Chapter 7 Evolution

Evolution

Process that results in heritable changes in a population spread over many generations (change in allele frequencies over time) leading to diversity of organisms on earth. It is the genetic change in a population or species over generations (Genes mutate, individuals are selected, and populations evolve).

Evidences of evolution:

From comparative anatomy

Comparison of body structures amongst different species comes under comparative anatomy. Certain anatomical similarities among species bear witness to evolutionary history. eg. the same skeletal elements make up the forelimbs of man, horse, whale and bat, but each of them perform different functions. However, structural similarities in all mammals descended from a common ancestory with prototype forelimbs are common suggesting homology. Comparative anatomy confirms that evolution is a remodeling process. Ancestral structures that originally functioned in one capacity become modified as they take on new functions-descent with modification

Homologous organs	**Analogous organs**
Same basic structural plan and origin but different function	Different structure and origin but same function
It **suggests common ancestry**	It **do not suggests common** ancestry
Indicates Divergent evolution	***Indicates Convergent evolution***
Thorn of *Bougainvillea* Tendril of *Cucurbits*	Thorn of citrus and spine of *Opuntia* Tendril of cucumbers and tendril of pea
Flipper of seal, wing of bat, cats paw, human hand	Wing of insect and wing of bird

Adaptive radiation or mega evolution

Diversification, over evolutionary time, of a species or group of species into several different species or subspecies that are typically adapted to different ecological Group of organisms diversify greatly and take on new ecological roles. (for example, Darwin's finches in the Galapagos Island and Marsupials in Australia).

Allopatric speciation:or geographic speciation

is speciation that occurs when biological populations of the same species become vicariant or permutable— isolated from each other to an extent that prevents or interferes with genetic interchange. Can be the result of population dispersal leading to emigration, or by geographical changes such as mountain formation, island formation, or large scale human activities (for example agricultural and civil engineering developments). Artificial selection: Process by which humans breed animals and cultivate crops to ensure that future generations have specific desirable characteristics.(In artificial selection, breeders select the most desirable variants in a plant or animal population and selectively breed them with other desirable individuals).

Atavism or reversion:

the reappearance of those ancestral characteristics in an organism or in the organisms of a group, which do not occur normally or which represent the reminiscent of normal structures possessed by the individuals of other groups. Examples - human baby born with tail etc.

Big bang theory:

States that the universe began in a state of compression to infinite density, and that in one instant

states that the universe began in a state of compression to infinite density, and that in one instant all matter and energy began expanding and have continued expanding ever since.

Biological Evolution

In the early 1800s French naturalist Jean Baptiste Lamarck suggested that evolution is a process of adaptation, the refinement of characteristics that equip organisms to perform successfully in their environment. However, unfortunately we remember Lamarck for his erroneous view of how adaptation evolved (the inheritance of acquired characters).

Branching descent and natural selection are the two key concepts of Darwinian Theory of evolution. According to him all the species inhabiting earth today descended from ancestral species (descent with modification) and natural selection is the mechanism for such descent with modification. Natural Selection states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals, resulting in a change in the populations genetic composition over time.

Convergent Evolution

Convergent evolution takes place when species of different ancestry begin to share analogous traits because of a shared environment or other selection pressure. For example, whales and fish have some similar characteristics since both had to evolve methods of moving through the same medium : water.

Darwin‘s finches

Divergent Evolution: Evolutionary pattern in which two species gradually become increasingly different. This type of evolution often occurs when closely related species diversify to new habitats. On a large scale, divergent evolution is responsible for the creation of the current diversity of life on earth from the first living cells. On a smaller scale, it is responsible for the evolution of humans and apes from a common primate ancestor. Adaptive radiation is one example of divergent evolution.

Directional selection

shifts the overall makeup of the population by favoring variants of one extreme within a population. Natural selection may be directional: it may favor, for example, smaller individuals and will, if the character is inherited, produce a decrease in average body size. Directional selection could, of course, also produce an evolutionary increase in body size if larger individuals had higher fitness.

