys in 1984.

Case study :-
~~Connor~~
Coonoor helico-pter crash.
↓
martyred soldiers identified using DNA fingerprinting

- **Basic underlying principle**

1) DNA consists of coding & non-coding regions.
2) Non-coding regions since don't contribute in protein synthesis; mutations accumulate in them.
3) This causes variation in DNA of every individual. This genetic variation is the basis of DNA profiling

(a) Variable Number of Tandem repeats (VNTR):-

(5) In every individual short DNA sequences exist as tandem repeats.
↳ However, VNTR pattern, that is size & no. of such repeats is unique in every individual.

(b) Restriction Fragment Length Polymorphism (RFLP):- Since there might be change in certain base pairs of DNA of different individuals, when restriction endonuclease act on them, DNA fragments produced are of different lengths.
→ Since DNA sequence differs among individuals, DNA fragments of different length are obtained through action of restriction endonuclease.

- **Methodology**

1) Extraction of DNA from a biological sample like semen, hair, blood etc.
2) Amplifying the DNA available through PCR.

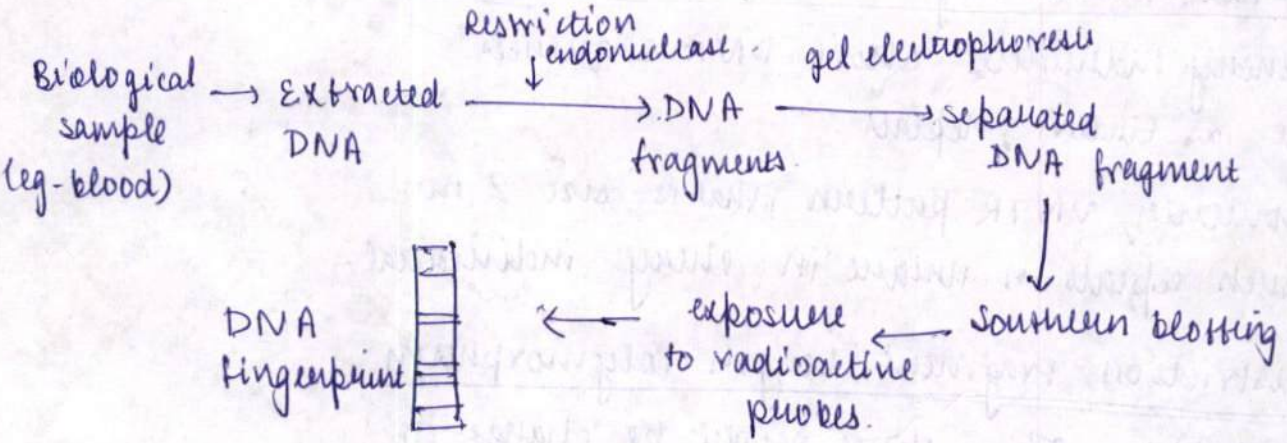
3) Cleavage by restriction endonuclease to yield DNA fragments

4). Separation of DNA fragments according to their size through gel electrophoresis

5) Southern blotting :- separated DNA fragments are blotted on nitrocellulose membrane.

6) The membrane is exposed to radioactive probes.

Is These probes ~~is~~ are complementary to VNTR sequence and ~~thereafter~~ accordingly DNA profiling can be completed.



- **Applications.**

1) Criminal investigation :- It can be used to identify culprits and relieve innocents in a crime.

2) Settlement of disputed parentage :- As DNA of a child ~~has~~ has similarity with DNA of mother and father.

3) Genetic counselling :- Accurate advice for prevention of genetic diseases can be provided only when accurate information about biological parents / relatives is known.

4) Used for tracing frequency of donor cells in bone marrow transplant etc.

5) Patent and IPR :- with regards to identification and production of certain plant varieties etc.

- **Limitations**

1) Lack of infrastructure
2) Lack of availability of probes.
3) Lack of awareness about technology.
4) DNA chimera possess unique case of presence of multiple cell lines, i.e., some cells having different genetic material.

- **Conclusion.**

DNA fingerprinting thus provides more reliable and accurate results as compared to ABO blood grouping, dermatography etc. DNA profile is now even accepted as evidence in court of law.

Q.15 Explain gene mapping & genome study.

