LECTURES IN EVOLUTION AND NATURAL SELECTION

Dr. khalaf Ammar

PRINCIPLES, CONCEPTS AND ASSUMPTION

..Evaluation

Evaluation is a process that results in changes in the genetic material of a population overtime , It reflects the Adaptations of organisms to their changing environments and can result in altered gens ,novel traits and new species ,and refere to the scientific theories about life on earth.

In biology Evaluation is the change in the characteristics of species over several generations and relies on the process of natural selection .

It considered a type of causal relationship that caused cummuitive change in historical systems , Evulationary processes are fundamental characteristic of our universe , which is important for human to understanding ourselves by describing our origin ,our relationships to other living things , the history and significance of variation within and among different group of people.

There are five types of Evulation , Evulation by mutation ,genetic drift , gene flow ,non random matting and natural selection .

Theories of organic evolution

1. biologists are gradually getting a clear comprehension of the overall picture of evolution Many fields of biological study have made contributions towards its understanding The difficulty of testing experimentally is a serious disadvantage to any line of scientific inquiry and explains the relative slowness in working out the mechanic of organic evolution.

Theories of evolution

a. Lamarckism “inheritance of acquired characters:”

Lamarckism Jean - Baptist Lamarck (1744-1829) : made a name for himself by theorizing . He laid the foundation of modern Ma evolutionary theory , with his concept of " inheritance of acquired characters , " which was later given the name Lamarckism . Lamarckism can be summarized into :-

1. Organs that are in use or become disused , enlarge or shrink . Therefore new characteristics are acquired , usually as a

result of environmental changes . These acquired traits enable the individual to become better adapted to his environment . The individual who does not acquire this trait , becomes extinct.

2. The acquired trait is inherited by the offspring . In 1809 , he published a book “ Philosophe zoologique” in which he declared that the inheritance of acquired characters is used to explain the complete adaptation of many plants and animal to the environment such as: the giraffe got its long neck by stretching it up to reach the higher branches , and birds that lived in water grew webbed feet . According to that , if you pull hard on your feet , you will gradually increase their length . And , if you decide in your mind to do so , you can grow hair on your bald head and your offspring will never be bald. the limbs of the snake would be explained by the handicap of the legs due to growing through vegetation , and thus the loss of the legs through disuse.

Disproving Lamarck's theory

1. August Friedrich Leopold Weismann (1834-1914) was a German biologist who disproved Lamarck's theory of " the inheritance of acquired characteristics . " He cut off the tails of 901 young white mice in 19 successive generations , yet each new generation was born with a full - length tail . The final generation , he reported , had tails as long as those originally measured on the first . Weismann also carried out other experiments that buttressed his refutation of Lamarckism . In the later , he found that the inheritance of characteristics depend on the DNA genetic coding and not habits or environmental condition .

a. **The Darwin - Wallace theory** " Natural Selection ": Darwin and Wallace's explanation for how volition occurs can be described as follows:

The Darwin published his first book “Origin of the” , in November 1859. The full title , On the Origin of the Species by Means of Natural Selection or the Preservation of Favored Races in the Struggle for Life **Natural Selection** : When a plant or animal

produces offspring , variations appear . Some of the offspring will be different from other offspring .

1. **Variation** is characteristic of every group of plants and animals two individuals are exactly alike there are variations in size , coloration , physiology , habits and other characteristics.

Darwinists declare that , these variations (which they call " natural selection ") alone which have caused all life forms on our planet . In the years that have passed since Charles Darwin , this theory of " natural selection " has continued as a mainstay of evolutionary theory.

2. **Great rate of increase among offspring**: In every generation the young produced are for more numberous than parents Even in a slow breeding from, such as the elephant, if all the offspring lived and produced offspring in turn, in a few hundred years the earth Could not hold the elephants More of each kind of organism begins to grow than can passably obtain food, survive and reproduce Most of the offspring

perish for the population of most species remains fairly constant under natural conditions.

