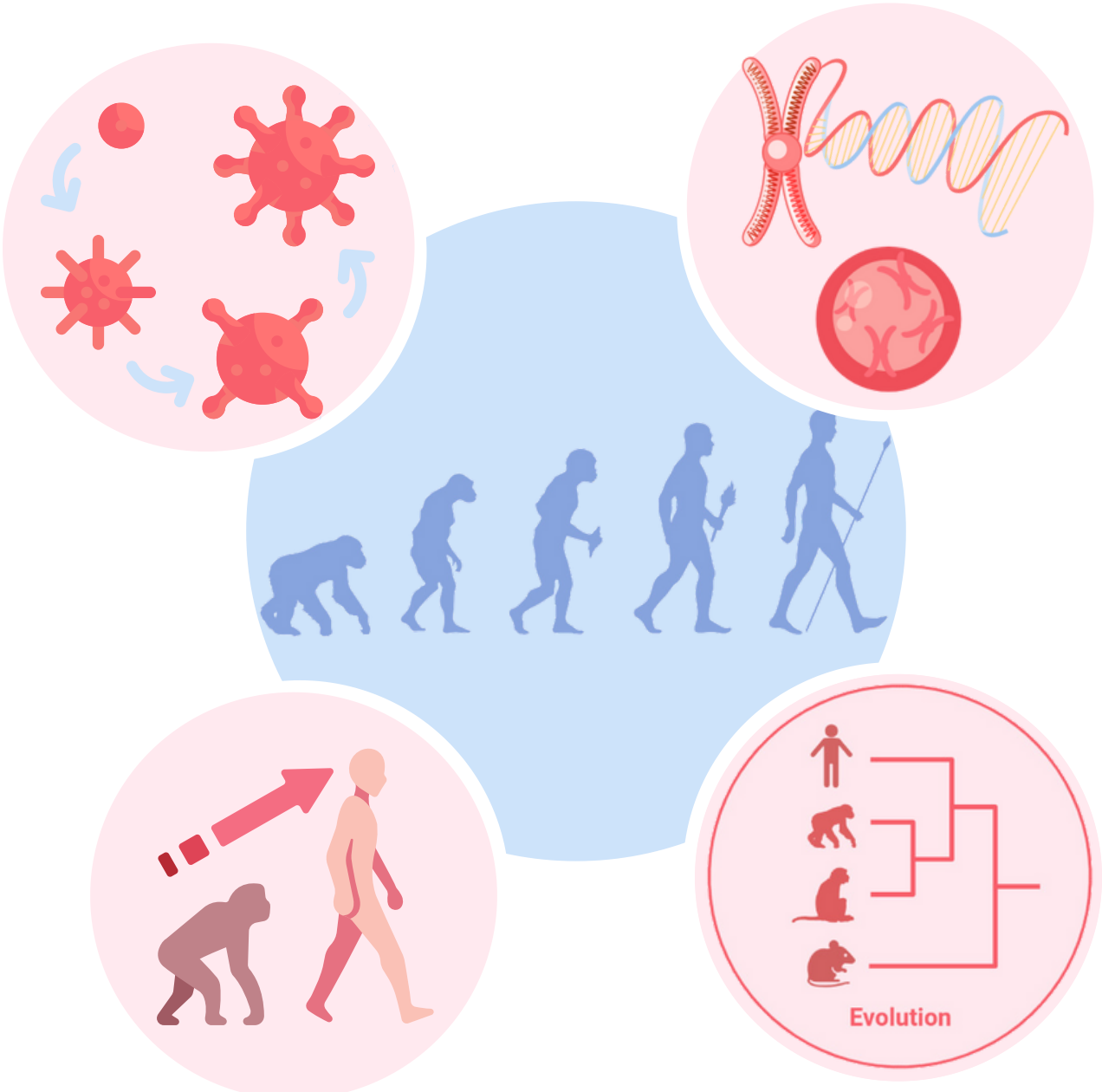
PreMed.PK

EVOLUTION



High Yield Notes

NOTES EVOLUTION

INTRODUCTION TO EVOLUTION

Evolution refers to the processes
that have transformed life from its earliest forms to the diversity observed today.
Evolutionary change is based on
interactions of populations of organisms with their environment.

EVOLUTION VS SPECIAL CREATION:

To explain the diversity of life and relationships among different organisms, two opposing ideas rose.

The theory of evolution was that organisms evolve through time, with one type of organism giving rise to another type.

