

## SPECIATION

Speciation is simply splitting of a single species into several populations. It shows genetic differentiation and eventual reproductive isolation.

A/c to Ernest Mayr (1970) species originate in following two ways -

1) Transformation of old species into a new one in due course of time

Name

1) Phyletic speciation  
or  
Autogenous speciation.  
True speciation

2) Multiplication of species

A) Instantaneous Speciation

a) Chromosomal mutation

b) Autopolyploidy

c) Amphiploidy

B) Gradual Speciation

a) Gene mutation

b) Adaptation

c) Natural Selection

2) Quantum Speciation

3) Sympatric Speciation

4) Semigeographical Speciation

5) Allopatric Speciation

or  
Geographical Speciation.

1) Phyletic Speciation -

In this type of speciation a preexisting species 'A' is transformed into species 'B' over a long period of time by slow and steady changes. It occurs due to

adaptation, and increasing specialisation for a particular environment. It shows simply a line of succession in which one species is replaced by other.

2) Quantum speciation :- According to Simpson, the quantum evolution speciation due to chromosomal aberration (inversion and translocation) or change in chromosome number (Polyploidy, autopolyploidy and amphidiploidy). Both autopolyploidy and allopolyploidy have played major role in the origin of new species from the pre existing ones. The process of quantum speciation ~~hypothesis~~ is not fully understood, but chromosomal rearrangement (translocation) and change in gene regulation play an important role. Quantum speciation often occurs during adaptive radiation.

3) Instantaneous Speciation :- It is defined as the production of a single ~~individual~~ totally different individual or the offspring from the parental stock and that is capable of establishing a new species population. It is achieved by following means -

a) Through mutation

b) Through macrogenesis - Sudden origin of new species, new type is known as macrogenesis. It occurs by complete genetic reconstruction or by macromutation.

c) Through Chromosomal Aberration :- chromosomal aberration or alteration in genetic material through loss, gain, or rearrangement of a particular segments may cause speciation.

into three stages -

- 1) Formation of isolated population by geographical barriers.
- 2) Persistence of isolated populations and their differentiation from the parental population (genetic divergence).
- 3) Establishment of reproductive isolation between new population and formation of new species.

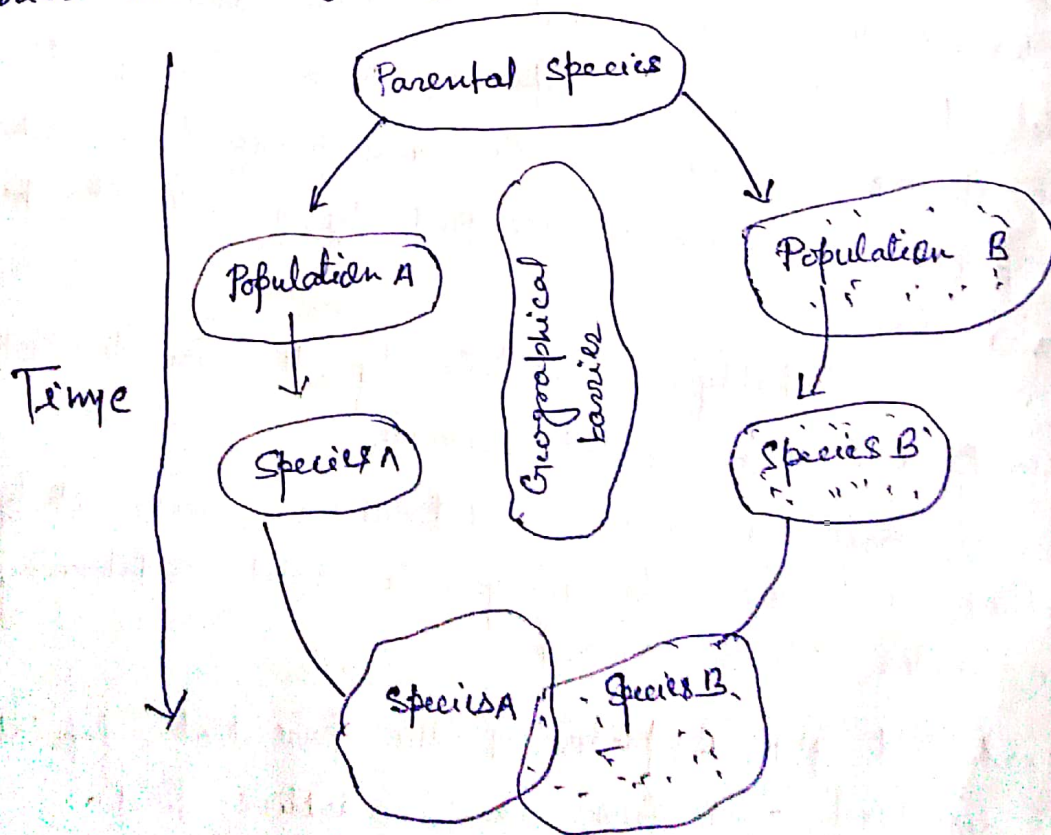
Allopatric speciation can be best explained by "Founder effect in Darwin's Finches. It was explained by Grant (1986) through a South American ground finch Geospiza magnirostris native of S. America colonised Galapagos. These islands were separated from the mainland by ocean (geographical barrier) and the new population evolved independently of the parent population and become reproductively isolated to form a new species. ~~These~~ Subsequent speciation from the species occurred later on and presently, each island of Galapagos Archipelago is occupied by a different species of Darwin finch.

