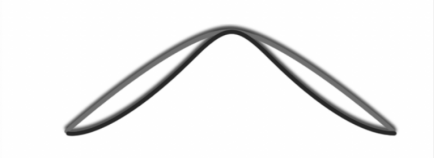
Natural Selection Overview

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

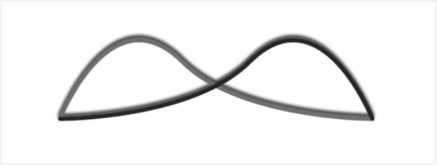
Types of Natural Selection

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

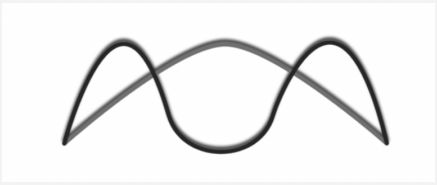
Stabilizing Selection



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
p^2 = frequency of AA genotype
2pq = frequency of Aa genotype
q^2 = frequency of aa genotype

Random Occurrences

explain how random occurr-ences affect the genetic makeup of a population	evolution is also driven by random occurrences mutations is a random process that contributes to evolution genetic drift is a nonselective process occurring in small populations: bottlenecks and founders effect migrat-ion/gene flow can drive evolution
Bottleneck effect	magnification of genetic drift as a result of natural events or catastrophes
Founder effect	event that initiates an allele frequency change in part of the population, which is not typical of the original population

Genetics

Gene flow	flow of alleles in and out of a population due to the migration of individuals or gametes
Gene pool	all of the alleles carried by all of the individuals in the population
Genetic drift	effect of chance on a population's gene pool

Genetics (cont)

Genetic structure	distribution of the different possible genotypes in a population
Genetic variance	diversity of alleles and genotypes in a population
Genotype frequency	the proportion of a specific genotype in a population relative to all other genotypes for those genes that are present in the population

Reproduction

Reprod-uctive isolation	situation that occurs when a species is reproductively independent from other species; this may be brought about by behavior, location, or reproductive barriers
Assortative mating	when individuals tend to mate with those who are phenot-ypically similar to themselves
Evolut-ionary fitness	individual's ability to survive and reproduce
Fitness	measure of successful reproduction, the passing on alleles to the next generation
Inbreeding	mating of closely related individuals
Nonrandom mating	changes in a population's gene pool due to mate choice or other forces that cause individuals to mate with certain phenotypes more than others