

16-2 Evolution as Genetic Change

Natural selection affects which individuals survive and reproduce and which do not.

If an individual dies without reproducing, it does not contribute its alleles to the population's gene pool.

If an individual produces many offspring, its alleles stay in the gene pool and may increase in frequency.

Evolution is any change over time in the relative frequencies of alleles in a population.

Populations, not individual organisms, can evolve over time.

Natural Selection on Single-Gene Traits

How does natural selection affect single-gene traits?

Natural selection on single-gene traits can lead to changes in allele frequencies and thus to evolution.

Organisms of one color may produce fewer offspring than organisms of other colors.

For example, a lizard population is normally brown, but has mutations that produce red and black forms.

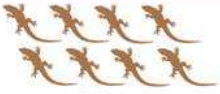

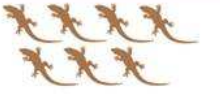






Red lizards are more visible to predators, so they will be less likely to survive and reproduce. Therefore, the allele for red color will become rare.

Black lizards may warm up faster on cold days. This may give them energy to avoid predators. In turn, they may produce more offspring.

The allele for black color will increase in relative frequency.

Natural selection on single-gene traits can lead to changes in allele frequencies and thus to evolution.

Organisms of one color, for example, may produce fewer offspring than organisms of other colors.

Effect of Color Mutations on Lizard Survival			
Initial Population	Generation 10	Generation 20	Generation 30
 80%	 80%	 70%	 40%
 10%	0%	0%	0%
 10%	 20%	 30%	 60%

Natural Selection on Polygenic Traits

How does natural selection affect polygenic traits?

Natural selection can affect the distributions of phenotypes in any of three ways:

- **directional selection**
- **stabilizing selection**
- **disruptive selection**

Directional Selection

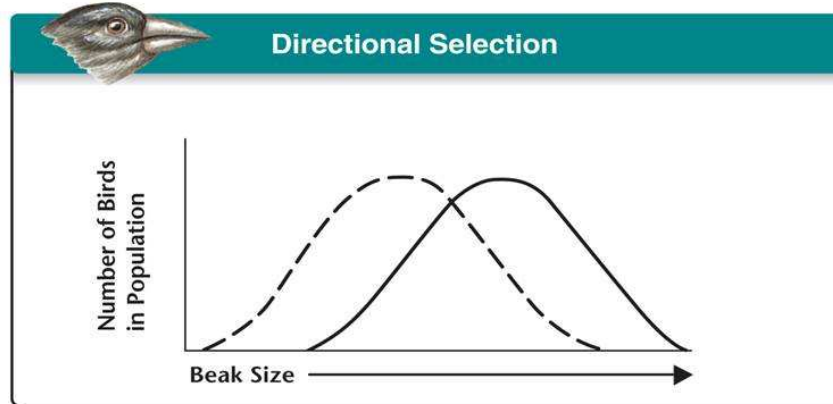
When individuals at one end of the curve have higher fitness than individuals in the middle or at the other end, **directional selection** takes place.

The range of phenotypes shifts as some individuals survive and reproduce while others do not.

Directional selection occurs when individuals at one end of the curve have higher fitness than individuals in the middle or at the other end. In this example, a population of seed-eating birds experiences directional selection when a food shortage causes the supply of small seeds to run low. The dotted line shows the original

distribution of beak sizes. The solid line shows how the distribution of beak sizes would change as a result of selection.

In this case, birds with larger beaks have higher fitness. Therefore, the average beak size increases.



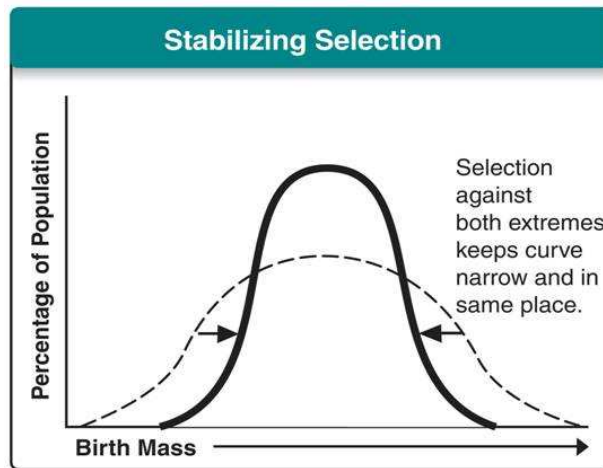
Stabilizing Selection

When individuals near the center of the curve have higher fitness than individuals at either end of the curve, **stabilizing selection** takes place.

This keeps the center of the curve at its current position, but it narrows the overall graph.

In this example of stabilizing selection, human babies born at an average mass are more likely to survive than babies born either much smaller or much larger than average.

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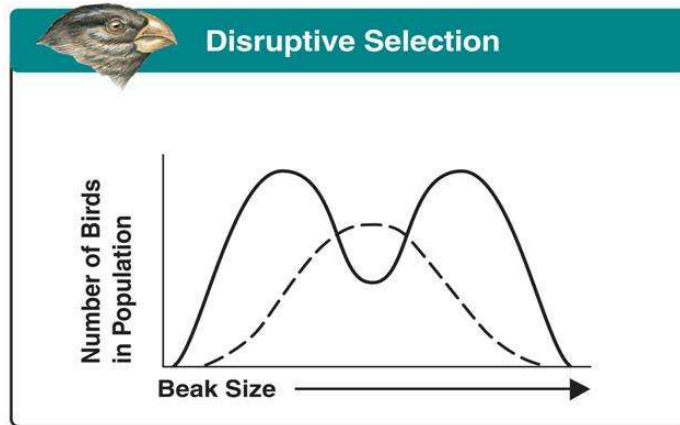
Disruptive Selection

When individuals at the upper and lower ends of the curve have higher fitness than individuals near the middle, **disruptive selection** takes place.