Probably, speciation by the founder effect is more frequent and more rapid because -

- 1) In a novel environment, mutations are more likely to be adaptive and are able to generate novel evolutionary steps than those in the old environment.
- 2) Coadapted gene complexes of the parental population tend to get disrupted and form new adaptive feat.
- 3) Beneficial changes in the gene pool become fixed much more rapidly in a small population than in the large population.

Gradual Speciation - Gradual speciation is the gradual divergence of a population over a long period of time under the influence of natural selection. In this process, one species give rise to one or more new species. Following models have been postulated -

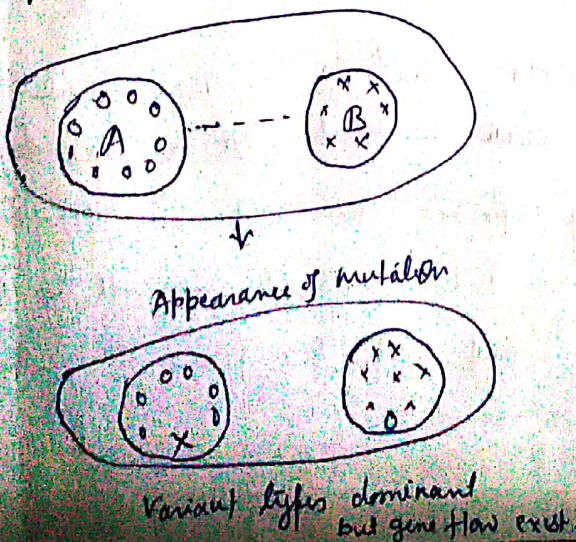
1) Allopatric or Geographic speciation - According to Mayr new species arise when some physical geographical barriers like ocean, mountain, river, valley and even distance divides the large population of a species into two or more small population. The individuals of these isolated populations ~~also~~ cannot interbreed. In another way, the geographical barriers obstruct free gene flow between the population.



Allomen (1992) divide the process of allopatric speciation

4) It provides opportunities for chromosomal evolution during founder speciation, which may permit exploitation of a new set of ecological conditions or resources in a very different manner.

Mays (1963) pointed out that peripheral populations have more chances of undergoing allopatric speciation. This view is called marginal population allopatric speciation model. It was mainly applicable to the parasitic organism. Each isolated population is exposed to a somewhat different selection pressure. Thus, random mutations together with genetic drift and selection pressure establish genetic differences and morphological and physiological variations in formerly similar populations. These differences gradually accumulate and cause more and more divergence in the genetic constituents of the population and this leads to establishment of clines, race and finally distinct subspecies. Subspecies can interbreed and produce fertile hybrids. The first step in the allopatric speciation is the formation of races and the development of races is followed by reproductive isolation and leads to the formation of new species.



Sympatric speciation :- Sympatric speciation is the formation of species within a single population without geographical isolation. In another way, speciation is defined as the establishment of new population of a species in different ecological niches within the normal range of parental population.

Sympatric speciation can occur by rapid reproductive isolation between members of the population in different niches. The reproductive isolation can arise due to chromosomal aberration (polyploidy, aneuploidy, haploidy and translocation). Sympatric speciation is caused by the same natural situations like - sibling species, monophagous species, parasites, species swarms and the instantaneous splitting of fossil lineage.

Hypothesis of sympatric speciation -

- 1) Homogamy - A/c to this concept, the most similar individual of a population tend to mate each other and homogamy leads to Homogamy. But this view got no popularity.
- 2) Conditioning - Thoope (1945) was of the view that establishment of a new sympatric population especially in insects in a new niche might be achieved by conditioning, but this assumption was not accepted.
- 3) Preadaptation and niche selection :- This concept was accepted by many ~~scientists~~ workers. A/c to this hypothesis the individual dispersing species has species specific habitat preferences and these are not identical for all the various genotypes of a species. But with the time this theory was also discarded.

Founder flush theory - This was proposed by H. Carson. A/c to this theory, a single fertilized female can colonize an isolated territory which was not occupied by its members previously. If conditions are favourable, the population founded by the single individual will undergo a flush or rapid expansion. After several generations it causes population crash. The cyclic event of population flush and crash come to an equilibrium and the gene pool of the population acquires changes and become much distinct from the gene pool of parental population and finally lead to speciation.

PARAPATRIC SPECIATION - Parapatric speciation is the development of reproductive isolation among the members of a continuous population in the absence of geographical barrier. Parapatric population coexist only in one or more overlapping region at the periphery of their geographical distribution. A/c to White (1968) chromosomal aberration lead to partial reproductive isolation in the individual of a population in a particular region. The lower fertility with further addition of structural change in the chromosome finally establish reproductive isolation forming new species.

