



- Chapter 24
The Origin of Species

Essential Knowledge

- 1.C.1 – Speciation and extinction have occurred throughout the Earth's history
- 1.C.2 – Speciation may occur when two populations become reproductively isolated from each other

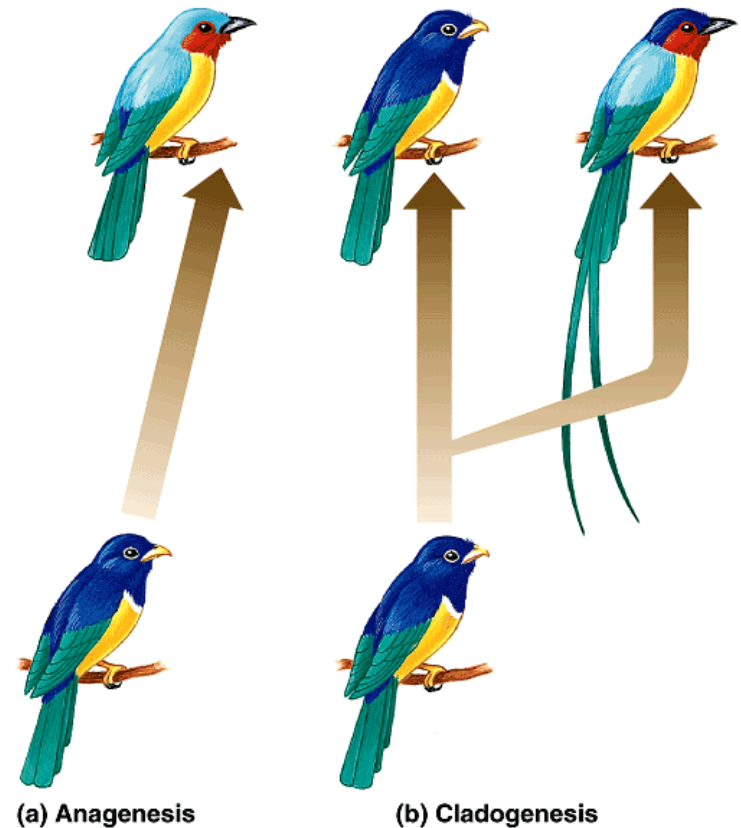
Things To Know

- Difference between microevolution and macroevolution
- Biological concept of species
- Prezygotic and postzygotic barriers that maintain reproductive isolation in natural populations
- How allopatric and sympatric speciation are similar and different
- How punctuated equilibrium and gradualism describes two different tempos of speciations

- Microevolution = change in genetic makeup of a population from generation to generation
 - Confined to single gene pool
- Macroevolution = evolutionary change above the species level

Macroevolution: *the origin of new taxonomic groups*

- Speciation: the origin of new species
- Results in diversity of life forms
 - 1- *Anagenesis* (phyletic evolution): accumulation of heritable changes
 - 2- *Cladogenesis* (branching evolution): budding of new species from a parent species that continues to exist (basis of biological diversity)



