

Microevolution is a generation-to-generation change in a population's allele frequencies

- The Hardy-Weinberg theory provides a baseline against which we can compare the allele and genotype frequencies of an evolving population.
- We can define **microevolution** as generation-to-generation change in a population's frequencies of alleles.
- Four factors can alter the allele frequencies in a population:
 - genetic drift
 - gene flow
 - mutation
 - natural selection
- All represent departures from the conditions required for the Hardy-Weinberg equilibrium.
- Natural selection is the only factor that generally adapts a population to its environment.
- The other three may effect populations in positive, negative, or neutral ways.
- **Genetic drift** occurs when changes in gene frequencies from one generation to another occur because of chance events (sampling errors) that occur when populations are finite in size.
 - The smaller the sample, the greater the chance of deviation from an expected result.
- For example, in a small wildflower population with a stable size of only ten plants, genetic drift can completely eliminate some alleles.
- Genetic drift at small population sizes often occurs as a result of two situations: *the bottleneck effect or the founder effect*.
- The **bottleneck effect** occurs when the numbers of individuals in a larger population are drastically reduced by a disaster.
 - Reduces population size drastically
 - Reduces genetic diversity and therefore adaptability
 - For example, the genetic variation in the three small surviving wild populations of cheetahs is very low when compared to other mammals.
 - Their genetic variation is similar to highly inbred lab mice!

- The **founder effect** occurs when a new population is started by only a few individuals that do not represent the gene pool of the larger source population.
 - Founder effects have been demonstrated in human populations that started from a small group of colonists.
 - Example: dwarfism (dd): Switzerland – 1 in 1,000 dd
Pennsylvania Amish – 1 in 14 dd , descendants of 30
Swiss with high percentage of dwarfism
- **Gene flow** is genetic exchange due to migration of fertile individuals or gametes between populations.
- Gene flow tends to reduce differences between populations.
 - If extensive enough, gene flow can transform neighboring populations into a single population with a common genetic structure.
 - The migration of people throughout the world is transferring alleles between populations that were once isolated, increasing gene flow.
- A **mutation** is a change in an organism's DNA.
- A new mutation that is transmitted in gametes can immediately change the gene pool of a population by substituting the mutated allele for the older allele.
- While mutations at an individual locus is a rare event, the cumulative impact of mutations at *all* loci can be significant.
 - Each individuals has thousands of genes, any one of which could experience a mutation.
 - Populations are composed of thousands or millions of individuals that may have experienced mutations.
- Over the long term, mutation is a very important to evolution because it is the original source of genetic variation that serves as the raw material for natural selection.
- **Natural selection** is clearly a violation of the conditions necessary for the Hardy-Weinberg (H-W) equilibrium.
 - H-W expects that all individuals in a population have **equal ability** to survive and produce viable, fertile offspring.
 - However, in a population with variable individuals, **natural selection** will lead some individuals to leave more offspring than others.
 - Selection results in some alleles being passed along to the next generation in numbers **disproportionate** to their frequencies in the present generation.
 - In our wildflower example, if herbivorous insects are more likely to locate and eat white flowers than red flowers, then plants with red flowers (either RR or Rr) are more likely to leave offspring than those with white flowers (rr).
 - This would increase the frequency of the R allele in the population and decrease that of the r allele.
- Natural selection accumulates and maintains favorable genotypes in a population.

The effect of selection on a varying characteristic can be directional, diversifying, or stabilizing

- Natural selection can affect the frequency of a heritable trait in a population, leading to directional selection, diversifying selection, or stabilizing selection.
- **Directional selection** is most common during periods of environmental change or when members of a population migrate to a new habitat with different environmental conditions.
- Directional selection shifts the frequency curve for a phenotypic character in one direction by favoring what had been rare individuals.
- Peter and Rosemary Grant documented directional evolution in beak size for the medium ground finch in the Galapagos Islands.
 - During wet years when seeds are abundant, all individuals consume relatively few large seeds.
 - However, during dry years when seeds are scarce, the small seeds are quickly depleted and birds with larger, stronger beaks that can crack large seeds are at an advantage, and their genes increase in the population.
- **Diversifying selection** occurs when environmental conditions favor individuals at both extremes of the phenotypic range over intermediate phenotypes – favors 2 or more varieties
- Diversifying selection can result in balanced polymorphism – the maintenance of two or more phenotypic forms in a population
 - For example, two distinct bill types are present in black-bellied seedcrackers in which larger-billed birds are more efficient when feeding on hard seeds and smaller-billed birds are more efficient when feeding on soft seeds.
- **Stabilizing selection** favors intermediate variants and acts against extreme phenotypes.
- Stabilizing selection reduces variation and maintains the predominant phenotypes.
 - Human birth weight is subject to stabilizing selection.
 - Babies much larger or smaller than 3-4 kg have higher infant mortality.