3. **Struggle for survival**: Since a larger number of individuals are born than can survive, there is a "competition for food" and space , a struggle for survival This might be an active kill - or be - killed contest , or one less immediately apparent , but nonetheless real , such as the struggle of plants and animals to survive or other unfavorable environmental conditions This drought , cold competition for food shelter , breeding places , and other environmental factors results in the elimination of those that are unfavorably suited to meet these requirements.
4. **Survival for the fittest:** Genetic variations that best prepare an organism to thrive in a particular environment will favor their possessors over less well-adapted species. The idea of "survival of the fittest" is central to Darwin's welfare theory of natural selection.
5. **The surviving individuals** will give rise to the next generation and in this way the successful variations are transmitted to the next

generation and to the succeeding ones The less fit tend to eliminated before they have reproduced.

- Obviously, all the above examples are only variations within species; none go across species . That is variation within species, not evolution across species , it is a reassortment of the DNA and genes , but nothing more.
- It has been found that natural selection does not produce evolution that is, change from one true species into another. In fact, natural selection is obviously misnamed: It is " natural variation, " not " natural selection " -for it is only composed of simple variations, or gene reshuffling, within an existing species. Or to be even more accurate, it is " random variation. " It is NOT " selection.

Mutation theory:-

Hugo deVries (1848-1935) while working with primroses, thought he had discovered a new species. He actually had found a new variety (sub-species) of the primrose, but deVries conjectured that perhaps "new species" had suddenly sprung into existence as a "mutation." To prove this mutation theory, deVries and other researchers began experimentation on fruit flies; and it has continued ever since but totally without success in producing new species. In 1914 Edward Jeffries discovered that deVries' primrose was just a new

Some concepts about mutations:-

A mutation is a change in a hereditary determiner, a DNA molecule inside a gene. Genes and DNA molecules are very complicated, if a change actually occurs, there will be a corresponding change in the organism and in its descendants.

If this change occurs in a somatic (body) gene, it only injures the individual; but if to a gametic (reproductive) gene, it will be passed on to his descendants.

If the mutation does not kill the organism, it will weaken it. Mutations generally produce one of three types of changes: (1) an alteration of DNA sequence in the genes, (2) changes in chromosomes structure, or (3) a change in the number of chromosomes.

A mutation is a change in the DNA sequence of an organism. Mutations can result from errors in DNA replication during cell division, exposure to m

Types of mutations:-

There are two types of mutations: chromosome mutations and gene mutations utagens or a viral infection.

chromosome mutations :- Chromosomal mutations are accompanied by a visible change in the structure of the chromosome; rearrangement during meiosis, or by a change in the total number of chromosome par cell The rearrangement of the chromosomes may involve inversion of the linear order of the genes, traslocation of portions of chromosomes in which a part of one chromosome becomes attached to another nonhomologous chromosome and some other irregular procedures

The change in number of chromosomes occur when a singular chromosome may be added to, or deleted from, the usual diploid set, or the entire set of chromosomes may be doubled or tripled, yielding organisms called "polyploids" polyploid plants and animals are usually larger and more robust than their diploid parents.

The gene mutation :- is caused by a chemical or physical change of gene resulting in a visible alternation of the original character It involves some alteration in the nucleotide sequence in genie DNA .

Causes of mutations:-

Both spontaneous (natural) and artificially induced mutations occur at random.

Both gene and chromosomal mutations can be produced artificially by alpha, beta or gamma rays, x-rays, neutrons, head, cold, and ultraviolet rays or by chemicals Cosmic and other natural rays bombarding the earth may cause some of the "spontaneous" notations that are observed Others may result simply from errors that occur during the replication of genes.

Frequency of mutations :-

Different genes possess different frequencies of mutation rates for some genes are more stable than others mutation is also a reversible process and cases of back mutation are well known Gene "A" for instance, may mutate to gene "a" and gene mutate back to gene "A" this reversibility must be taken into account in mutation equilibrium, and the difference between the mutation rate in one direction and the mutation rate in the reverse direction constitutes "mutation pressure" which is usually of a low magnitude Certain genes are also known to increase the mutation rate of other genes in the same organism.

Adaptations and Natural Selection

Natural selection :

- Natural selection is the process through which populations of living organisms adapt and change. Individuals in a population are naturally variable, meaning that they are all different in some ways.

- This variation means that some individuals have traits better suited to the environment than others. Individuals with adaptive traits that give

them some advantage are more likely to survive and reproduce.