If the pressure of natural selection is strong enough and long enough, the curve will split, creating two distinct phenotypes.

In this example of disruptive selection, average-sized seeds become less common, and larger and smaller seeds become more common. As a result, the bird population splits into two subgroups specializing in eating different-sized seeds.

If average-sized seeds become scarce, a bird population will split into two groups: one that eats small seeds and one that eats large seeds.



Genetic Drift

A random change in allele frequency is called **genetic drift**.

In small populations, individuals that carry a particular allele may leave more descendants than other individuals do, just by chance.

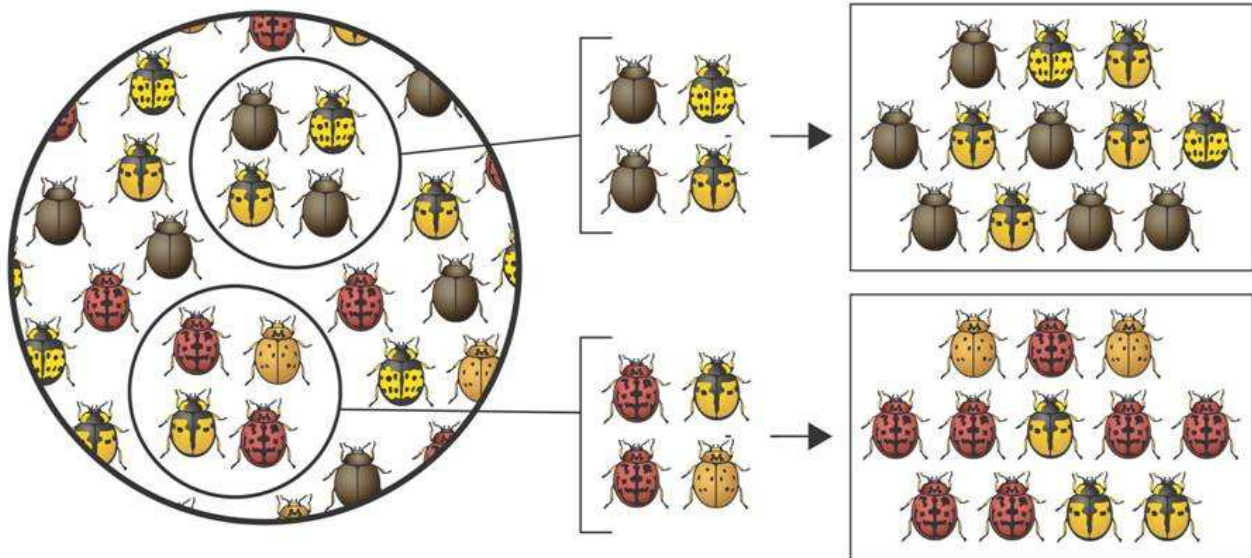
Over time, a series of chance occurrences of this type can cause an allele to become common in a population.

Genetic drift may occur when a small group of individuals colonizes a new habitat.

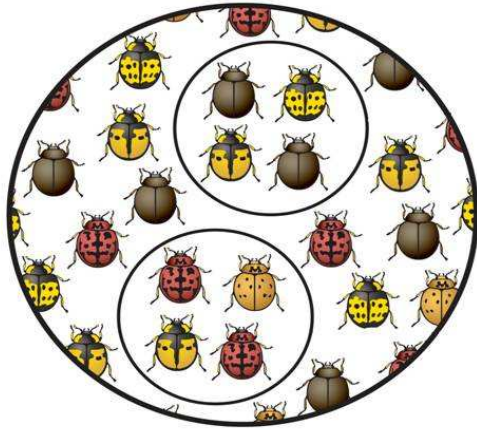
Individuals may carry alleles in different relative frequencies than did the larger population from which they came.

The new population will be genetically different from the parent population.

In small populations, individuals that carry a particular allele may have more descendants than other individuals. Over time, a series of chance occurrences of this type can cause an allele to become more common in a population. This model demonstrates how two small groups from a large, diverse population could produce new populations that differ from the original group.



Sample of Original Population



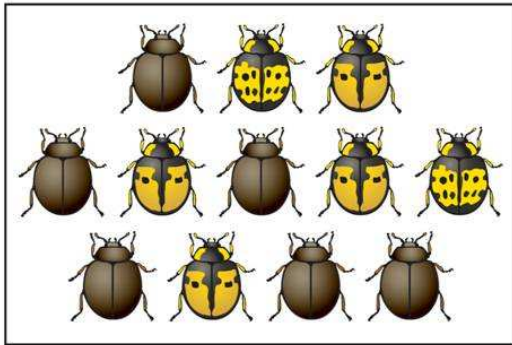
Founding Population A



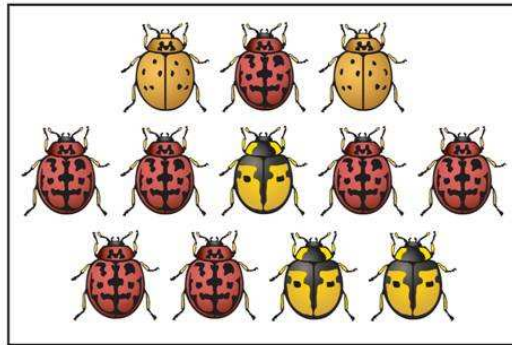
Founding Population B



Descendants



Population A



Population B

When allele frequencies change due to migration of a small subgroup of a population it is known as the **founder effect**.