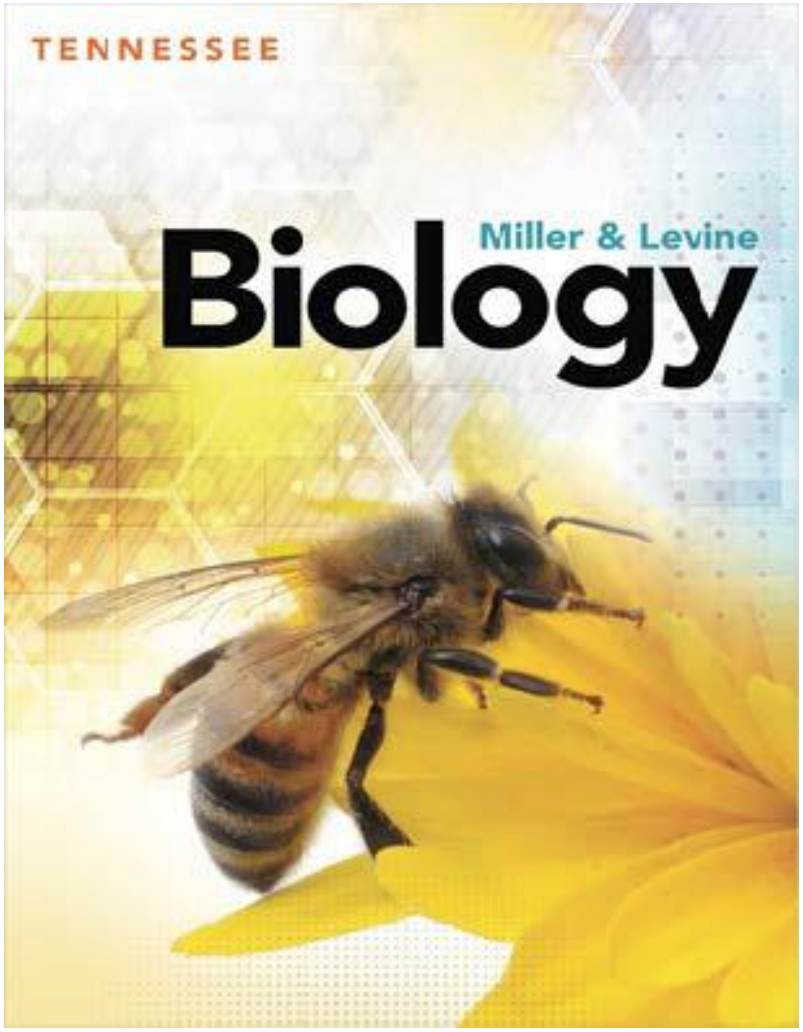


Lesson Overview

18.3 The Process of Speciation

THINK ABOUT IT

Factors such as natural selection and genetic drift can change the relative frequencies of alleles in a population, but this alone does not lead to development of a new species.

How does one species become two?

Isolating Mechanisms

- What types of isolation lead to the formation of new species?

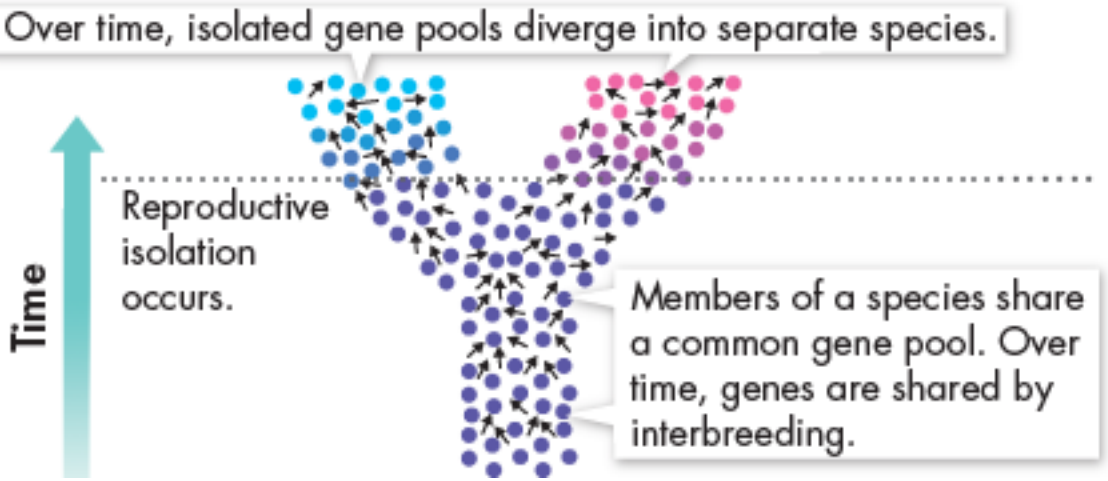
- When populations become reproductively isolated, they can evolve into two separate species. Reproductive isolation can develop in a variety of ways, including behavioral isolation, geographic isolation, and temporal isolation.

