

Natural Selection and Evolution - Vocabulary and Concepts

Natural Selection - is the differential survival and reproduction of some individuals over others due to differences in their traits. Natural selection is based on 3 basic principles. 1. There is variation in traits within a population. 2. There is differential survival and reproduction based on the traits. 3. There is heredity of traits. Variations of traits that increase survival and reproductive success are more likely to be passed on to future generations. In other words, if you have variation of traits, differential survival and reproduction, and heredity, eventually you will have evolution by natural selection as an outcome.

Artificial Selection - the intentional breeding of plants or animals for their desirable traits, often called selective breeding. This process is called artificial selection because people (instead of nature) select which organisms get to reproduce.

Evolution - changes in the frequencies of alleles within a population of organisms. Mechanisms that can lead to changes in allele frequencies (evolution) include natural selection, genetic drift, mutation and gene flow.

Allele - one of a number of alternative forms of the same gene or same genetic locus. Sometimes, different alleles can result in different observable phenotypic traits, such as different pigmentation.

Allele Frequency - the relative frequency of an allele (alternative forms of a gene) at a particular locus in a population. Specifically, it is the fraction of all chromosomes in the population that carry that allele.

Phenotype - an organism's observable characteristics or traits.

Genotype - an organism's collection of genes.

Derived Traits - traits that exist in a present organism, but did not exist in the organism's ancestors.

Ancestral Traits - traits that exist in a present organism and also in the organisms ancestors, for example teeth or nails.

Homology - a characteristic shared by two species (or other taxa) that is similar because of common ancestry. Homology can be morphological (anatomy features such as the humerus in mammals), Embryological (similarities in embryo between taxa), or Molecular (similarities in DNA, RNA and proteins).

Vestigial - A structure in an organism that has lost all or most of its original function in the course of evolution, such as human appendixes.

Analogous - structures in different species having the same appearance, structure or function but have evolved separately, thus do not share common ancestor. For example the wings of insects and birds.

Biogeography - the study of the distribution of species.

Adaptation – a trait shaped by natural selection that increases and organisms chance of survival and reproductive success. For example camouflage or mimicry.

Fitness – a measure of the relative contribution a trait makes to the next generation, often expressed as the number of viable offspring an organism produces in the next generation.

Hardy-Weinberg Principle – stats that in the absence of evolutionary forces allele frequency remains constant. Also called genetic equilibrium.

Genetic Drift – any change in allele frequency in a population due to chance.

Founder Effect - a special case of genetic drift, occurring when a small group in a population splinters off from the original population and forms a new isolated population that carries a random subset of the original population's genes.

Genetic Bottleneck – when a population declines to a very small number and then rebounds. The resulting new population usually has reduced genetic diversity due to inbreeding.

Gene Flow - the transfer of alleles or genes from one population to another. Migration into or out of a population may be responsible for a change in allele frequencies. Immigration may also result in the addition of new genetic variants (alleles) to the established gene pool of a particular species or population.

Mutation – a random change in genetic material. Mutations result from damage to DNA which is not repaired, errors in the process of replication, or from the insertion or deletion of segments of DNA. Mutations may or may not produce changes in the observable characteristics (phenotype) of an organism. Mutations are usually harmful or even fatal to an organism. However, if the mutation provides a selective advantage it can be naturally selected for and lead to evolution.

Directional Selection - natural selection for one extreme trait.

Disruptive Selection - natural selection for two (or more) extreme traits.

Stabilizing Selection - natural selection for the median (average value) trait.

Allopatric Speciation- occurs when a new species evolves in geographic isolation from its ancestor. It can happen like this: One species could split into two if a physical barrier, such as a new river, divides its geographic range. If the barrier is large enough, then gene flow between them would stop and the two separate populations would evolve independently. Over time, different alleles would appear in each population due to genetic drift, natural selection of different traits, or possibly mutation. If the two populations are separated long enough for significant divergence to take place, then even if the barrier is removed and the populations are reunited, they might remain distinct from each other. There would now be two species where there was formerly one.

Sympatric Speciation - a species splits into two without any separation of the ancestral species' geographic range.

Adaptive Radiation - a process in which species diversify rapidly into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches. Starting with a single recent ancestor, this process results in an array of species exhibiting different traits. Very often this occurs on islands. Examples include Darwin's Finches in the Galapagos, Anolis lizards on Caribbean islands and many others.

Divergent Evolution - the process where members of a species become more and more different, eventually resulting in two (or more) new species.

Convergent Evolution - the process where species not closely related, independently evolve similar traits as a result of having to adapt to similar environments or ecological niches.

Coevolution - when two (or more) species affect each other's evolution. For example, an evolutionary change in the traits of a plant, might affect the traits of an herbivore that eats the plant, which in turn might affect the evolution of the plant, which might affect the evolution of the herbivore...and so on.

Gradualism – a theory that suggests that evolution proceeds in small, gradual steps over long periods of time.

Punctuated Equilibrium - a theory that suggests that once species appear in the fossil record they will become stable, showing little evolutionary change for most of their history. This state is called stasis. When significant evolutionary change occurs, it is restricted to rare, relatively rapid events where a species splits into two or more distinct species, rather than one species gradually transforming into another.