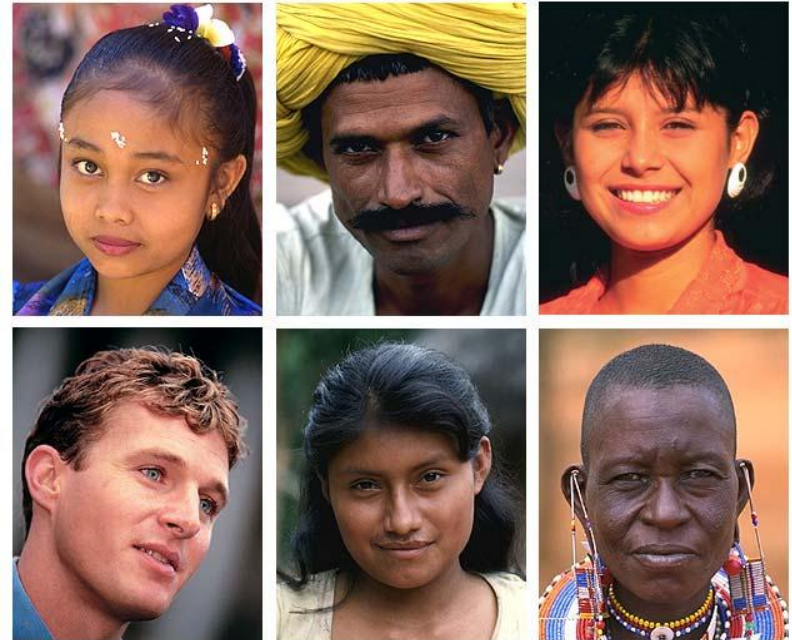
(a) Anagenesis

(b) Cladogenesis

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What is a species?

- Biological species concept (Mayr): a population or group of populations whose members have the potential to interbreed and produce viable, fertile offspring
 - genetic exchange is possible and that is genetically isolated from other populations



Reproductive Isolation

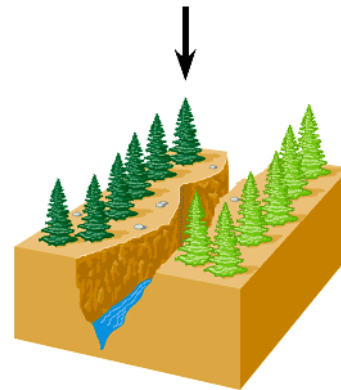
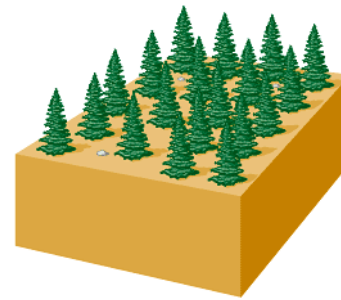
- Defined as:
 - Existence of biological barriers that impede members of two species from producing viable, fertile hybrids by preventing gene flow
- May gain or lose alleles by gene flow
 - Limit formation of hybrids or completely isolate the gene pool
- Two types of speciation can prevent members from mating and producing successful offspring
 - Allopatric (other country) and Sympatric (same country)

Types of speciation

(based on how gene flow is interrupted)

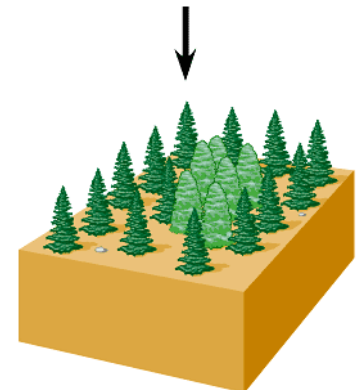
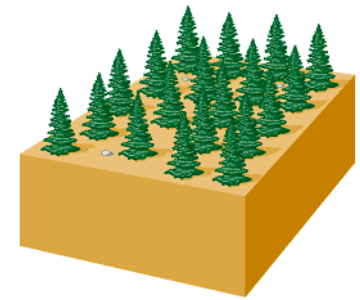
- *Allopatric:*
populations segregated by a geographical barrier; can result in adaptive radiation (island species)

- *Sympatric:*
reproductively isolated subpopulation in the midst of its parent population (change in genome)