The opposing theory of special creation was that every individual species was created by Nature in the form in which it exists.

NOTES

EVOLUTION FROM PROKARYOTES TO EUKARYOTES:

Beginning of life	Prokaryotes to Eukaryotes
First living being, Archaea, originated in underwater hot springs/hydrothermal vents through spontaneous reactions. The early atmosphere of Earth was hot and lacked oxygen and ozone. Early prokaryotes were absorptive	There are two theories about the evolution from Prokaryotes to Eukaryotes; the Endosymbiont theory and the membrane invagination (process of a surface folding in on itself to form a cavity, pouch or tube) theory

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Early prokaryotes were absorptive heterotrophs(one that feeds by externally digesting organic matter and then absorbing the nutrients) then chemosynthetic autotrophs (Autotrophs that perform chemosynthesis do not use energy from the sun to produce food. Instead, they make food using energy from chemical reactions, often combining hydrogen sulfide or methane with oxygen) came into existence.
First photosynthetic organisms used hydrogen sulphide as a source of hydrogen to reduce carbon dioxide to sugars, later water was used.
Oxygen by photosynthesis accumulated in the atmosphere , thus the reducing atmosphere changed to oxidising, ozone began to filter UV radiation from the Sun.
In an oxidising atmosphere, life could no longer arise abiotically (in a way that involves the absence of life or the absence of living forms)

According to Endosymbiont theory, a large anaerobic ameboid prokaryote ingested some small aerobic bacteria, stabilised them instead of digesting them which led to mitochondria formation.
Similarly ingestion of prokaryotes similar to cyanobacteria (a phylum of gram-negative bacteria that obtain energy via photosynthesis) led to development of chloroplasts.
This theory is supported by the fact that mitochondria and chloroplasts are similar in size to bacteria, have their own DNA and ribosomes.
According to membrane invagination theory, Prokaryotic cell membrane invaginated to enclose copies of its genetic material, resulting in the formation of several double membrane bound organelles in a single cell.
Newly formed eukaryotic cells evolved into multicellular organisms.

NOTES

LAMARCKISM

Jean Baptiste de Lamarck was a French scientist who was one of the early proponents of evolution.

Ideas of evolution presented by Lamarck are known as Lamarckism.

His explanation of evolution had two main assumptions:

Use and disuse of organs:

- Organs/body parts which are more frequently used become stronger.
- Body parts which are not used as frequently begin to diminish and eventually disappear in the coming generations.
- Lamarck used the example of a blacksmith developing a larger bicep in the arm working the hammer and the giraffe stretching its neck to increase length to be able to eat leaves that are high up.

Inheritance of acquired characteristics:

- Characteristics that were acquired during the lifetime of an organism could be passed on to the offspring.
- We now know that both the ideas of Lamarckism have no genetic bases so they have been disproved.

Contributions of other scientist to the theory of evolution:

Carolus Linnaeus (1707-1778) classified organisms by introducing the taxonomic system of binomial nomenclature(the biological system of naming the organisms in which the name is composed of two terms, where, the first term indicates the genus and the second term indicates the species of the organism), which later became a focal point in Darwin's arguments for evolution

- Charles Lyell (1797-1875) published the Principles of Geology in the 1830s which Darwin used to support his ideas
- James Hutton proposed the theory of Uniformitarianism (the assumption that the same natural laws and processes that operate in our present-day scientific observations have always operated in the universe in the past and apply everywhere in the universe)
- Thomas Malthus (1766-1834) wrote an essay The Principle of Populations (the law of supply and demand applied to the relationships between food production and population growth)
- Cuvier (1760-1832) contributed to the science of palaeontology (scientific study of life of the geologic past that involves the analysis of plant and animal fossils, including those of microscopic size, preserved in rocks)
- Alfred Wallace(1823-1913) wrote an essay almost identical to Darwin's about the origin of species.

NOTES

Charles Darwin:

- He was an English physician
- He joined an expedition aboard the Beagle (1831) to the South American coastline and noticed that the species had a distinct South American stamp, different from those he studied in Europe.
- He closely studied the 13 species of finches (small to medium-sized passerine birds in the family Fringillidae) from the Galapagos island.
- When he returned to England, he perceived the idea of speciation and adaptations as closely related processes.
- Darwin believed that natural selection was the mechanism for evolution.
- Darwin wrote an essay on the origin of species and natural selection in 1844.
- Darwin published his book "The Origin of Species by means of Natural Selection" in 1859.

