

Natural Selection Overview

Causes organisms with heritable traits that favor survival (provide a competitive advantage) tend to survive longer and are able to create a greater amount of offspring that are likely to inherit this favorable trait

Effect As organisms with favorable traits are able to create more offspring with this trait, the presence of the trait (often represented by allele frequency) will increase within the population over time

Types of Natural Selection

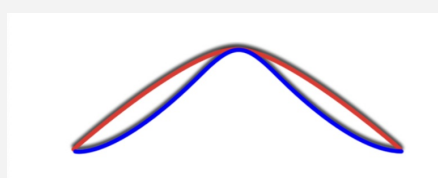
Artificial Selection humans select desirable traits and breed organisms to produce these traits, rather than allowing organisms to reproduce (evolve and change gradually) without human interference

Stabilizing Selection occurs when selective pressures work against two extremes of a trait in favor of the intermediate or "middle" trait

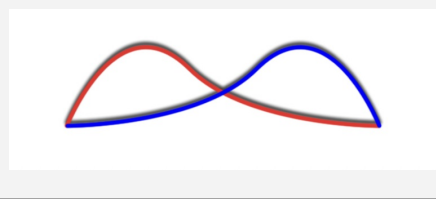
Directional Selection selective pressures work in favor of one extreme of a trait

Disruptive Selection selective pressures work in favor of two extremes of a trait against the intermediate trait

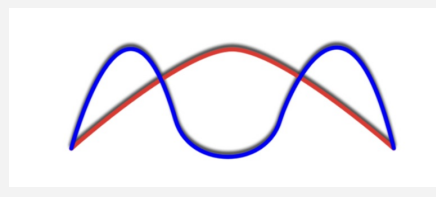
Stabilizing Selection



Directional Selection



Disruptive Selection



Evolution

Describe the types of data that provide evidence for evolution evolution is supported by scientific evidence from many different disciplines - geographical, geological, physical, biochemical, and mathematical data

Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time molecular, morphological, and genetic evidence from present and extinct organisms adds to our understand of evolution fossils can be dated by a variety of methods - the age of the rocks where a fossil is found, the rate of decay of isotopes, and geographical data morphological homologies represent features shared by common ancestry a comparison of DNA nucleotide sequences and/or protein amino acid sequences provides evidence for evolution and common ancestry

Evolution (cont)

Explain how evolution is an ongoing process in all living organisms populations of organisms continue to evolve all species have evolved and continue to evolve: genomic changes over time, continuous change in fossil records, evolution of resistance to antibiotics, pesticides, herbicides, or chemotherapy drugs, and pathogens evolve and cause emergent diseases evolution ensures that organisms are fully adapted to their surroundings, and gives rise to new species, as well as making others extinct

Evolution (cont)

Describe the types of evidence that can be used to infer an evolutionary relationship

phylogenetic trees and cladograms show evolutionary relationships among lineages

phylogenetic trees show the amount of change over time

calibrated by fossils or a molecular clock

traits that are either gained or lost during evolution can be used to construct phylogenetic trees and cladograms

molecular data typically provides more accurate and reliable evidence than morphological traits in the construction of phylogenetic trees or cladograms

Variation

Importance of phenotypic variation

Phenotypic variation is important because the environment may change at any point to favor different traits. If there is not variation in a population when the environment changes the population may not be able to survive to change with the environment.

Acquired characteristics

modifications caused by an individual's environment that can be inherited by its offspring

Variation (cont)

Population variation

distribution of phenotypes in a population

Variation

genetic differences among individuals in a population

Environment

Effects of environment on changes in the population

change in an organisms environment forces the organism to adapt to fit the new environment, eventually causing it to evolve into a new species

convergent evolution occurs when similar selective pressures result in similar phenotypic adaptations in different populations or species

Adaptation

heritable trait or behavior in an organism that aids in its survival and reproduction in its present environment

Allopatric speciation

speciation that occurs via geographic separation

Habitat isolation

reproductive isolation resulting when populations of a species move or are moved to a new habitat, taking up residence in a place that no longer overlaps with the other populations of the same species

Bottleneck effect

magnification of genetic drift as a result of natural events or catastrophes

Environment (cont)

Geographical variation

differences in the phenotypic variation between populations that are separated geographically

Selective pressure

environmental factor that causes one phenotype to be better than another

Hardy Weinberg Equilibrium

The Hardy--Weinberg equation

operates under the following assumptions:

The population contains only diploid organisms that reproduce sexually. Generations do not overlap and mating occurs randomly. The population size is infinitely large. Allele frequencies are roughly equal between the sexes. There is no mutation, migration, or selection occurring in the population.

Hardy--Weinberg principle of equilibrium

a stable, non-evolving state of a population in which allelic frequencies are stable over time

explain the impacts on the population if any of the conditions of Hardy--Weinberg are not met

changes in allele frequencies provide evidence for the occurrence of evolution in a population

small populations are more susceptible to random environmental impact than large populations

leads to variation in a population

Hardy Weinberg Eq.

$$p + q = 1$$

$$(p + q)^2 = 1$$

$$p^2 + 2pq + q^2 = 1$$

p = frequency of allele A
 q = frequency of allele a
 p² = frequency of AA genotype
 2pq = frequency of Aa genotype
 q² = frequency of aa genotype

Random Occurrences

explain evolution is also driven by
 how random occurrences
 random mutations is a random process
 occur- that contributes to evolution
 ences genetic drift is a nonselective
 affect the process occurring in small
 genetic populations: bottlenecks and
 makeup of founders effect migrat-
 a ion/gene flow can drive
 population evolution

Bottleneck magnification of genetic drift
 effect as a result of natural events or
 catastrophes

Founder event that initiates an allele
 effect frequency change in part of
 the population, which is not
 typical of the original
 population

Genetics

Gene flow of alleles in and out of a
 flow population due to the migration of
 individuals or gametes

Gene all of the alleles carried by all of
 pool the individuals in the population

Genetic effect of chance on a population's
 drift gene pool

Genetics (cont)

Genetic distribution of the different
 structure possible genotypes in a
 population

Genetic diversity of alleles and
 variance genotypes in a population

Genotype the proportion of a specific
 frequency genotype in a population
 relative to all other genotypes
 for those genes that are
 present in the population

Reproduction

Reprod- situation that occurs when a
 utive species is reproductively
 isolation independent from other
 species; this may be brought
 about by behavior, location,
 or reproductive barriers

Assortative when individuals tend to mate
 mating with those who are phenot-
 ypically similar to themselves

Evolut- individual's ability to survive
 ionalary and reproduce
 fitness

Fitness measure of successful
 reproduction, the passing on
 alleles to the next generation

Inbreeding mating of closely related
 individuals

Nonrandom changes in a population's
 mating gene pool due to mate choice
 or other forces that cause
 individuals to mate with
 certain phenotypes more
 than others



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Not published yet.

Last updated 16th March, 2023.

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