(a) Allopatric speciation

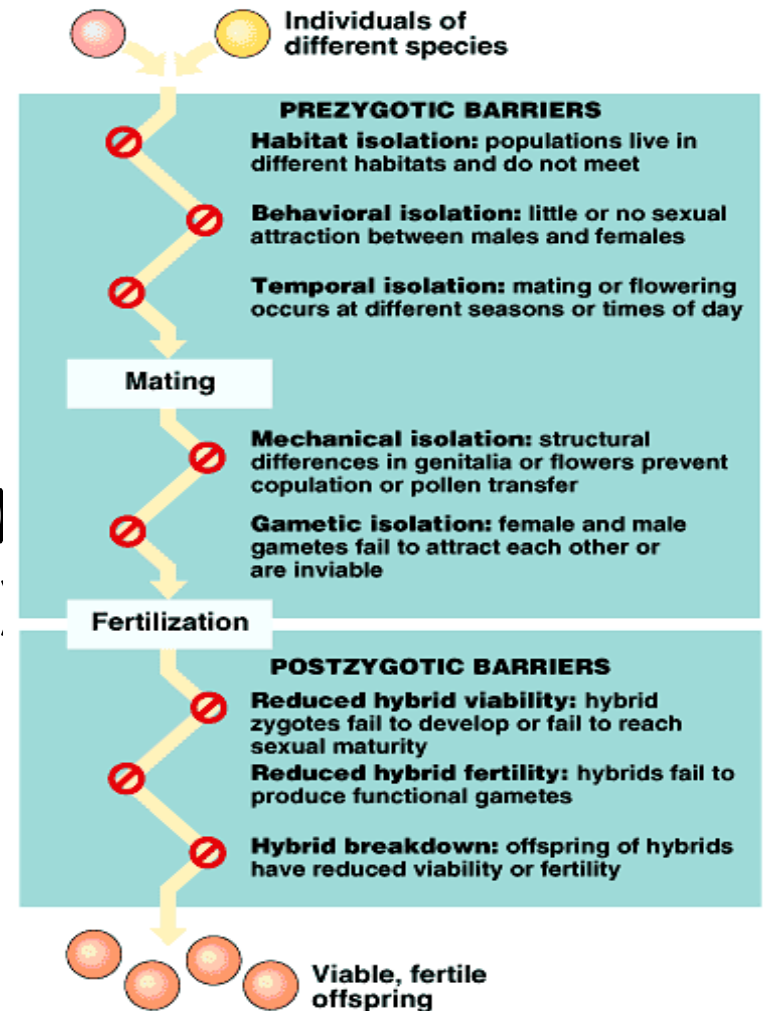
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(b) Sympatric speciation

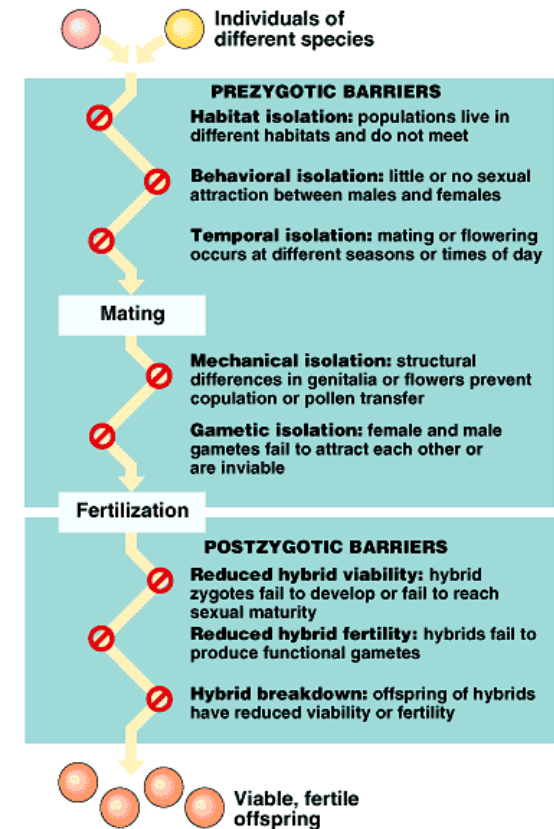
Reproductive Isolation: Sympatric

- Prezygotic barriers: *impede mating between species or hinder the fertilization of the ova*
- Habitat (snakes; water/terrestrial)
- Behavioral (fireflies; mate signaling)
- Temporal (salmon; seasonal mating)
- Mechanical (flowers; pollination anatomy)
- Gametic (frogs; egg coat receptors)



Reproductive Isolation: Sympatric

- Postzygotic barriers: fertilization occurs, but the hybrid zygote does not develop into a viable, fertile adult
- **Reduced hybrid viability** (frogs; zygotes fail to develop or reach sexual maturity)
- **Reduced hybrid fertility** (mule; horse x donkey; cannot backbreed)
- **Hybrid breakdown** (cotton; 2nd generation hybrids are sterile)