Mnemonic:

Luke Told Levi Great Happenings
Under Mathew's Population
Control Program
Linnaeus Taxonomic System
Lyell Geology
Hutton Uniformitarianism
Malthus Population
Cuvier Paleantology

NOTES

DARWINISM

Darwin's book focused on two main points; Descent with Modification and Natural selection and adaptation

Descent with Modification:
All organisms are descended from one common ancestor, and as time went by, organisms were exposed to different environments and thus developed different modifications to survive.

Natural selection and adaptation:

- Production of more individuals than the local environment can support.
- Struggle for existence among the individuals of a population, only a fraction of them are able to survive.
- Those who survive do not do so by random chance but due to their hereditary characteristics.
- Individuals with characteristics that are more suited to the environment are more likely to survive and pass on their favourable characteristics, which then accumulate over generations, leading to a gradual change in a population's gene pool.
- Natural selection occuring over large time spans is responsible for the entire diversity of life

Artificial selection:

- Breeding of domesticated plants and animals
- Selecting individuals with desired characteristics

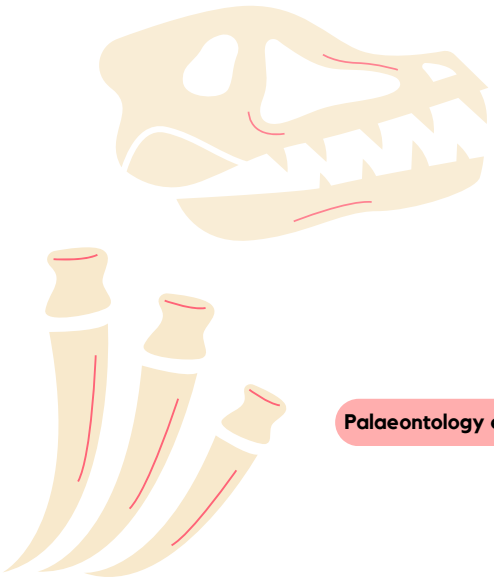
NOTES

NEO DARWINISM

It is the reappraisal of the theory of Natural Selection in terms of modern population genetics

Neodarwinisim uses evidence from numerous fields including, but not limited to:

- Palaeontology
- Taxonomy
- Biogeography
- Population genetics (a field of biology that studies the genetic composition of biological populations, and the changes in genetic composition that result from the operation of various factors, including natural selection)



Palaeontology extracts

NOTES

EVIDENCES OF EVOLUTION

BIOGEOGRAPHY:

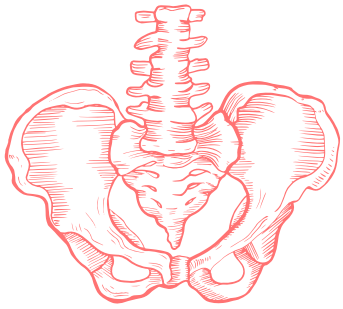
- Biogeography is the study of the distribution of species and ecosystems in geographic space and through geological time.
- It provides evidence of prehistoric climates, habitats and animal distribution patterns.
- Biogeography shows that lifeforms in various parts of the world have distinctive evolutionary history.

FOSSIL RECORDS:

- Chronological sequence of different classes of vertebrates is present
- Provides visual record in complete series showing evolution

COMPARATIVE ANATOMY:

- Similarities in anatomy between different species supports the theory of evolution
- Homologous organs have similar origin, are structurally alike but have evolved to perform different functions e.g. the forelimbs of man, bat, horse. This shows divergent evolution.
- Analogous organs are structurally different but have evolved to perform similar functions, owing to convergent evolution e.g. wings of birds and insects.
- Vestigial organs: organs that have lost most of their original functions through evolution e.g. human appendix, tailbone etc.



COMPARATIVE EMBRYOLOGY:

- Closely related organisms undergo similar stages in embryonic development.
- All vertebrates have gill pouches on the side of their throats at a certain stage.
- In fish, these develop into gills and in terrestrial vertebrates they develop into Eustachian tubes

MOLECULAR BIOLOGY:

- Evolutionary relationships between species are shown through their DNA and proteins
- All organisms utilise the same dna triplet code and the same 20 amino acids in their proteins
- These similarities are only explained by descent from a common ancestor.

NOTES

HARDY-WEINBERG THEOREM:

This theorem describes the genotype frequencies of non evolving populations.

It states that for a population, allele and genotype frequencies remain constant, unless it is acted upon by agents other than sexual recombination.

