

7.10 Speciation

Diagram illustrating speciation models: Ancestor branching into two lineages, Speciation A and Speciation B. Questions: "Are we species yet?" are asked at various points along the branches.

Ernst Mayr's portrait is shown next to the diagram.

ENDURING UNDERSTANDING
EVO-3 Life continues to evolve within a changing environment.

The Ice Age The Present The Future?

During the Ice Age, many large mammals roamed the earth, filling out deep branches on the mammal Tree of Life.

Since then, all the largest species have been chopped off the mammal Tree by extinctions.

Surviving species will have to diversify for millions of years to restore the missing evolutionary history and regrow the Tree of Life.

EVO-3.D Describe the conditions under which new species may arise.

□ Speciation may occur when two populations become reproductively isolated from each other.

- Two patterns
 - Anagenesis
 - Phyletic evolution
 - Accumulation of heritable changes
 - Cladogenesis
 - Branching evolution
 - New species from a parent species that continues to exist
 - Basis of biological diversity

(a) Anagenesis (b) Cladogenesis

EVO-3.D Describe the conditions under which new species may arise.

□ The Biological Species Concept

- Provides a commonly used definition of species for sexually reproducing organisms.
- Species can be defined as a group capable of interbreeding and exchanging genetic information to produce viable, fertile offspring.

□ Proposed by Ernst Mayr (1942)

- Problems
 - Asexual organisms
 - Geographically isolated populations
 - Extinct species?

EVO-3.E Describe the rate of evolution and speciation under different ecological conditions.

□ Punctuated equilibrium is when evolution occurs rapidly after a long period of stasis.

□ Gradualism is when evolution occurs slowly over hundreds of thousands or millions of years.

(a) Gradualism model (b) Punctuated equilibrium model

EVO-3.E Describe the rate of evolution and speciation under different ecological conditions.

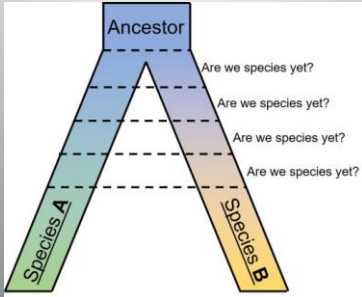
□ Divergent evolution occurs when adaptation to new habitats results in phenotypic diversification.

□ Speciation rates can be especially rapid during times of adaptive radiation as new habitats become available.

Mammalian adaptive radiation

EVO-3.F Explain the processes and mechanisms that drive speciation.

□ Speciation results in diversity of life forms.



EVO-3.F Explain the processes and mechanisms that drive speciation.

□ Speciation may be sympatric or allopatric.

(a) Allopatric speciation:

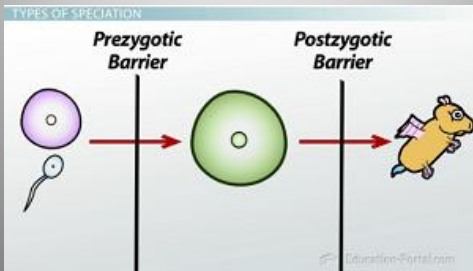
(b) Sympatric speciation:

Examples of allopatric speciation:

- Haplochromis chilotae* (feeds on insects)
- Haplochromis macrognathus* (feeds on other fish)
- Astatotilapia nigres* (generalized bottom feeder)
- Microhaplochromis bicolor* (feeds on snails and other molluscs)

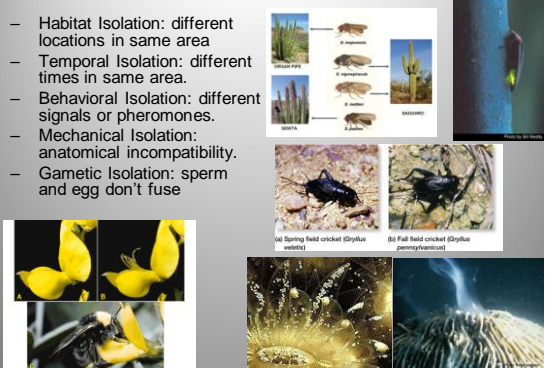
EVO-3.F Explain the processes and mechanisms that drive speciation.

□ Various prezygotic and postzygotic mechanisms can maintain reproductive isolation and prevent gene flow between populations.



Pre-zygotic Barriers

- Habitat Isolation: different locations in same area
- Temporal Isolation: different times in same area.
- Behavioral Isolation: different signals or pheromones.
- Mechanical Isolation: anatomical incompatibility.
- Gametic Isolation: sperm and egg don't fuse



Postzygotic Barriers

- Reduced Hybrid Viability: weak embryos or juveniles die (grassfrogs)
- Reduced Hybrid Fertility: horse + donkey = mule (sterile)
- Hybrid Breakdown: feeble or sterile F₂ generation (cotton)

Mare (Female Horse) <i>Equus caballus</i> 2n = 64 n = 32	X	Jackass (Male Donkey) <i>Equus asinus</i> 2n = 62 n = 31	=	Mule 2n = 63 n = ?
Stallion (Male Horse)	X	Jennyass (Female Donkey)	=	Hinny