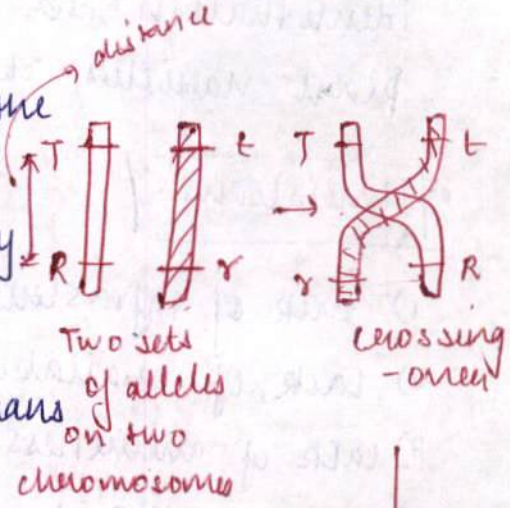
- Intro :- Gene mapping can be defined as a process that helps in identifying which gene is located on which chromosome and at what exact location.

Hence, it tells about
- 1) Locus of a gene.
- 2) Distance between genes.

↳ The objective of large-scale genome mapping is achieved through human genome project

• Types of gene mapping

1) Linkage mapping :- It determines the distance between two genes using the recombination or crossing over frequency b/w the two.



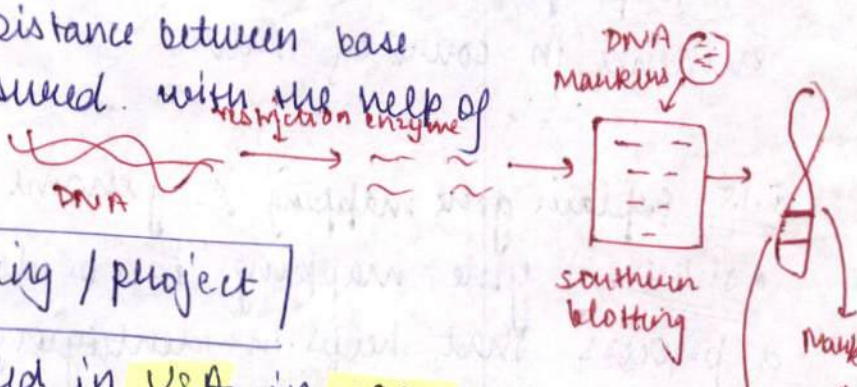
↳ Limitation :- long life span of humans & limited no. of offsprings

↳ However, it can be done through pedigree data.

2) Cytogenetic mapping

2.1) Chromosomal banding technique :- cells are fixed in metaphase & stained to get banding patterns. Different parts of chromosomes are stained differently, thus helping in gene mapping

3) Physical mapping :- Distance between base pairs and genes is measured with the help of genetic markers.



• Human genome mapping / project

↳ The project was founded in USA in 1990

↳ Objective :- Determine all the 3 billion base pairs in human genome and identify all the genes.

↳ Development of capacity to collect, store, distribute & analyse the generated data.

30,000

→ Methodology :- I. Extraction of entire genetic material

↓

II. DNA divided into fragments using restriction endonuclease

↓

III. Inserting DNA fragments into bacterial chromosomes (BAC)

↓

IV. Positioning of BAC on individual chromosome

↓

V. Production of BAC clones.

↓

VI. ~~Arranging~~ Detection of overlapping DNA segments on clones

↓

VII. Arranging them into ~~contigs~~ contigs :- large set of overlapping clones.

↓

VIII. Entire genome is mapped using computer algorithm.

→ Findings :- 1) Total no. of genes are estimated at 30,000.

2) almost 99% of nucleotide bases are same for all people ; 98% of DNA is non-coding

3) Functions are unknown ~~for~~ of over 50% of genes.

• Applications.

1) Easy diagnosis of genetic disease by identifying defective genes and timely treatment

2) Boost to gene therapy as exact location of gene can be found out.

3) Prevention of infectious diseases as certain genotypes are more susceptible to them.

4) Help in production of drugs → Insulin etc. for improving human health by sequencing genomes of bacteria etc.

7) GM crops.

5) Evolution :- Information about location & presence of genes can help in establishing evolutionary linkage of humans with other species.

6) Anthropological perspective :- Understanding variation among different ethnic groups and as well as studying the migration pattern of early human.

• Limitations & concerns.

1) Ethical & Legal concern surrounding issues such as designer babies, birth to child of preferred sex etc.

