

Chapter 13d - Mechanism of Evolutionary Change

Natural populations rarely, if ever, meet *all* the criteria of an equilibrium population. Populations are, then, usually *evolving* e.g., undergoing genetic changes (**changes in allele frequencies**) over time

Mechanisms of evolutionary change (or violations in the HW equilibrium)

- mutations
- migration or gene flow
- genetic drift
- nonrandom mating
- natural selection and sexual selection

Mutations (ultimate source of genetic variation)

Mutations are heritable changes in the DNA: Chromosomal mutations and Gene mutations

Mutations can alter allele frequencies within a population by changing one allele into a different allele

Neutral mutation - affects the phenotype, but this has no impact on the organism's survival or reproduction

Beneficial mutation - affects the phenotype; results in an increase in survival or reproduction

Gene Flow or Migration

Allele frequencies will also change when individuals leave a population (emigrate = lose alleles) or when new individuals enter a population (immigrate = gain alleles). Alleles are carried with them and are either adding or removing alleles from the population

Genetic Drift

Unpredictable changes in allele frequency due to small population size

Population bottleneck - genetic drift resulting from reduction of a population, typically via a natural disaster, such that the surviving population is no longer genetically representative of the original population

Founder Effect - genetic drift that occurs when a few individuals separate from a large population and establish a new one

Nonrandom Mating

A limited probability of mating with any other individual in the population

Nonrandom mating may result from

Inbreeding - Results in changes in the genotype frequencies predicted by HW, although the frequencies of alleles in the population may remain unchanged

Assortative mating - individuals select partners that are like themselves in certain phenotypic characters

Natural Selection

Differential survival and reproduction of alternate genetic variants

Selection occurs because members of a population exhibit variability in their traits and this variability is heritable

Some varieties of the heritable traits are more adaptive than others, and thus improve the chances that individuals possessing them will survive

These individuals will probably reproduce more and leave more offspring in subsequent generations

The result of NS is **adaptation**, the accumulation of traits that increases an organisms *fitness* (ability to survive and reproduce)

Note: Natural Selection does not necessary yield perfection

Historical constraints

Adaptive compromises

Chance events

Availability of variations

Modes of Natural Selection

NS can affect populations in 3 ways: directional selection, stabilizing selection, and disruptive selection

The mode of selection depends on the relationship between phenotype and fitness

The type of selection can be described by its effect on average trait values and trait variance.

<u>selection</u>	<u>mean trait value</u>	<u>trait variance</u>
stabilizing	no change	decreases
directional	change	usually no change
disruptive	no change	increases

Stabilizing Selection - This form of selection occurs when intermediate phenotypes have a higher fitness than extreme phenotypes.

Directional Selection - Directional selection occurs when an extreme phenotype has higher fitness than other phenotypes.

Disruptive Selection - Disruptive selection occurs when intermediate phenotypes are of lower fitness than extreme phenotypes.

Sexual Selection

Selection based on variation in secondary sex characteristics, leading to the enhancement of sexual dimorphism

Males and females of many animal species show marked differences in addition to differences in the reproductive organs that define the sexes

And this distinction between the secondary sex characteristics of the male and female is called **sexual dimorphism**

Many of these secondary sex characteristics do not appear adaptive, but they enhance reproductive success:

1. Used in male-male aggression (direct or indirect)
2. Used to attract females