Disruptive selection,

like directional selection, favors the variants of opposite extremes over intermediate individuals. Disruptive selection differs in that sudden changes in the environment creates a sudden force favoring that. In nature, sexual dimorphism is probably a common example.

Founder Effect

A cause of genetic drift attributable to colonization by a limited number of individuals from a parent population. When few individuals colonize a new habitat, genetic drift will more than likely occur.

The founder population is small and again the alleles present in this small population will not be representative of the original population. Saltation (from Latin, saltus, "leap") is a sudden change from one generation to the next, that is large, or very large, in comparison with the usual variation of an organism. The term is used for occasionally hypothesized, non gradual changes (especially single-step speciation) that are atypical of, or violate, standard concepts involved in neo-Darwinian evolution.

Genetic drif

Changes in the frequencies of alleles in a population that occur by chance, rather than because of natural selection.

Gene frequency

The frequency in the population of a particular gene relative to other genes at its locus. Expressed as a proportion (between 0 and 1) or percentage (between 0 and 100 percent).

Gene pool

All the genes in a population at a particular time.

Geological time scale: Tabular record of the divisions of earth history. Major divisions are known as"eras", these in turn are divided into"periods", which are further subdivided into "epochs".Era→ period →epoch →geographical time scale Imprinting: a special type of learned behavior in which the learning occurs only during a brief, sensitive period early in the animal‘s life; it usually cannot be unlearned. It may involve an attachment for another individual regarded as the animal‘s mother and may influence its choice of mate later in life.

Hardy-Weinberg principle

In population genetics, the idea that if a population experienced no selection, no mutation, no migration, no genetic drift, and are randomly mating, then the frequency of each allele and the frequencies of genotype in ardy-Weinberg principle: In population genetics, the idea that if a population experienced no selection, no mutation, no migration, no genetic drift, and are randomly mating, then the frequency of each allele and the frequencies of genotype in the population would

mating, then the frequency of each allele and the frequencies of genotype in the population would remain the same (constant) from one generation to the next generation. p2 + 2pq + q2 = 1 or, (p + q)2 = 1Calculation of allele frequencies Recessive traits If the frequency of a recessive trait such as cystic fibrosis or PKU is known, it is possible to calculate allele frequencies and genotype frequencies using the Hardy Weinberg equation and its assumptions are as follows:

i. say 1 in 1, 2500 Indian newborns have cystic fibrosis which means that the frequency of homozygotes for this recessive trait is $q^2 = 1/2,500 = 0.0004$

ii. The square root of the frequency of recessives is equal to the allele frequency of the cystic fibrosis allele q = (0.0004)0.5 = 0.02

iii. The frequency of the normal allele is equal to 1 - the frequency of the cystic fibrosis allele p = 1- q = 1 - 0.02 = 0.98105

iv. The frequency of carriers (heterozygotes) for the cystic fibrosis allele is 2pq = 2 (0.98)(0.02) = 0.04 or 1/25

v. The frequency of homozygotes for the normal allele is $p^2 = (0.98)^2 = 0.96$vi. Thus the population is composed of three genotypes at the calculated frequencies of homozygous normal = 0.96, heterozygous carriers = 0.04, homozygous affected = 0.0004 Macroevolution: large scale evolutionary changes, occurring over a long period Macroevolution: large scale evolutionary changes, occurring over a long period of time and involving the origin of major taxa. Example: extinction of Dinosaurs

Superficial but close resemblance of one organism to another or to natural objects among which it lives, that secures its concealment, protection or some other advantage so that it either escapes itself from observation or advertises as being harmful, which is not actually the case. The organism which mimics is known as mimic or mimetic and the organism or object which is imitated or copied is called the model. The palatable viceroy butterfly, Lementis, which can be easily preyed upon, mimics the distasteful or a non-palatable monarch butterfly, Danais.

states that a population of organisms can change over the generations if individuals having certain heritable traits leave more offspring than other individuals resulting in a change in the populations genetic composition over time.