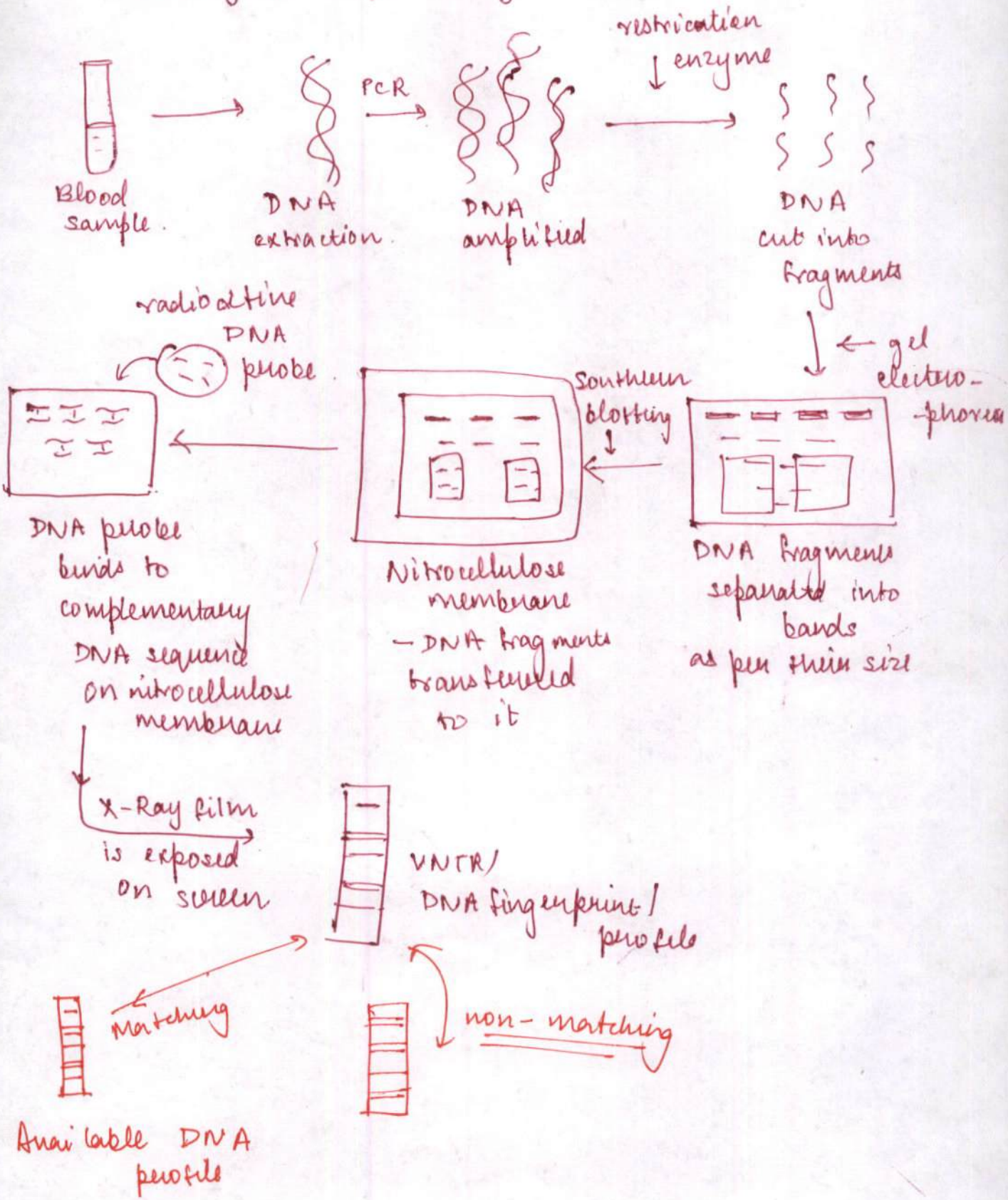
2). Privacy concerns and future use of personal data.

3) Genetic discrimination :- differential socio-economic ~~treatment~~ behaviour with individuals suffering from genetic diseases.

• Conclusion

Thus, gene mapping and genome study can open a plethora of possibilities. However, in a developing state like India, along with advancements in genetic studies, proper interventions to upscale primary healthcare facilities should also be taken.

• DNA fingerprinting Diagram



Unit-9.5

Q.1 Explain the concept of race.