- These individuals then pass the adaptive traits on to their offspring. Over time, these advantageous traits become more common in the population. Through this process of natural selection, favorable traits are transmitted through generations.

is not random. It occurs in response to environmental changes and results in adaptation by advantageous traits being passed on.

Mechanism for Natural Selection

* These are the four principles Darwin used to explain what causes natural selection.

1) All living things have variety within species.

2) Traits are inherited from parents to offspring.

3) Species compete with one another for limited resources (food, shelter, water, nutrients etc.).

4) Those individuals that inherit an advantageous trait from their parents will be more fit to survive and therefore more successful at reproducing and passing on their genes to the next generation.

example for Natural Selection :

Darwin observed that a population of giant tortoises found in the Galapagos Archipelago have longer necks than those that lived on other islands with dry lowlands. These tortoises were “selected” because they could reach more leaves and access more food than those with short necks. In times of drought, when fewer leaves would be available, those that could reach more leaves had a better chance to eat and survive than those that could not reach the food source. Consequently, long-necked tortoises would more probably be reproductively successful and pass the long-necked trait to their offspring. Over time, only long-necked tortoises would be present in the population.

Adaptations

Adaptation :

The process by which organisms that can adapt to changes in their environment are able to survive and reproduce or Changes in structure or behavior of populations to become more suited to an environment through natural selection.

Mainly there are three types of adaptation :

1 - Structural Adaptations

2 - Behavioral Adaptations

3 – Environmental Changes and Natural Selection

Firstly : Structural Adaptations :-

A trait in an organism's body that helps it to survive in its environment. (Physical) Ex: camouflage, specialized structures, body parts, etc.

*Ex. For Structural Adaptations :

1 - Giraffes eat from tall trees instead of the shorter ones where all other animals eat.

2 - Zebras eat from the top part of the grass Wildebeest eats the leaves .

3 - Gazelles eat the rest of what's left.

*Some provide camouflage from predators or prey Examples:

1- Great Potoos are birds that hide from predators .

2- Lions hide from their prey to sneak up .

3- chameleon is a lizard that can change colors to blend with the surroundings .

* Some provide body Protection to make them harder to eat Examples:

1- Armadillos have armor and can roll up .

2- Bees have a stinger to protect the hive .

Secondly : Behavioral Adaptations :-

An action of an organism takes to help it survive in an environment .

Ex: Group behavior, migration, hibernation, etc.

Thirdly : Environmental Changes and Natural Selection :-

* The environment is always changing. Organisms that are adapted to the environmental change will survive and reproduce.

* Populations can change/shift due to the environmental change.

Population Responses to Environmental Change:

*** Gradual Change :-**

1) Population Shift - increase in the amount of individuals with favorable traits
2) Speciation - emergence of a new species through new, specialized adaptations .

*** Sudden Change :-**

Death in that area or extinction .

Evidence for Evolution :-

*** Fossil Record**

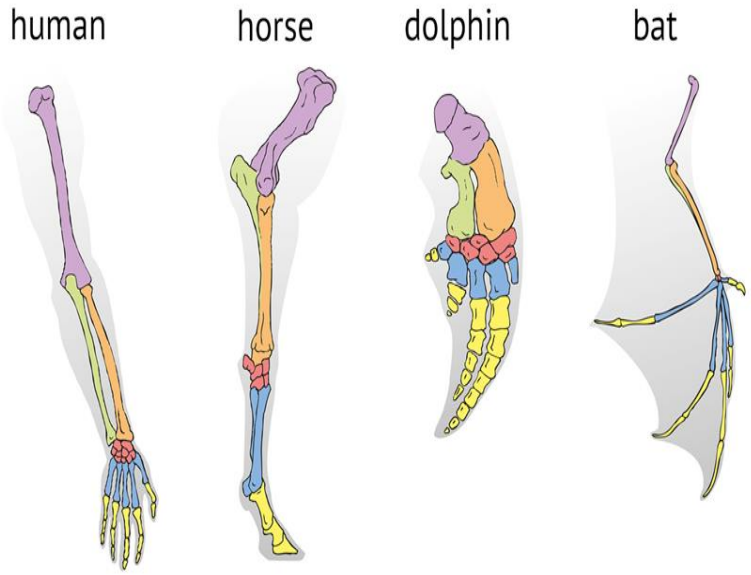
*** Comparative Anatomy**

Fossils :-

A record of the history of life on Earth Can see organisms that lived in the past and how they are related to today's organisms .

