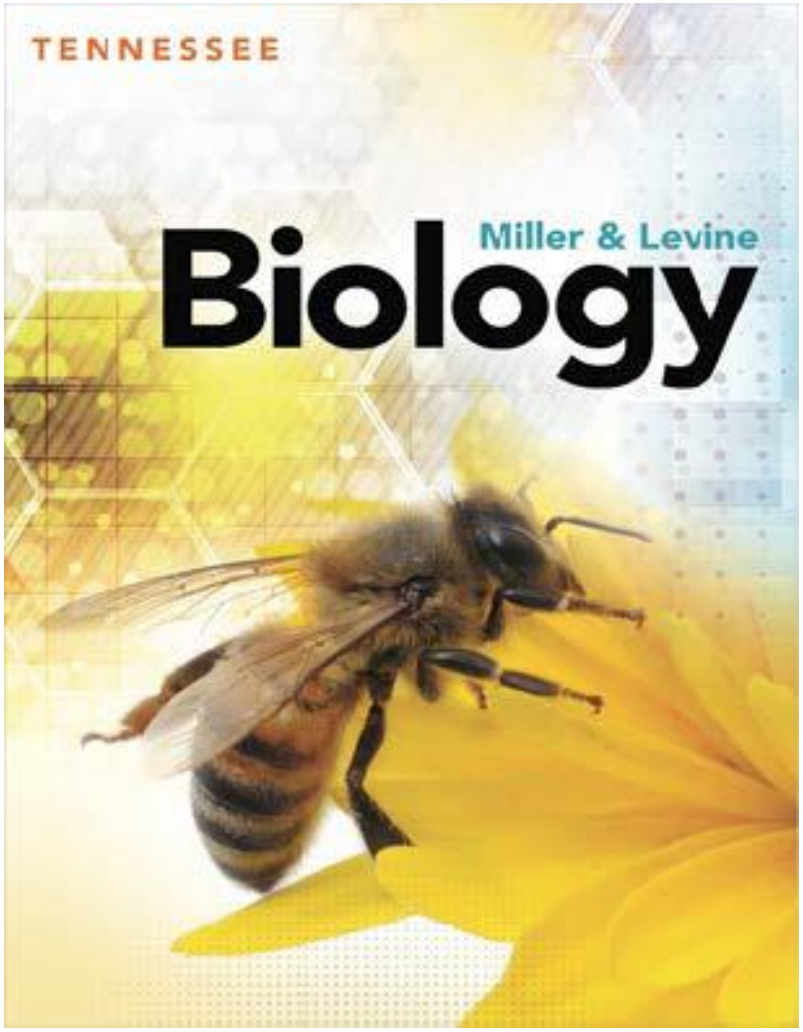


Lesson Overview

18.2 Evolution as Genetic Change in Populations

THINK ABOUT IT

Insect populations often contain a few individuals that are resistant to a particular pesticide. Those insects pass on their resistance to their offspring and soon the pesticide-resistant offspring dominate the population. The relationship between natural selection and genetics explains how pesticide resistance develops.

How Natural Selection Works

- How does natural selection affect single-gene and polygenic traits?
- Natural selection on single-gene traits can lead to changes in allele frequencies and, thus, to changes in phenotype frequencies.
- Natural selection on polygenic traits can affect the distributions of phenotypes in three ways: directional selection, stabilizing selection, or disruptive selection.

How Natural Selection Works

Evolutionary fitness is the success in passing genes to the next generation.

Evolutionary adaptation is any genetically controlled trait that increases an individual's ability to pass along its alleles.

Natural Selection on Single-Gene Traits

Natural selection for a single-gene trait can lead to changes in allele frequencies and then to evolution.

For example, a mutation in one gene that determines body color in lizards can affect their lifespan. So if the normal color for lizards is brown, a mutation may produce red and black forms.

Natural Selection on Single-Gene Traits

If red lizards are more visible to predators, they might be less likely to survive and reproduce. Therefore the allele for red coloring might not become common.

Natural Selection on Single-Gene Traits

Single-Gene Traits: The allele for red coloring might not become common.

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 Single-Gene Traits

Black lizards might be able to absorb sunlight. Higher body temperatures may allow the lizards to move faster, escape predators, and reproduce.

Natural Selection on Single-Gene Traits

Single-Gene Traits: The allele for black color might become more common.

Effect of Color Mutations on Lizard Survival

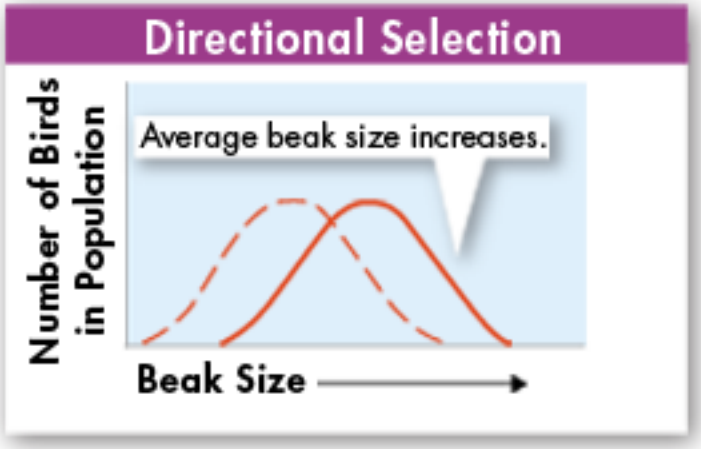
Initial Population	Generation 10	Generation 20	Generation 30
80%	80%	70%	40%
10%	0%	0%	0%
10%	20%	30%	60%

Natural Selection on Polygenic Traits

Polygenic traits have a range of phenotypes that often form a bell curve.