• Intro :- Dobzhansky defined race as 'a group of population which are reproductively isolated to the extent that the exchange of genes b/w them is absent or so slow that the genetic differences are not diminished or swamped.'

Ashley Montagu defined race as "a group that differs from others w.r.t certain gene frequencies."

→ Features of Race.

1) Difference in gene frequency :- Different races differ from each other in gene frequency.
↳ Such difference might be a result of selection & chance.

2) Reproductive isolation :- The genetic difference b/w races is maintained by reproductive isolation.

3) Interbreeding :- Members of different races can interbreed & produce viable offsprings as they belong to the same specie.

4) Biological concept :- Races exist due to difference in gene frequencies as a result of isolation, hybridisation, selection, small ~~a~~ mutations & chance.

↳ Race is different from national, religious & cultural groups. Eg :- Indian / British etc are not racial groups.

5) Difference in morphological & genetic traits
↳ Eg :- skin color, hair color, facial index, nasal index etc.

• Cause of emergence of races

1) Although, all members of a species can potentially interbreed, most matings take place within smaller groups.

2) This is due to various geographical, social, cultural & religious barriers.

3) Thus, over time these subpopulations start having difference in gene frequencies. → This is due to isolation, environmental influence, selection and chance.

4) Thus, they come to exhibit sufficient noticeable differences to be classified as different races.

• 3 Major races of the world.



1) Caucasoid :- Europe, North Africa, Middle East, India, USA etc.

2) Mongoloid :- China, Mongolia, South-East Asia, Japan etc.

3) Negroid :- Africa, Andaman, New Guinea etc.

→ However, humans have undergone so much interbreeding that discrete classifications cannot be made in many cases.

↳ Eg:- Australoid (Australian aborigines, Tribes in South & Central India - Bhil, Gond etc.).

→ With increasing globalisation, the concept of race has further diluted due to increased interbreeding between diverse groups.

• Conclusion

Thus, race is largely a genetic concept.

The notion of racism is completely unscientific and was a tool for justifying atrocity and inhumane behaviour against certain groups.

Q.2 Describe racial criteria. / What are biological basis of racial classification.

- Intro :- There are certain morphological and genetic features according to which human beings can be divided into different races. This is called racial criteria.

→ 3 major races of the world are :-
Caucasoid, Mongoloid, Negroid.

→ Characteristic of racial criteria

1) The features must be hereditary.
2) They should be non-adaptive, at least in short term, that is, not influenced by environmental factors.
   ↳ Eg :- skin tone of an equatorial inhabitant would not change even if he moves to temperate region.

- Morpological racial criteria

I. Morphoscopic or non-metric criteria.

1) Skin color :- It depends on concentration of melanin.
   1.1) Generally, people living in tropical regions have higher concentration of melanin as compared to those in temperate regions. → as → and hence darker skin tone
   → Glogger's rule
   absorbs most light on skin surface & prevents its deep penetration which can destroy vit D. structure.

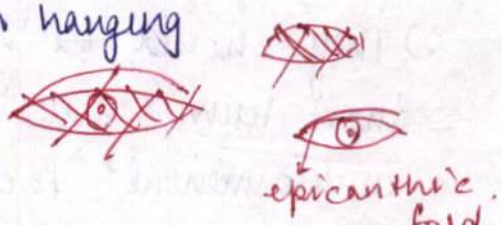
1.2) → Caucasoid - Leucoderm ; various shades of white
↳ Mongoloid - Xanthoderm ; various shades " yellow
↳ Negroid :- Melanoderm ; various shades of dark skin color.

2) Hair color, texture and form
↳ Difference in hair color is also due to melanin

	Hair color	Hair texture
Caucasoid	light blonde to brown	fine texture ; cymotrichous - wavy
Mongoloid	Brown to brown black	Leiotrichous :- smooth.
Negroid	brown black.	Ulotrichous :- woolly & kinky

3) Eye color and shape

3.1) Eye shape :- Mongoloid-eyes are characterised by :-
a) Oblique palpebral fissure
b) Narrow eye opening
c) Presence of epicanthic fold (skin hanging over upper eyelid).



3.2) Eye color :-
↳ Caucasoids - light blue to light brown
↳ Mongoloids - Light brown to dark brown
↳ Negroids :- Dark brown to brown black.

4) Body-built :- Caucasoids - linear to lateral ;
Mongoloids - ~~more lateral~~ lateral with traces of linear ;
Negroid - more lateral

II Morphometric or measurable criteria.