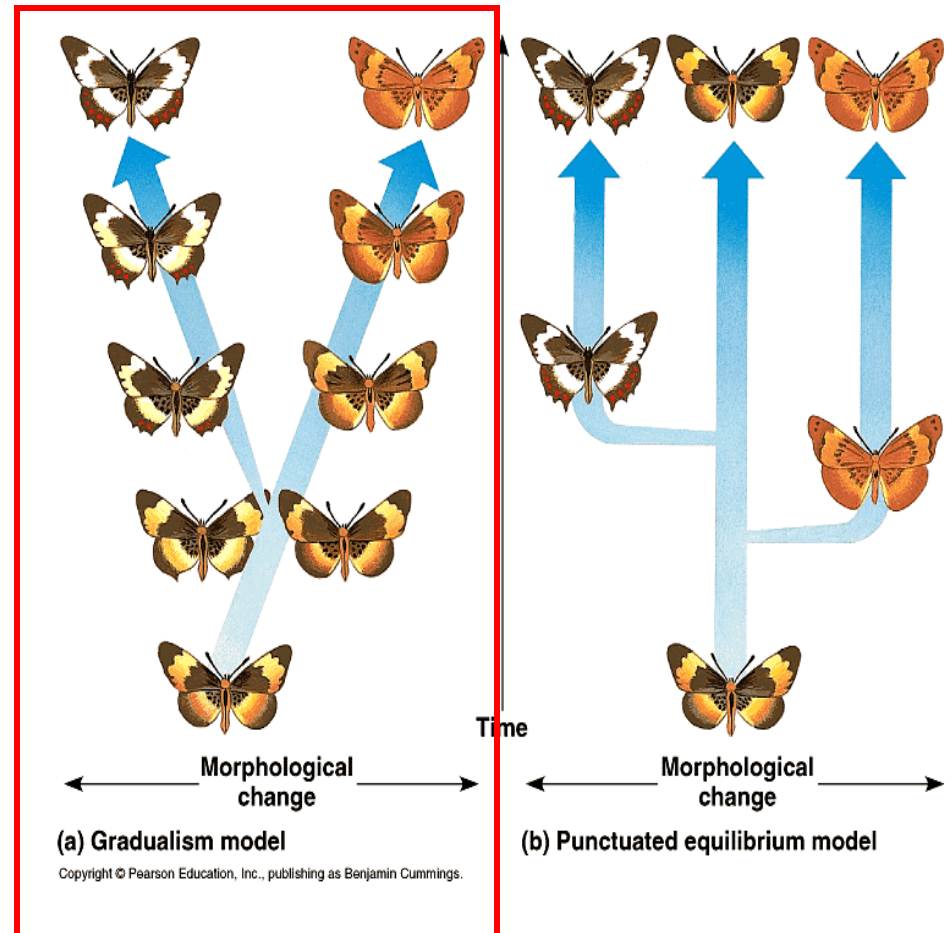


Sympatric Speciation

- **Polyploidy** = species originates by an accident in cell division and has extra sets of chromosomes (nondisjunction mutation)
- Autopolyploidy = individual with more than 2 sets of chromosomes derived from a single species
 - Ex: banana, potato, strawberry
- Allopolyploid = production of a fertile hybrid from a sterile one
 - Ex: Bread wheat: contains chromosomes from 3 other types of wild wheat