The fitness of individuals may vary from one end of the curve to the other.

Natural selection can affect the range of phenotypes and hence the shape of the bell curve.

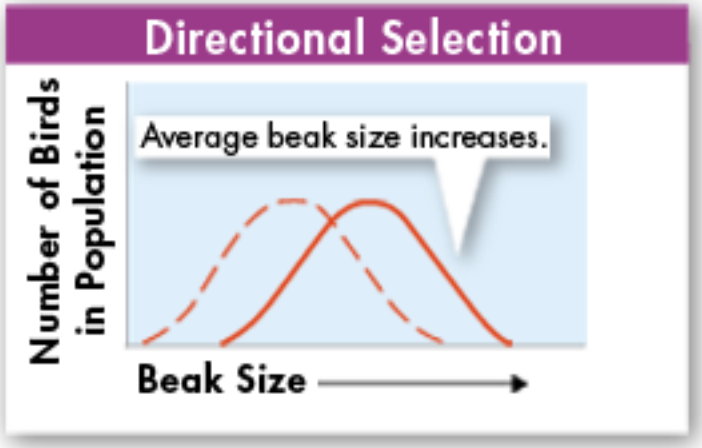


Directional Selection

Directional selection occurs when individuals at one end of the curve have higher fitness than individuals in the middle or at the other end. The range of phenotypes shifts because some individuals are more successful at surviving and reproducing than others.

Directional Selection

For example, if only large seeds were available, birds with larger beaks would have an easier time feeding and would be more successful in surviving and passing on genes.

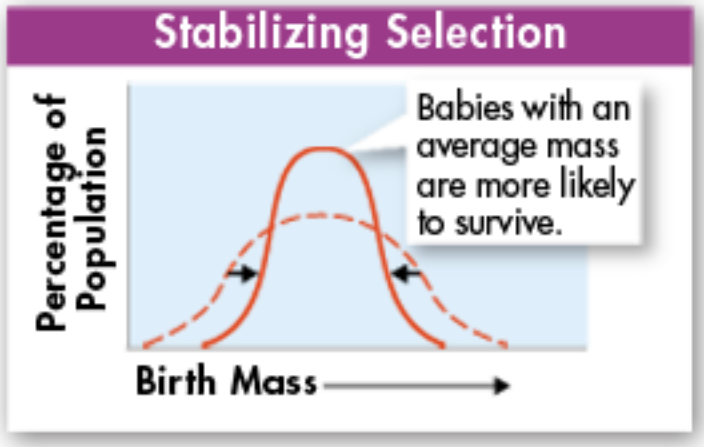


Stabilizing Selection

Stabilizing selection occurs when individuals near the center of the curve have higher fitness than individuals at either end. This situation keeps the center of the curve at its current position, but it narrows the overall graph.

Stabilizing Selection

For example, very small and very large babies are less likely to survive than average-sized individuals. The fitness of these smaller or larger babies is therefore lower than that of more average-sized individuals.

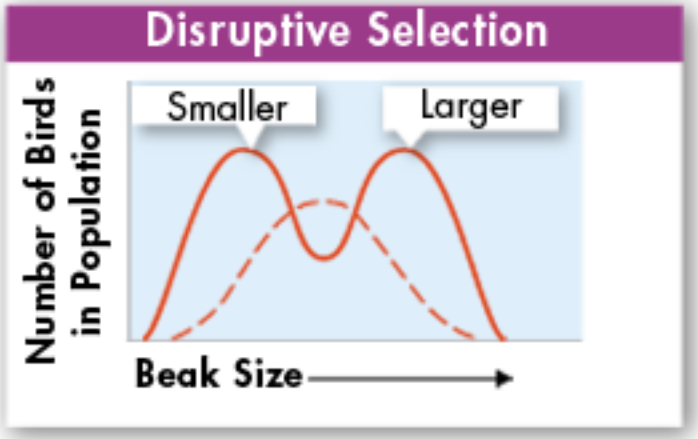


Disruptive Selection

Disruptive selection occurs when individuals at the upper and lower ends of the curve have higher fitness than individuals near the middle. Disruptive selection acts against individuals of an intermediate type and can create two distinct phenotypes.

Disruptive Selection

For example, in an area where medium-sized seeds are less common, birds with unusually small or large beaks would have higher fitness. Therefore, the population might split into two groups—one with smaller beaks and one with larger beaks.



Genetic Drift

- What is genetic drift?

- In small populations, individuals that carry a particular allele may leave more descendants than other individuals, just by chance. Over time, a series of chance occurrences can cause an allele to become more or less common in a population.

Genetic Drift

Genetic drift occurs in small populations when an allele becomes more or less common simply by chance. Genetic drift is a random change in allele frequency.

Genetic Bottlenecks

The **bottleneck effect** is a change in allele frequency following a dramatic reduction in the size of a population.

For example, a disaster may kill many individuals in a population, and the surviving population's gene pool may contain different gene frequencies from the original gene pool.

The Founder Effect

The **founder effect** occurs when allele frequencies change as a result of the migration of a small subgroup of a population.

The Founder Effect

Two groups from a large, diverse population could produce new populations that differ from the original group.