1) Cephalic index :- shape of head is influenced by genetic & environmental factors like nutrition.
↳ It can be measured as = $\frac{\text{Breadth of head}}{\text{Length of head}} \times 100$.

↳ a) ~~Caucasoid~~ Dolicocephalic (long & narrow head) :-
Caucasoids & Negroids (dolicocephalic dominant)

↳ b) Mesocephalic (~~broad~~) :- Mongoloids, Negroids, Caucasoids.
Medium.

↳ c) Brachycephalic (broad) :- Mongoloid & Caucasoid.
↳ (Brachycephalic dominant)

2) Facial index :- $\frac{\text{Length of face}}{\text{Breadth of face}} \times 100$.

↳ a) Caucasoids :- Euryprosopic (Broad face)
↳ b) Mongoloid :- Mesoprosopic (Medium face)
↳ c) Negroid :- Leptoprosopic (Long & narrow face).

→ Caucasoids & Mongolids also don't show or show little prognathism whereas it is marked to a greater degree among negroids.

3) Nasal index :- shape of nose has been influenced by environment.

↳ a) Caucasoid :- Leptorrhine (narrow nose)
↳ b) Mongoloid :- Mesorrhine (Medium ")
↳ c) Negroid :- Platyrrhine (Broad nose).
↳ Broad nose better adapted for warm & humid conditions as it allows large amount of warm air to exit.

4) Stature :- It depends on both genetic & environmental factors.

↳ 1) Tall (>170 cm) :- Caucasoid, Nilotic negro.
↳ 2) Medium (170-160 cm) :- Mediterranean caucasoid
↳ 3) short (<160 cm) :- Negroes (Bushmen), mongoloids etc.

• Genetic criteria

1) Blood group :-

a) O-blood group :- commonest blood group (62%)
↳ found in American Indians

b) A-blood group :- It occurs in Europe, USA, Australian tribes.

c) B-blood group :- It is more common in Asia including India.

↳ Similarly ; Rh negative is very rare among mongoloids, medium frequency in negroids, and present in higher freq. in caucasoids.

2) Haemoglobin :- HbS in more common in Africa & South Asia (resistance to Malaria).
↳ Hb E is common in South-East Asia etc. ; Hb Hikari → Japan

3) Other serological criteria include variation in HLA system, immunoglobin, serum proteins etc.

4) Chromosomal variation :- Variation is in length of Y chromosome.
↳ Japanese have high freq. of long 'Y' chromosome
↳ Australian aboriginals have high freq. of short 'Y' chromosome.

5) Non serological features
↳ 5.1) Secretor status :- High frequency of secretor gene (S) in caucasoids & ~~deg~~ non-secretor gene (s) in Negroids.
↳ Mongoloids are placed in b/w.

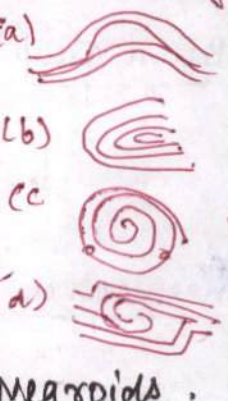
↳ 5.2) Tasting ability :- High frequency of tasters (T) genes of PTC are found in caucasoids and.

high frequency of non-taster genes (b) in negroids.
↳ Mongoloids lie in b/w the two.

- Conclusion.

Thus, race is purely a biological concept and should not be used to justify the myth of superior-inferior races (racism). With advent of globalisation & increased interbreeding, discrete classification of races cannot be made.

- Polygenic criteria
↳ Dermatoglyphics, study of dermal ridges on fingers, & palm. humans classified into races by parameters like — total ridge count, main line index, thenar ridge count



on fingers.

Q.3. Distinguish b/w caucasoids, mongoloids & Negroids.

Criteria	Caucasoids	Mongoloids	Negroids
1) Region :-	(1) Europe, USA, Middle East, India, North Africa	(1) China, Japan, S-E Asia.	(1) Africa, (eg :- Bushmen, Bantu etc.), Andaman, New Guinea etc.
2) Skin	(2) Leucoderm. (shades of white)	(2) Xanthoderm (shades of yellow).	(2) Melanoderm (dark skin tone).
3) Hair	(3) light blonde to brown ↳ wavy hair	(3) brown to brown black ↳ smooth hair	(3) Brown-black. ↳ wooly & kinky hair.
(4) Eye shape (5) Eye color (6) Body built (7) Cephalic index (8) facial index	- - - - same as Q. 2 - - -		
(9) Prognathism - little or absent	⟶ "	⟶	greater degree
(10) Nasal	- - - - same as Q. 2.		