Isolating Mechanisms

Speciation is the formation of a new species. A species is a population whose members can interbreed and produce fertile offspring.

Isolating Mechanisms

Reproductive isolation occurs when a population splits into two groups and the two populations no longer interbreed. When populations become reproductively isolated, they can evolve into two separate species.



Behavioral Isolation

Behavioral isolation occurs when two populations that are capable of interbreeding develop differences in courtship rituals or other behaviors.

Geographic Isolation

Geographic isolation occurs when two populations are separated by geographic barriers such as rivers, mountains, or bodies of water.

For example, the Kaibab squirrel is a subspecies of the Abert's squirrel that formed when a small population became isolated on the north rim of the Grand Canyon. Separate gene pools formed, and genetic changes in one group were not passed on to the other.

Temporal Isolation

Temporal isolation happens when two or more species reproduce at different times.

For example, three species of orchid live in the same rain forest. Each species has flowers that last only one day and must be pollinated on that day to produce seeds. Because the species bloom on different days, they cannot pollinate each other.

Testing Natural Selection in Nature

- What did the Grants' scientific investigation show about Galápagos finches?
- The Grants documented that natural selection takes place frequently—and sometimes rapidly.
- The Grants' work also shows that variation within a species increases the likelihood that the species can adapt and survive environmental change.

Testing Natural Selection in Nature

Darwin hypothesized that the Galápagos finches had descended from a common ancestor.

He proposed that natural selection shaped the beaks of different bird populations as they became adapted to eat different foods.

A Testable Hypothesis

Peter and Rosemary Grant from Princeton University realized that Darwin's hypothesis rested on two testable assumptions:

For beak size and shape to evolve, there must be enough heritable variation in those traits to provide raw material for natural selection.

Differences in beak size and shape must produce differences in fitness.

Variation

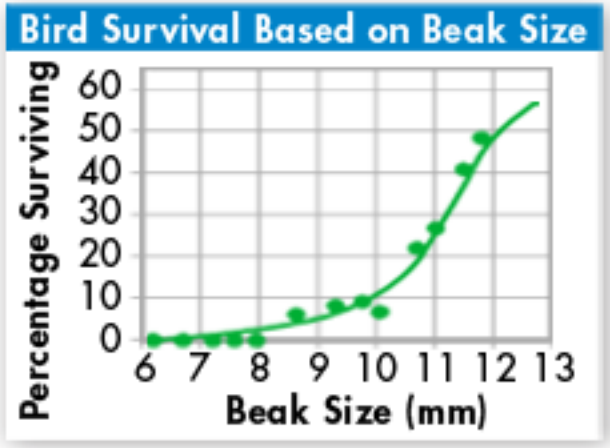
Many of the recorded anatomical characteristics appeared in bell-shaped distributions typical of polygenic traits.

These data indicate there is great variation of heritable traits among the Galápagos finches.

Natural Selection

The Grants' data showed individual finches with different-sized beaks had different chances of surviving drought. When food was scarce, individuals with the largest beaks were more likely to survive.

The Grants observed that average beak size in that finch population increased dramatically over time.



Finch Research in Perspective

The Grants documented directional selection in nature.

Their data also shows that competition and climate change drive natural selection.

In addition, their work shows that variation within a species increases the likelihood that the species can adapt and survive environmental change.

Speciation in Darwin's Finches

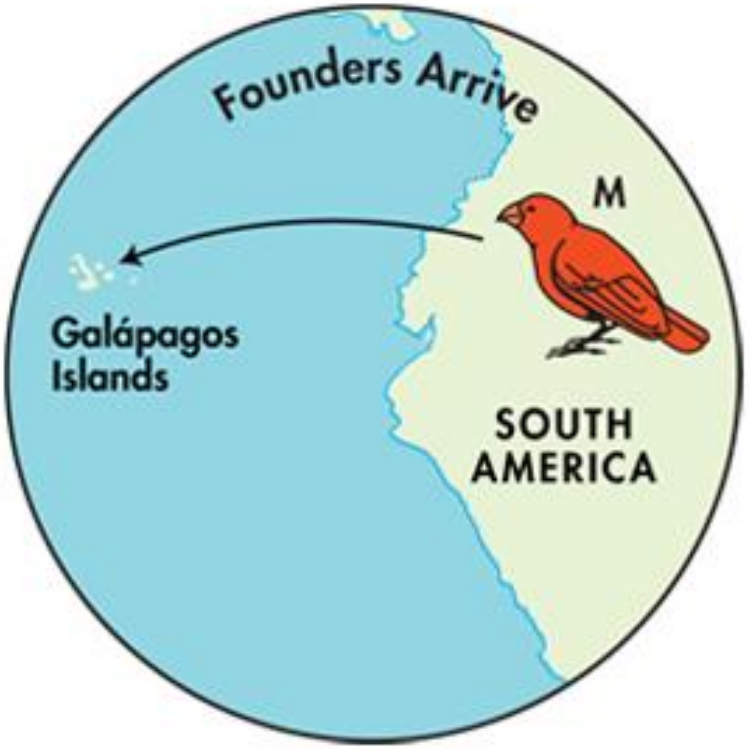
- What is a current hypothesis about Galápagos finch speciation?

