**Speciation**

*Speciation* refers to the formation of species. It occurs when there is reproductive isolation between populations. *Allopatric* refers to populations that are geographically isolated (they do not overlap). *Sympatric* refers to populations whose ranges overlap. The diagram below is a map of the distribution of two populations. Each population occupies a circular area. The two populations are allopatric in part of their range but are sympatric (overlap) in part.

![Diagram of allopatric and sympatric populations](https://bio.libretexts.org/Under_Construction/Purgatory/Core_Construction/BIO_102/Reading_and_Lecture_Notes/Speciation)

**Allopatric Speciation**

Allopatric speciation occurs when species are formed as a result of populations being isolated from each other so that they do not interbreed. Allopatric speciation is the most common type of speciation.

**Hypothetical Example of Allopatric Speciation**

The following hypothetical example illustrates how isolating two populations can lead to the formation of two species.
Suppose...

Suppose that there are two populations of rabbits, each on an island in the ocean. One island has predators that eat rabbits and the other does not. How might natural selection change the rabbit populations after several thousand years?

Suppose that the rabbit food is different on one island than it is on the other. How might natural selection change the rabbit populations with regard to their food requirements after several thousand years?

Suppose that the climate of one island is hot but the climate of the other is cold. How might the rabbits become adapted to the different climates?

Eventually, the two populations will become so different, that they will be different species.

Reproductive Isolation

In the diagram below, the population is divided into two isolated populations by the uplift of a mountain range between the two. After separation, evolution in one population will be independent of evolution in the other because they are not exchanging genes.
Example: Finches in the Galapagos Islands

All of the native bird species living in the Galapagos may be descended from a single species that arrived there from South America. The species now found there arose by allopatric speciation on the many different islands.

Sympatric Speciation

Sympatric speciation refers to the formation of species from a population that is not divided geographically. In order for two (or more) species to emerge from this population, individuals must become reproductively isolated.

Speed of Evolutionary Change

Two hypotheses have been proposed to explain the rate of evolutionary change.

Gradual Change

The gradualist explanation says that species change (evolve) slowly over time.

Example

Some characteristics of trilobites changed steadily over 3 million years.

Punctuated Equilibrium

The punctuated equilibrium explanation says that periods of slow evolutionary changed are interspersed (punctuated) with periods of rapid change. This explains why there are often fewer than expected numbers of intermediate forms in the fossil record. Intermediate forms exist only briefly during a period of rapid change.

Evolutionary change occurs rapidly during the early part of a species history because the species may not be well adapted to its environment. For example, if the food of a bird species is such that a long bill is needed to feed, you would expect evolution to produce long bills very rapidly. The pace of evolutionary change slows down as species become adapted to their environments.

Examples

The organisms living in a forest in northern New York are well adapted to their environment because they have lived there for thousands of years. If the climate were to start changing, the rate of evolutionary change is expected to increase so that organisms can remain adapted to their environment.
Evidence indicates that life first evolved in the ocean. When organisms first invaded the land, evolutionary change was rapid; major changes were needed for success. As they became adapted to terrestrial environments, the pace slowed down. Generally, you would expect the rate of evolution to be rapid when organisms are expanding into new environments that they are not ideally adapted to.

Contributors

- Michael J. Gregory, Ph.D. (Clinton Community College)