

16-3 The Process of Speciation

Natural selection and chance events can change the relative frequencies of alleles in a population and lead to speciation.

Speciation is the formation of new species.

A species is a group of organisms that breed with one another and produce fertile offspring.

What factors are involved in the formation of new species?

The gene pools of two populations must become separated for them to become new species.

Isolating Mechanisms

As new species evolve, populations become reproductively isolated from each other.

When the members of two populations cannot interbreed and produce fertile offspring, **reproductive isolation** has occurred. Reproductive isolation can develop in a variety of ways, including:

- behavioral isolation
- geographic isolation
- temporal isolation

Behavioral isolation occurs when two populations are capable of interbreeding but have differences in courtship rituals or other reproductive strategies that involve behavior.

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

Geographic barriers do not guarantee the formation of new species.



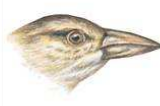



If two formerly separated populations can still interbreed, they remain a single species.

Potential geographic barriers may separate certain types of organisms but not others.

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

Testing Natural Selection in Nature

Studies showing natural selection in action involve descendants of the finches that Darwin observed in the Galápagos Islands. The finches Darwin saw were different, but he hypothesized that they had descended from a common ancestor.

| Galápagos Islands Finches | | | | Galápagos Islands Finches | | |
|------------------------------|---|---|---|--|---|---|
| Shape of Head and Beak |  |  |  |  |  |  |
| Common Name of Finch Species | Vegetarian tree finch | Large insectivorous tree finch | Woodpecker finch | Cactus ground finch | Sharp-beaked ground finch | Large ground finch |
| Main Food | Fruits | Insects | Insects | Cacti | Seeds | Seeds |
| Feeding Adaptation | Parrotlike beak | Grasping beak | Uses cactus spines | Large crushing beak | Pointed crushing beak | Large crushing beak |
| Habitat | Trees | Trees | Trees | Ground | Ground | Ground |

Detailed genetic studies have shown that these finches evolved from a species with a more-or-less general-purpose beak.

Peter and Rosemary Grant tested Darwin's hypothesis, which relied 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, causing natural selection to occur.

The Grants tested these hypotheses on the medium ground finch on Daphne Major, one of the Galápagos Islands. During the rainy season, there is plenty of food. During droughts, food becomes scarce. Individual birds with different-sized beaks had different chances of survival during a drought. When food was scarce, individuals with large beaks were more likely to survive.



This graph shows the survival rate of one species of ground-feeding finches, the medium ground finch. The Grants provided evidence of the process of evolution. Beak size can be changed by natural selection.

Speciation in Darwin's Finches

Speciation in the Galápagos finches occurred by:

- **founding of a new population**
- **geographic isolation**
- **changes in new population's gene pool**
- **reproductive isolation**
- **ecological competition**

Small groups of finches moved from one island to another, became reproductively isolated, and evolved into new species.

Founders Arrive

A few finches—species A—travel from South America to one of the Galápagos Islands. There, they survive and reproduce.

Geographic Isolation

Some birds from species A cross to a second island. The two populations no longer share a gene pool.

Changes in the Gene Pool

Seed sizes on the second island favor birds with large beaks. The population on the second island evolves into population B, with larger beaks.

Reproductive Isolation

If population B birds cross back to the first island, they will not mate with birds from population A. Populations A and B are separate species.

Ecological Competition

As species A and B compete for available seeds on the first island, they continue to evolve in a way that increases the differences between them. A new species—C—may evolve.

Continued Evolution

This process of isolation, genetic change, and reproductive isolation probably repeated itself often across the entire Galápagos island chain.

Studying Evolution Since Darwin

Scientific evidence supports the theory that living species descended with modification from common ancestors that lived in the ancient past.

Scientists predict that as new fossils are found, they will continue to expand our understanding of how species evolved.