

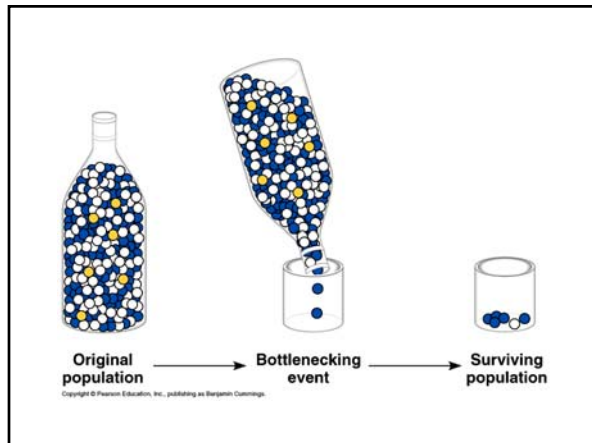
# Microevolution

## There are five potential causes of microevolution

1. **Genetic drift** is a change in a gene pool of a small population due to chance. The effect of a loss of individuals from a population is much greater when there are fewer individuals.

•The **bottleneck effect** is genetic drift resulting from a disaster (earthquakes, floods, fires, etc.) that reduces population size.

*i.e.-* Hunters in the 1890s reduced the population northern elephant seals in California to about 20 individuals. Since then it has become a protected species, and the population has grown to over 30,000 members. However, in examining the gene loci researchers found no variation.



- There is about .04% heterozygosity in the gene loci of the South African cheetah, and 1.4% heterozygosity in the East African population. These organisms suffered bottlenecks due to disease, hunting, and drought.

**NOTE:** This is a high degree of genetic uniformity- higher than some strains of highly inbred laboratory mice.

•The **founder effect** is genetic drift resulting from colonization of a new area by a small number of individuals.

*i.e.-* The ancestors of the Galapagos marine iguanas were probably a few stray land iguanas that arrived from the South American mainland.

2. **Gene flow** is a gain or loss of alleles from a population due to immigration or emigration of individuals or gametes.

3. **Mutations** are rare events but they do occur constantly (as often as one per gene locus per  $10^5$  gametes). Mutation provides the raw material on which other mechanisms of microevolution work. Mutation is rarely, if ever, directly responsible for evolutionary change.

4. **Nonrandom mating** is more often the case, particularly among animals, where choice of mates is often an important part of behavior.

5. **Differential success in reproduction**, is probably always the case for natural populations. The resulting natural selection is the factor that is likely to result in adaptive changes to a gene pool.

**NOTE:** Differential reproductive success is measured in terms of fitness differences.

### Variation is extensive in most populations

- Variation in a single characteristic can be caused by the effect of one or more genes or from the action of the environment inducing phenotypic change.
- A population is **polymorphic** for a characteristic if two or more morphs (contrasting forms) are noticeably present; these may be visible or biochemical characteristics. Much of this variation can be attributed to polygenic inheritance.



Garter Snakes

- Most populations exhibit geographic variation in the distribution of characteristics; this variation may show stratification or be **clinal**, varying smoothly across the population.

**i.e.-** The body size of white-tailed deer, tends to increase gradually with increasing latitude and colder climate. Large size is adaptive in northern latitudes because it reduces the ratio of body surface to volume and helps conserve body heat.

### How natural selection affects variation

- An ancestral population is varied, with individuals having characteristics suited for many types of environments.
- Over successive generations, those individuals with characteristics best suited for the environment leave more offspring. These characteristics increase in subsequent generations.
- Those individuals with characteristics not suited for the environment leave fewer offspring. These characteristics decrease in subsequent generations.

- The effects of recessive alleles are not often displayed in diploid organisms. Recessive alleles may be "*hidden*" from natural selection when they are found in combination with a dominant allele. Thus variation is retained in a population subject to selection.

**NOTE:** Since such variation is hidden it takes many generations to eliminate (if eliminated at all) disadvantageous recessive alleles from a population.

- **Heterozygote advantage** is a situation in which the heterozygote is favored over either homozygote. As a result, variation is maintained in the population

**i.e.-** Sickle-cell & Tay-Sachs

**Not all genetic variation may be subject to natural selection**

- Some characteristics showing neutral variation (such as human fingerprints) apparently provide no selective advantage.
- The frequency of these characteristics may change as a result of genetic drift, but not by natural selection.
- It is impossible to demonstrate that an allele brings no benefit to an organism, and it may be that some supposedly neutral variations provide benefits in some environments.

**There are three main modes of natural selection**

1. **Stabilizing selection** tends to narrow the range in the population variability toward some intermediate form. This occurs in relatively stable environments.
2. **Directional selection** tends to move the modal (most common) form toward one of the extremes. This is most common during times of environmental change, or when organisms find themselves in new habitats.
3. **Diversifying selection** occurs when environmental conditions are varied in a way that favors both extremes over the intermediate form.