(11) Cheek bones — not prominent — prominent — prominent

(12) Lips — thin — medium — thick.

(13) Body hair — presence of hair on body & face — scanty hair on body & face. → 4

(14) Blood group — west to east → I^A to I^B. — I^B. — I^A

↳ Rh-ve high freq. — low freq. — medium freq.

(15) Haemoglobin :- Hb^S usually absent — HbE common in SE Asia. — HbS in high freq.

(16) Non-serological feature — ---- same as Q.2 ----

Q.4. Is race a myth ?

- Intro :- --- Defn --- same as Q.1.

Racial criteria
- Morphological
  - Non-metric
  - Metric
- Genetic
  - Serological → Polygenic
  - Chromosomal
  - Non-serological

→ **Various Racial criterias**

3 major races — Caucasoids, Mongoloids, Negroids.

I) Morphological features

1) Morphoscopic :- skin color, hair color & texture, eye color, eye shape, body built

2) Morphometric :- ----

II Genetic features

1) Serological :- blood type (ABO & Rh), Haemoglobin groups

2) Chromosomal variation

3) Non-serological.

RACE IS NOT A MYTH.

↳ Noticeable differences in physical features.

↳ Developed due to reproductive isolation, env. factors, hybridisation, selection & chance

↳ Hence, race is a biological concept distinct from cultural / religious

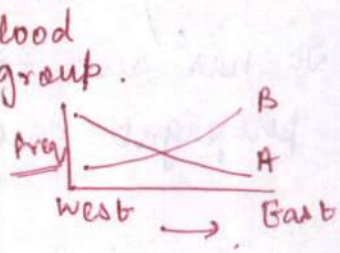
↳ Hence, not a myth.

Race is a Myth.

(1) Absence of discrete groups :- A very clear district classification of population cannot be made.
↳ Humans have exhibited so much interbreeding that discreteness among racial groups has diluted. Eg:- Australoids (mix of caucasoids & Negroids)

(2) Presence of clines or gradual differences :- large number of traits are continuous and show wide variety even within a racial group.
↳ Eg:- Caucasoids have skin color ranging from white to dark brown. → Caucasoids

(3) Larger genetic diversity within a racial group than b/w two races. :- Eg- Africans vary more among themselves as compared to the rest of the world.



↳ Pygmies and Bantu residing side by side vary greatly in height; former being very short while Bantu being of average height.

(4) Generalisations cannot be made within a racial group.

↳ Eg:- Negroids of Congo basin ~~are~~ have brown-black skin tone; whereas negroids of Borneo have pale yellow skin color; while negroids of Amazon have cinnamon skin color.

(5) Similarities b/w different races.

↳ Eg:- Dravidians of south India sometimes have darker skin tone than African negroids.

⑥ Racial classification has led to development of racism :- The belief in ~~this fa~~ superior-inferior races is unscientific and led to more harm.

⑦ Globalisation has further brought people from different racial groups closer. This has led to need interbreeding & dilution of distinct racial features.

• ~~End~~ Conclusion

Thus, while broad classification ~~into~~ of races has a biological basis, in reality the difference is not discrete but gradual. As a result, many scholars suggest disbanding the use of term 'race' & use 'ethnic groups' instead

Ashley Montagu authored UNESCO's declaration on racism & busted all racist myths in his book 'Man's most dangerous Myth' (1942)

It has also ~~bee~~ being misused to propagate racism & racist thinking.

or 'Mendelian Population'

Q.5 Differentiate b/w race & racism.

As per Boas, race is strictly a biological concept, whereas racism is a cultural construct.

• Intro :- Race is a biological concept and refers to morphological & genetic differences b/w groups of a population.

→ while racism is an unscientific socio-culturally determined notion. It is a result of misuse of racial classification to justify the atrocities & inhumane behaviour towards certain sections.

→ Eg :- Slavery
- genocide
- Jewish Holocaust

done.

→ Many 20th century anthropologists like Boas, Levi-Strauss denied & criticised racism

• Belief of Proponents of racism

1) Belief in superior-inferior races.