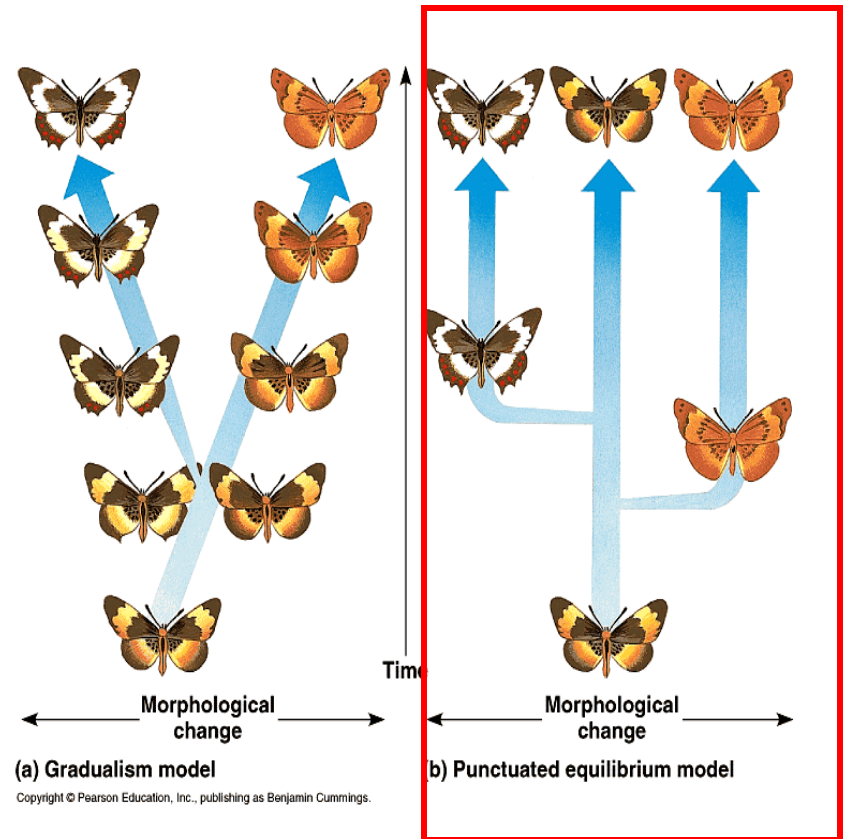
Rate (tempo) of Speciation

- Gradualism: species descended from a common ancestor and gradually diverge more and more in morphology



Rate (tempo) of Speciation

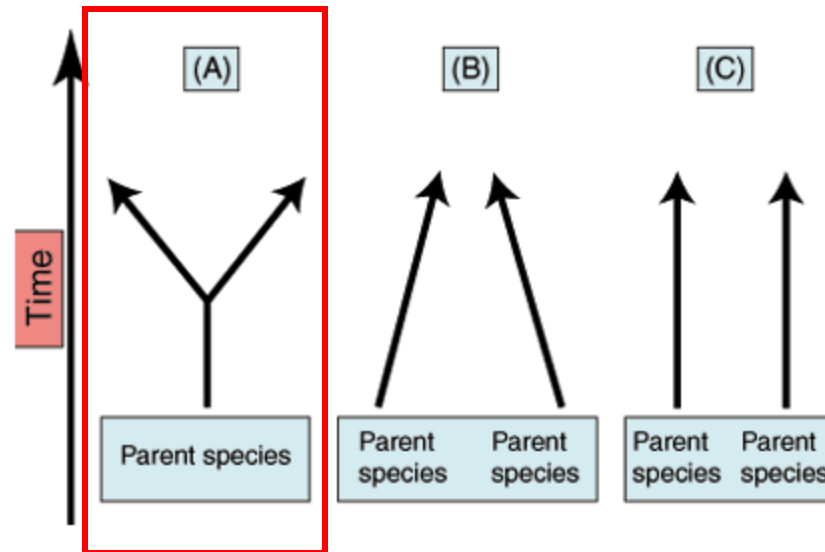
- Punctuated equilibrium: rapid bursts of change followed by periods of stability
 - Niles Eldredge and Stephen Jay Gould (1972); helped explain the non-gradual appearance of species in the fossil record