For a population to be in Hardy-Weinberg equilibrium, it must meet these criterion:
1. No mutation
2. No natural selection
3. No migration
4. Random mating
5. Large population size

MNEMONIC:
Neither Meg Nor Miles Now Need Raspberry Milkshake Like Parker
No Mutation No Migration No Natural selection Random Mating Large Population

For a gene locus, (with 2 alleles), letter p represents allele frequency of one allele and q represents the other. p+q=1

When zygotes are formed, probability of getting AA genotype (homozygous dominant) is p2, that of aa (homozygous recessive) is q2 and that of Aa or aA (heterozygous) is 2pq

$p2 + 2pq + q2 = 1$

NOTES

FACTORS AFFECTING GENE FREQUENCY

- Mutation leads to production of new alleles, it occurs rarely to change allele frequency on its own.
- Migration is movement of organisms from one population to another, either by immigration(adding foreign individuals in a population) or emigration(individuals leaving a population). They cause disturbance in the gene pool.
- Non-random mating is mating between specific individuals e.g inbreeding which is mating between closely related individuals. This results in decreased heterozygosity in the gene pool.
- Selection can be both natural or artificial, certain kinds of individuals leave behind more offspring depending on their inherited characteristics.

Genetic Drift:

It is the change in allele frequency over time, which occurs purely by chance certain individuals by chance would leave behind more offspring, causing allele freq to shift in that direction

Causes:
Bottleneck effect is when the size of a population decreases drastically due to a natural disaster, leading to loss of certain alleles and leaving behind a smaller, less diverse gene pool

Founder effect is when a new population is established by a few members of the original population, they have a small percentage of the total alleles of the original population, hence the allele frequency changes accordingly

Speciation:

It is the evolutionary process by which new species come into being. There are three types of speciation:

- Allopatric speciation: when two populations of a species are geographically isolated from one another. They can no longer mate and are faced with different environmental conditions, hence they evolve to better suit their environment. After a certain period of time, a large number of changes have accumulated between the two populations, and they can no longer interbreed, becoming different species.
- Sympatric speciation: it occurs when populations of the same species become reproductively isolated, occurs through polyploidy (a condition in which the cells of an organism have more than one pair of chromosomes) e.g. a tetraploid member of the same species cannot mate with a diploid member. Occurs mostly in plants
- Parapatric speciation: when populations are separated by extreme changes in habitat, reproductive isolation is more or less behavioural.

NOTES

ENDANGERED SPECIES

species that are in danger of possible extinction

Causes of Extinction:

1. Habitat destruction
2. Climate change
3. Pollution
4. Invasions from foreign species

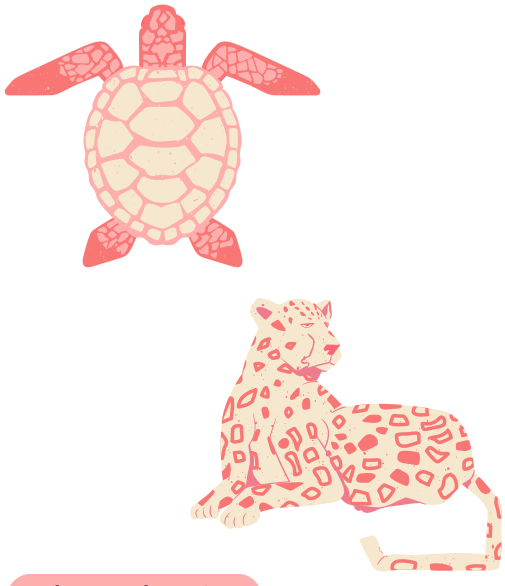
Mnemonic:

☆Harry Didn't Cause Complete Production Inclusion

- Habitat
- Destruction
- Climate Change
- Pollution
- Invasion

Conservation of Endangered Species:

- National parks should be constructed to protect wildlife
- Protected landscapes and multiple use areas providing privacy but also remains a wild area
- Botanical gardens/zoos



Endangered species

Factual Recall:

Earth Age	5 billion years
Life on Earth began	3.5 billion years ago
First living being on Earth	Archaebacteria
Archaebacteria maximum temp tolerance	120C
How many years ago enough ozone to sustain life on Earth	420 million years ago
Prokaryotes rose	3.5 billion years ago
Eukaryotes rose	1.5 billion (PTB)/ 1.9-2.3 billion years ago (FEDERAL)
Endosymbiont theory was proposed by	Lynn Margulis
Number of Vestigial structures in human body	About 90