Basis of Racism.

1) Based on purity & superiority of blood.
:- Exponents of racism believe in superior & inferior races based on birth.

2) Skin color. :- It is the most visible difference and hence often the most common basis used by racists to justify racism.

3). Mental & physical ability :- There is a false notion that non-Europeans are physically & mentally inferior.
↳ It can be seen in form of differential behaviour towards African-Americans in USA.

4) Cultural superiority. :- There is also another false belief that human civilisation, culture & scientific achievements are a contribution of a particular race.

Racism is a myth.

1). No such thing as superiority of blood.
↳ The difference in frequencies of I^A, I^B and I^O is due to migration, reproductive isolation, selection (I^B provides resistance against tropical diseases) & chance.
↳ Difference in Hb, i.e., presence of Hb^S in South Asia & Africa is also due to selective advantage.
↳ Moreover, blood group varies independent of skin color; both eskimos & australian aboriginals have high freq. of I^A

2) Skin color :- It is largely a result of environmental factors that impact conc. of melanin. - Gloger's rule.
↳ It is not related with Mental ability or any other trait.

3) Mental and Physical ability :- The initial criteria of measuring skull size has been proved wrong.
↳ Many studies such as Twin studies also show that intelligence is often influenced by environment.
↳ Recent eg's of Kamala Harris being elected as Vice-President of USA or Indians leading American - would class MNCs discredit this view point.

4) Culture & civilisation :- Many societies have established far more complex civilisations centuries before European colonialism
↳ Eg :- Mesopotamia, Indus Valley civilisation, African empire of Ghana, etc.

5) Role of infectious diseases :- It is believed that it was not European supremacy but outbreaks of smallpox against which inhabitants of New would had zero resistance that facilitated colonialisation of Americas.
↳ It is called one of the 1st eg's of biological warfare.

• UNESCO declaration about races & racism (1951) - authored by Ashley Montagu states that,
↳ To promote world peace, UNESCO has taken the initiative to check racial arrogance.

1) All human-beings belong to one species that is homo-sapiens. Pure races do not exist among human.

2) All the morphological & anatomical differences are a result of environment, genetic factors, mutation & hybridisation.

3). There ~~is~~ is no cultural & intelligence basis of racial differences.

4) All human beings are equal & they deserve equal treatment.

• Conclusion

---- same as D.4 ----

Racism / Racial discrimination is scientifically false, morally condemnable, social unjust & dangerous.

→ format

Define race & racism

→ Racial criteria in short.

→ features of race.

→ Basis of racism

(4) developed to understand inter and intra-population variations in a scientific manner.

(4) For discrimination, inhuman treatment, atrocities

~~Ass~~ Atrocities → back

→ features of racism :- 1) Inhumane treatment → Eg:- slavery, genocide such as Holocaust

2) Discriminatory policies

3) superiority of one race.

4) Prejudice

5) socio-cultural concept; unscientific.

→ why racism is a myth

→ UNESCO's stand.