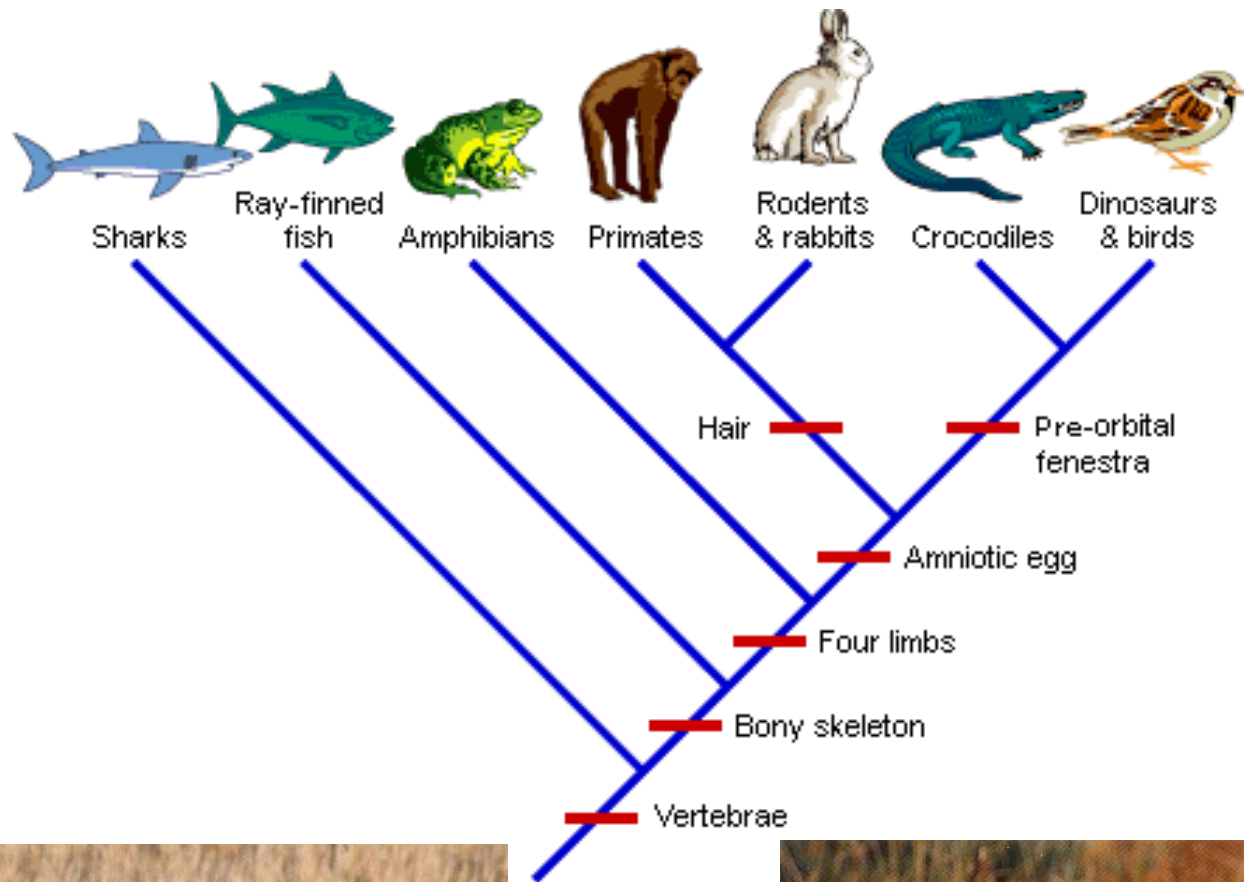


Patterns of Evolution:

Divergent Evolution

- Evolution into 2 new species from once closely related species due to population separation and new selective pressures
 - Adaptive radiation = periods of evolutionary change in which new species fill niches in the environment







small ground finch



medium ground finch



large ground finch



sharp-beaked ground finch



cactus finch



large cactus finch



small tree finch



large tree finch?



