

## 10.3 GENETICS AND EVOLUTION

### Gene Pool

- It represents the sum total of alleles for all genes present in a sexually reproducing population.

Large gene pool - more genetic diversity which increases the chances of survival

Small gene pool - less genetic diversity which reduces the chance of survival

- They can be used to determine the allele frequency.

### Mechanisms of change in the allele frequency:

- Mutation
- Gene flow

The movement of alleles into, or out of, a population as a result of immigration or emigration

- Sexual Reproduction
- Genetic Drift

The change in the composition of a gene pool as a result of a chance or random event

- Natural selection

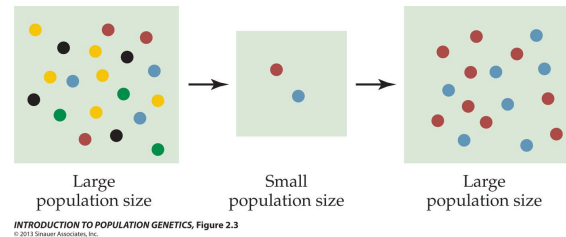


### Allele distribution

- Allele frequencies will change significantly when a large population is reduced to a small population
- The populations can change via population bottlenecks and the founder effect.

### Population Bottlenecks

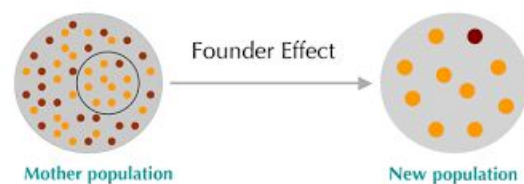
- occur when an event reduces population size by an order of magnitude ( $\sim >50\%$ )
- May result from natural occurrences or can be human-induced
- Surviving population will be less genetically diverse and will be subject to genetic drift.



INTRODUCTION TO POPULATION GENETICS, Figure 2.3  
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### Founder effect

- occurs when a small group breaks away from a larger population to colonize a new territory
- differs from population bottlenecks in that the original population remains largely intact



### Types of selection

Natural selection is the change in the composition of a gene pool in response to a differentially selective environmental pressure

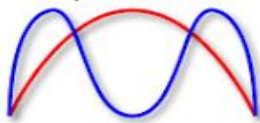
### Stabilizing selection

- an intermediate phenotype is favored at the expense of both phenotypic extremes
- results in the removal of extreme phenotypes
- Operates when environmental conditions are stable and competition is low

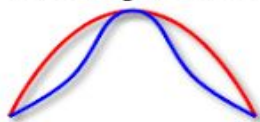
### Directional Selection

- one phenotypic extreme is selected at the cost of the other phenotypic extreme
- causes the phenotypic distribution to clearly shift in one direction
- Operates in response to gradual or sustained changes in environmental conditions

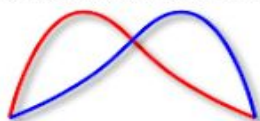
Disruptive selection



Stabilizing selection



Directional selection



### Disruptive Selection

- both phenotypic extremes are favored at the expense of the intermediate phenotypic ranges
- causes the phenotypic distribution to deviate from the center and results in a bimodal spread
- occurs when fluctuating environmental conditions (e.g. seasons) favor the presence of two different phenotypes

### Isolation Barriers

Reproductive isolation occurs when barriers prevent two populations from interbreeding.

Main categories of barriers-

- Prezygotic isolation - occurs before fertilization can occur
- Postzygotic isolation - occurs after fertilisation

### Prezygotic Isolation barriers

1. Temporal Isolation  
occurs when two populations differ in their periods of activity or reproductive cycles
2. Behavioral Isolation  
occurs when two populations exhibit different specific courtship patterns
3. Geographic Isolation  
occurs when two populations occupy different habitats or separate niches within a common region

### Speciation

an evolutionary process that results in the formation of a new species from a pre-existing species

Two mechanisms via which speciation can occur -

- **Allopatric speciation** (geographical isolation)

occurs when a geographical barrier physically isolates populations of an ancestral species

They evolve separately and diverge to a point where they can't interbreed which results in the formation of a new species.

- **Sympatric speciation** (reproductive isolation)

is the divergence of species within the same geographical location (i.e. without a physical barrier)

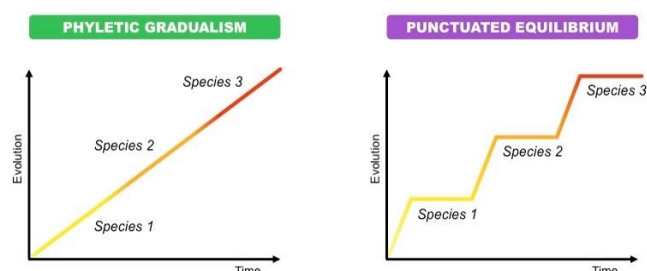
It might be a result of genetic abnormalities.

### Pace of Speciation

Evolution via speciation may occur by one of two alternative models: phyletic gradualism or punctuated equilibrium.

### Phyletic Gradualism

- Speciation occurs uniformly
- Steady and gradual transformation of whole lineages.
- Supported by the fossil records of horses.



### Punctuated Equilibrium

- Species remain stable for long periods of time before undergoing abrupt and rapid change
- Speciation is seen as a periodic process.
- Supported by lack of transitional fossils for many species.