white man's burden

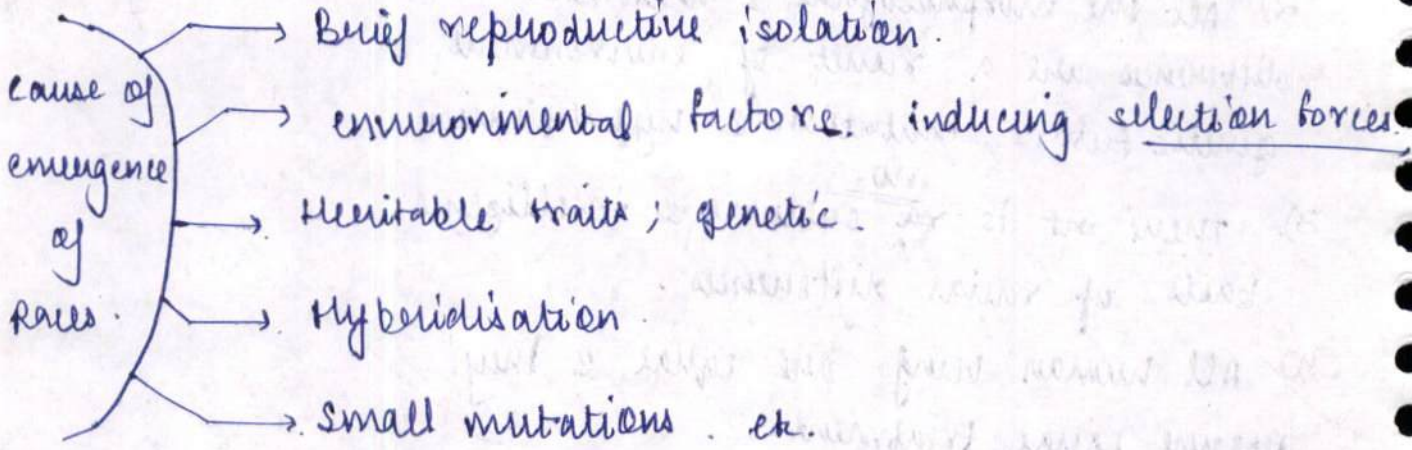
• Difference

	Race	Racism
1)	biological concept	cultural construct.
2) Basis	~~morpho~~ genetic	purity of blood, skin color, mental & physical superiority, cultural superiority
3) Cause	reproductive isolation, mutation, selection etc	Colonialism & imperialism - ethno.

(4) above ←→

Q.6 Explain the racial traits in relation to heredity & environment.

- Intro :- Race defn.



- Influence of environment → Gloger's rule.

1) Skin color :- Melanin more in tropics ; protects skin from harmful UV rays.
In temperate, lighter skin tone allows deep penetration of even small amount of sunlight facilitating production of Vit. D & Ca.

2) Hair color :- result of melanin.

3) Eye color :- in tropics ; dark eye color restrict entry of light into the pupil
↳ protects retina against damaging UV radiations.

4) Nasal index :- Narrow :- more surface area for incoming air to get warmed.
↳ Broad :- explanation given in previous ans. (broad passage for exhaling out warm air from body).

5) Stature :- Bergmann's rule
↳ ~~Small~~ large siberians.
↳ small pygmies
↳ Allen's rule.
↳ small limbs of eskimos
↳ tall limbs of Bantu & other African tribes.

6) ABO :- I^B resistance against tropical diseases

7) Hb^S :- - - - -

• **Influence of heredity**

↳ Most of the racial traits are heritable; passed on to the next generation.

↳ Non-adaptive; at least in short terms.

↳ Frequent interbreeding change in environmental condn can cause dilution of distinct racial traits in the long run.

Q.7 Racial crossing

• Intero :- It refers to interbreeding b/w 2 different human races resulting in mixing of their distinct racial traits.

→ Humans have interbred throughout the period resulting in admixture of traits (2° races).

↳ Examples :→ 1) Australoids (Australian aboriginals) :- cross b/w caucasoids & negroids.

↳ 2) Mulllato :- cross b/w white caucasoids & negroids. etc.

• **Reasons for Racial crossing**

1) Migration - Historical causes.

1.1) Colonialism :- European conquest all over the world.

↳ Transportation of Negroes to other parts of world.

1.2) War :- Napolean's conquest.

1.3) trade and expeditions to find new areas - Columbus.

2) Migration - contemporary causes.

2.1) Due to urbanisation, globalisation & industrialisation.

2.2) Transport & communication; foreign education & job opportunities.

- **Anthropological debate on race crossing**

1) The 19th & 20th century witnessed. civil war and condemnation of racial discrimination in the US and other parts of the world.

2) some 19th century scholars were against racial crossing citing superior-inferior notion in mental & physical abilities.
   - Eg:- Galton, Davenport, Castle etc.

3) However, scholars like Boas, Le-Strauss, Huxley etc. criticised the racial discrimination and supported racial crossing saying that it is harmless.

4) Later, UNESCO declaration on races (1951) also declared racism to be a myth and supported racial crossing. → by Ashley Montagu

- **Significance of racial crossing**

1) strong support to the notion that racism is a myth.

2) Enhanced cultural exchange & intermixing

3) Promotes world peace & harmony b/w different groups.

4) Prevents racial discrimination by extending equal opportunities to all.

5) Evolutionary significance :- formation of mixed races with new traits is often favourable; used widely - diversity → hybrid vigour

- **Conclusion**

Thus, racial crossing is more favourable as it leads to genetic variability which is probably more advantageous than 'perfect' human beings in the long run.

---

(5) Race - no discreet group; presence of cline & gradual features

(5) Racism - 2 discreet groups
- superior
- inferior races
- denies any continuity in trait