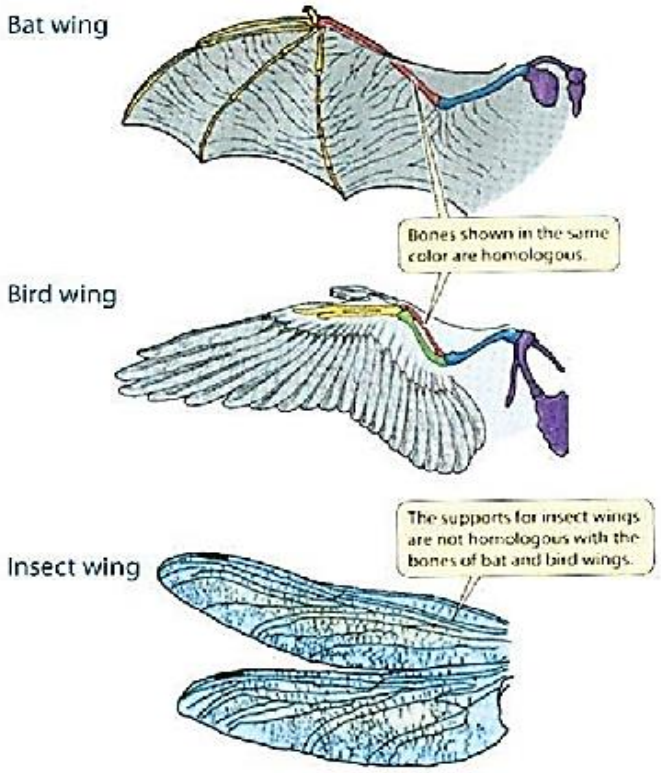
Comparative Anatomy :-

* **Homologous** Body Structures: similar in structure, but different functions, in different types of animals because of common ancestor .



Example: Human, Horse, Dolphin, Bat have same bone structure and are all mammals.

* **Analogous** Body Structures: similar in function, but different structure, in different types of animals with no common ancestor.
Example: Birds, Bats, and Insects have wings for flight, but do not share a common ancestor.



Hybridization

Hybridization is defined as Interbreeding between genetically distinct populations (different species) , Hybridization between closely related species is a natural phenomenon that has been observed in all major plant and animal , Animal hybrids are rare and more sterile than hybrids produced by plants for this reason hybridization has been considered less important in the Evolution of animals than in that in plants .

Hybridization between species may occur if closely related species Share an overlapping habitat or

through human Intervention during captive breeding .

Hybridization between species occur because of small population , Habitat fragmentation and species introduction,Anthropogenic hybridization which done in controlled environment, visual ,chemical and a caustic interference .

Advantage of species hybridization

Evolution of new interspecific breed , Hybrid vigour the hybrids utilise to hybrid vigour to become stronger ,hardier and more productive than the parent . Enhanced longevity and immunity to disease .

Limitation of species hybridization

Genetic extinction ,out breeding depression which happens when crosses between two genetically distant groups result in a reduction of fitness .

Example of species hybridization

*When Male ass (Jack) is crossed to female horse (Mare) to produce mule .

*Male horse (stallion) is crossed to female ass (Jennet) to produce hinny .

Mule and hinny both are always sterile unable to produce offspring , but hinny is Inferior to mule as a work animal .

*Male of Yalk is crossed to female of American buffalo to produce yakal which characters by male hybrids are sterile while female hybrids are fertile .

*Male of Domestic cow /bull is crossed to female Yak to produce pienniu ,male hybrids (Dzo) are sterile while female hybrids (Dzomo) are fertile.

*Male of Goat is crossed to female of sheep to produce Geep .

*Male of lion is crossed to female of tiger to produce liger ,they grow to be very large , quickly and are the biggest cats in the world , Males are sterile and females are fertile , larger than the parent species.

*Male of tiger is crossed to female of lion to produce tigon , tigon sized appearance midway between tiger and lion ,males are sterile and females are fertile ,smaller than either species.

*Male of false killer whale is crossed to female of Dolphin to produce wolphin ,very few of these

hybrids extinction in the world but some of the few that survive can be fertile.