- In this hypothesis, speciation in Galápagos finches occurred by founding of a new population, geographic isolation, changes in the new population's gene pool, behavioral isolation, and ecological competition.

Founders Arrive

Many years ago, a few finches from South America—species M—arrived on one of the Galápagos islands, as shown in the figure.

Because of the founder effect, the allele frequencies of this founding finch population could have differed from those in the South American population.



Geographic Isolation

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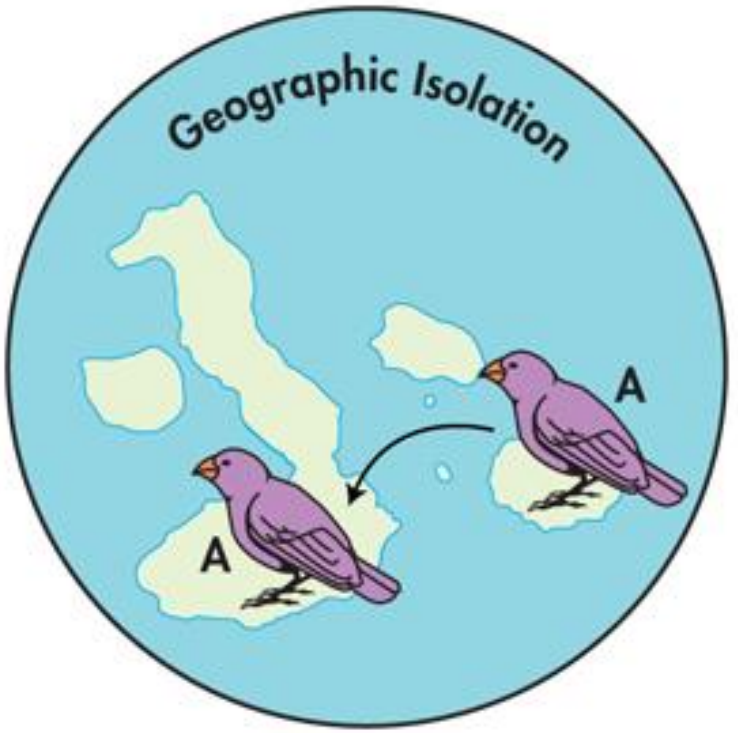


Changes in Gene Pools

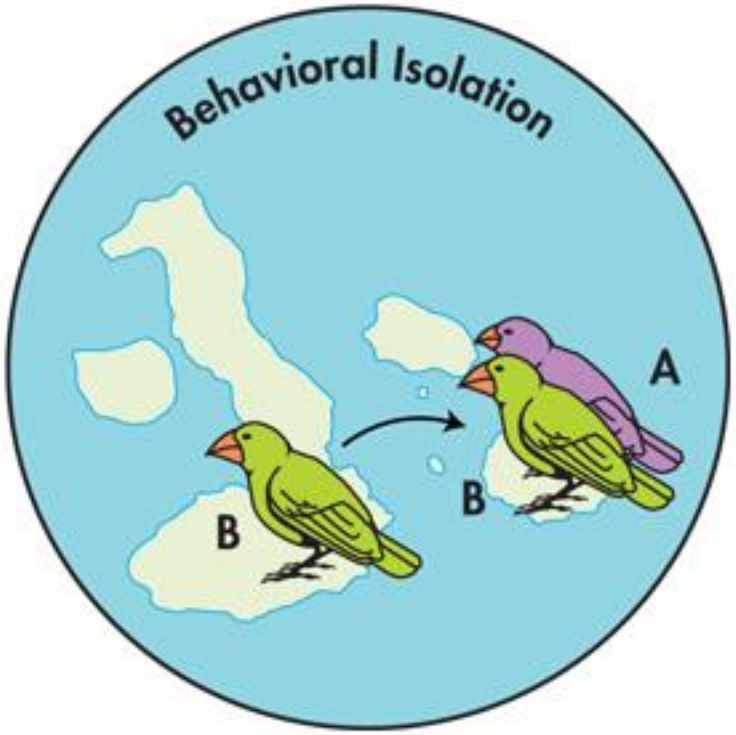
Over time, populations on each island adapted to local environments.

Natural selection could have caused two distinct populations to evolve (A and B), each characterized by a new phenotype.

Behavioral Isolation

Over time, populations on each island adapted to local environments.

Natural selection could have caused two distinct populations to evolve (A and B), each characterized by a new phenotype.



Competition and Continued Evolution

Birds that are most different from each other have the highest fitness. More specialized birds have less competition for food. Over time, species evolve in a way that increases the differences between them, and new species may evolve (C, D, and E).