vegetarian finch



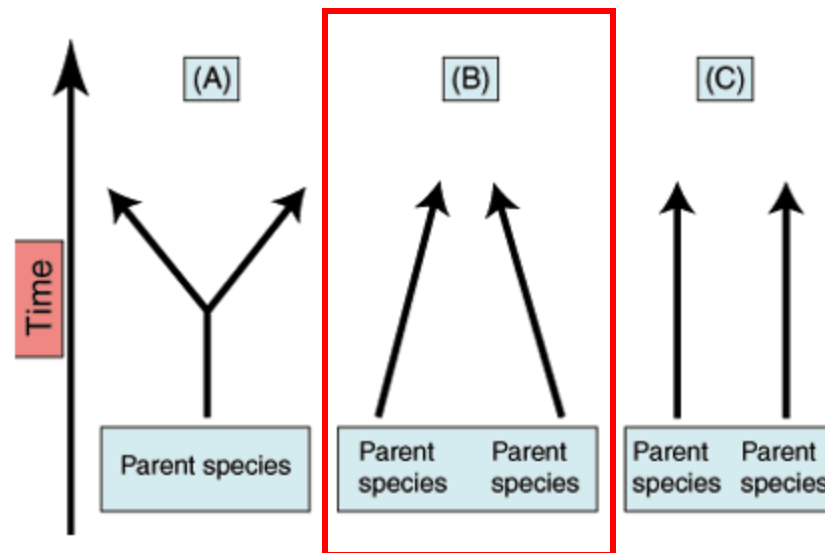
woodpecker finch



warbler finch

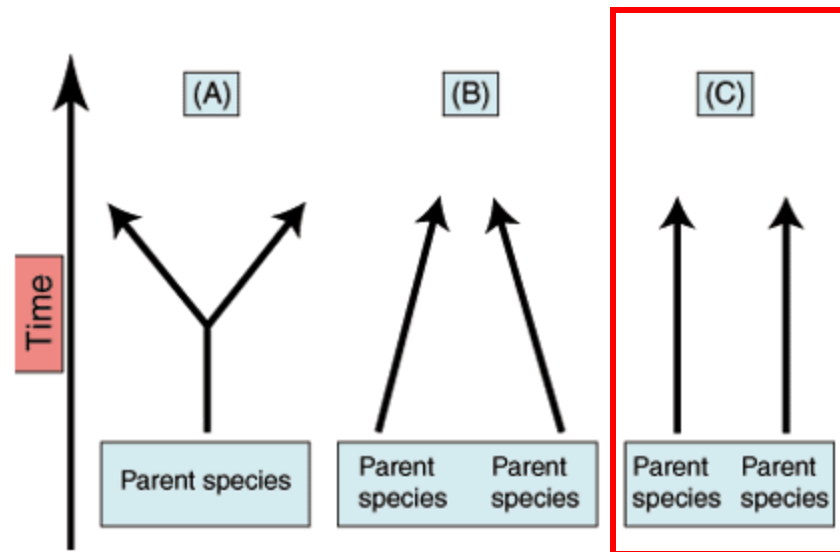
Patterns of Evolution: Convergent Evolution

- When unrelated species live in the same environment, subjected to the same selective pressures, and develop similar adaptations



Patterns of Evolution: Parallel Evolution

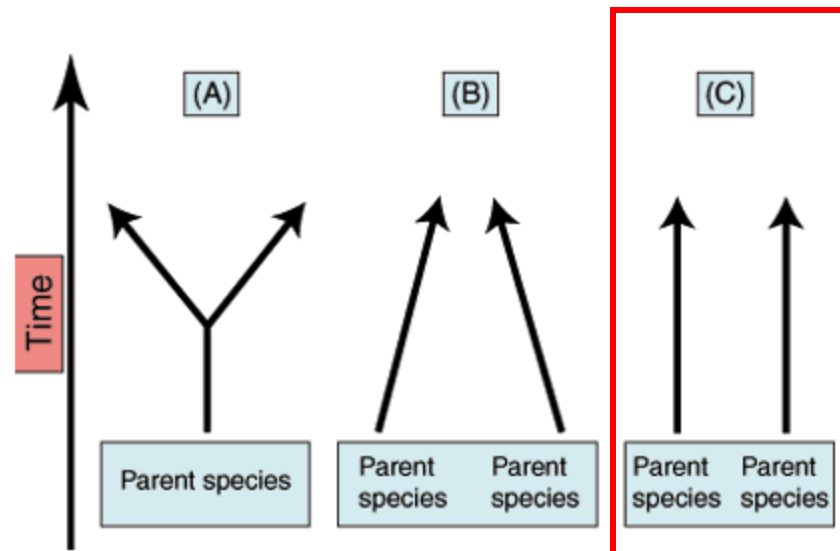
- Two related species that have made similar evolutionary adaptations after their divergence from a common ancestor





Patterns of Evolution: Coevolution

- Reciprocal evolutionary set of adaptations of two interconnected species (symbiotic relationship)
 - Predator and prey



Acacia Tree and Acacia Ant





Orchid Praying Mantis



Yucca Moth and Yucca Plant

