Conditions needed for Genetic Equilibrium

Hardy-Weinberg Principle

The original proportion of genotypes in a population remains constant

if

- population size is large
- random mating is occurring
- no mutations
- no genes are introduced or lost
- no selection occurs
  - means: all genotypes can survive and reproduce equally well

But that would never exist for long…

So we get natural selection, sexual selection, genetic drift and gene flow… eventually we can get speciation

Speciation

- The formation of a new species
  - As new species evolve populations can become reproductively isolated
    - When members cannot interbreed and/or produce fertile offspring
- A species is a group of organisms that can interbreed, therefore, they share a gene pool

Reproductive Isolation

- Prezygotic – before attempting to mate
  - Geographic
  - Ecological – occupy different habitats
  - Temporal – mating seasons
  - Behavioral
  - Mechanical
  - Gamete Incompatibility
- Postzygotic – after attempting mating
  - Hybrid Inviability
  - Hybrid Infertility

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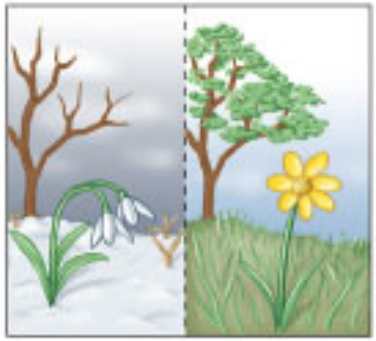
Reproductive Isolating Mechanisms

Mechanism		Description
Prezygotic Isolating Mechanisms		
Geographic isolation		Species occur in different areas, which are often separated by a physical barrier such as a river or mountain range.
Ecological isolation		Species occur in the same area, but they occupy different habitats and rarely encounter each other.
Temporal isolation		Species reproduce in different seasons or at different times of the day.

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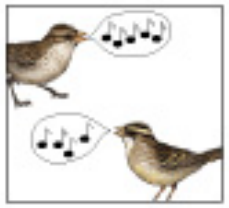
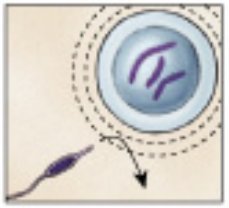
Reproductive Isolating Mechanisms

Mechanism		Description
Behavioral isolation		Species differ in their mating rituals.
Mechanical isolation		Structural differences between species prevent mating.
Prevention of gamete fusion		Gametes of one species function poorly with the gametes of another species or within the reproductive tract of another species.
Postzygotic Isolating Mechanisms		
Hybrid inviability or infertility		Hybrid embryos do not develop properly, hybrid adults do not survive in nature or hybrid adults are sterile or have reduced fertility.

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Tigon

Hybrids - Result of male tiger and female lion mating in captivity. Offspring are infertile. Separated both geographically and ecologically in real world.

Liger - Result of male lion and female tiger mating in captivity. Offspring are infertile.

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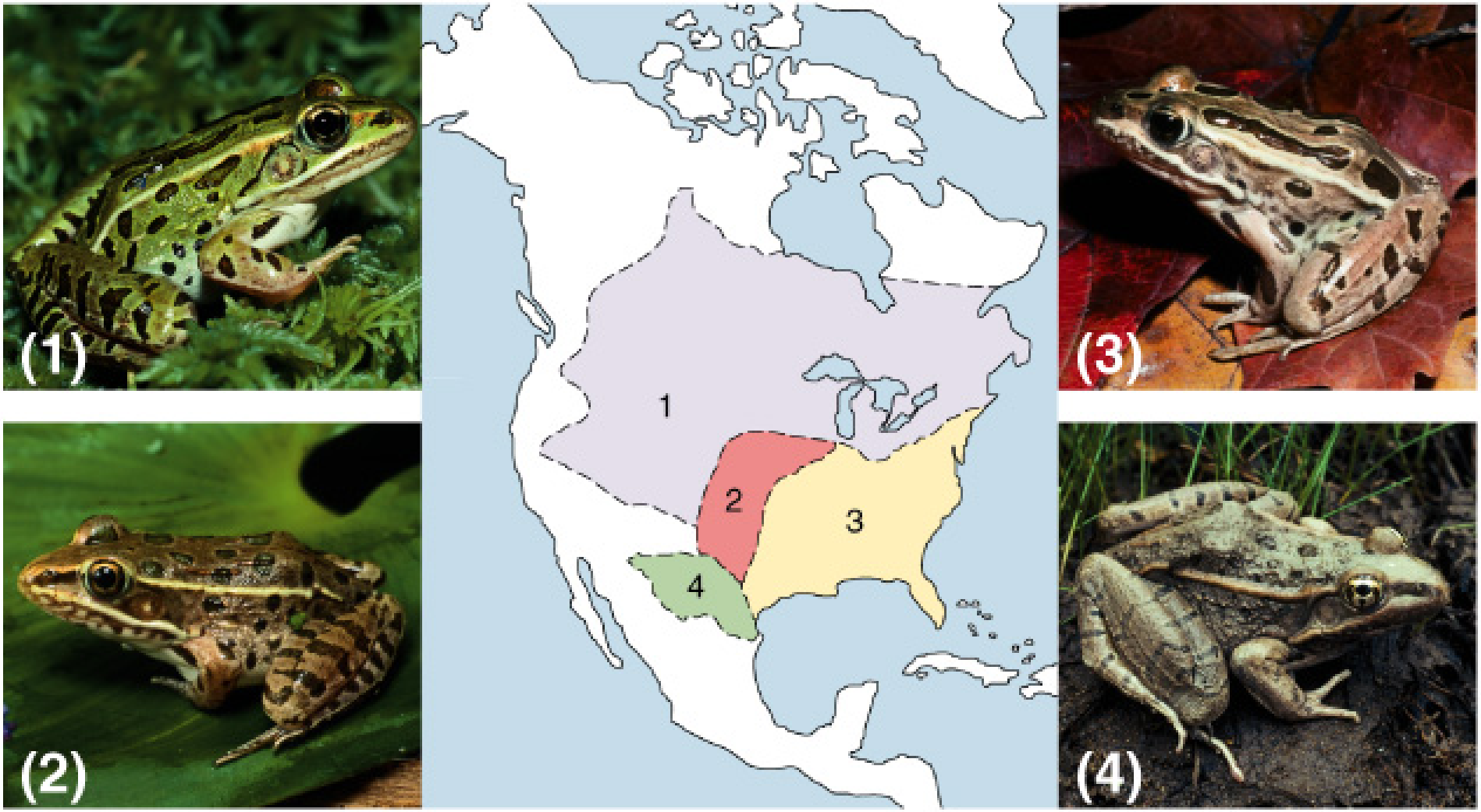


Four species of leopard frogs - differ in their mating calls. Hybrids are inviable.

These squirrels live on opposite sides of the Grand Canyon. This is an example of geographic isolation.

Speciation Theory 1

- Punctuated Equilibrium
  - Species evolve rapidly and then stay the same for long periods of time
  - Caused by mutations to a few essential regulatory genes which mainly function during embryo stage of development
  - Ex/ genes that determine the body segments of an insect

Punctuated Equilibrium, The Gulf & Eyeless Shrimp - YouTube

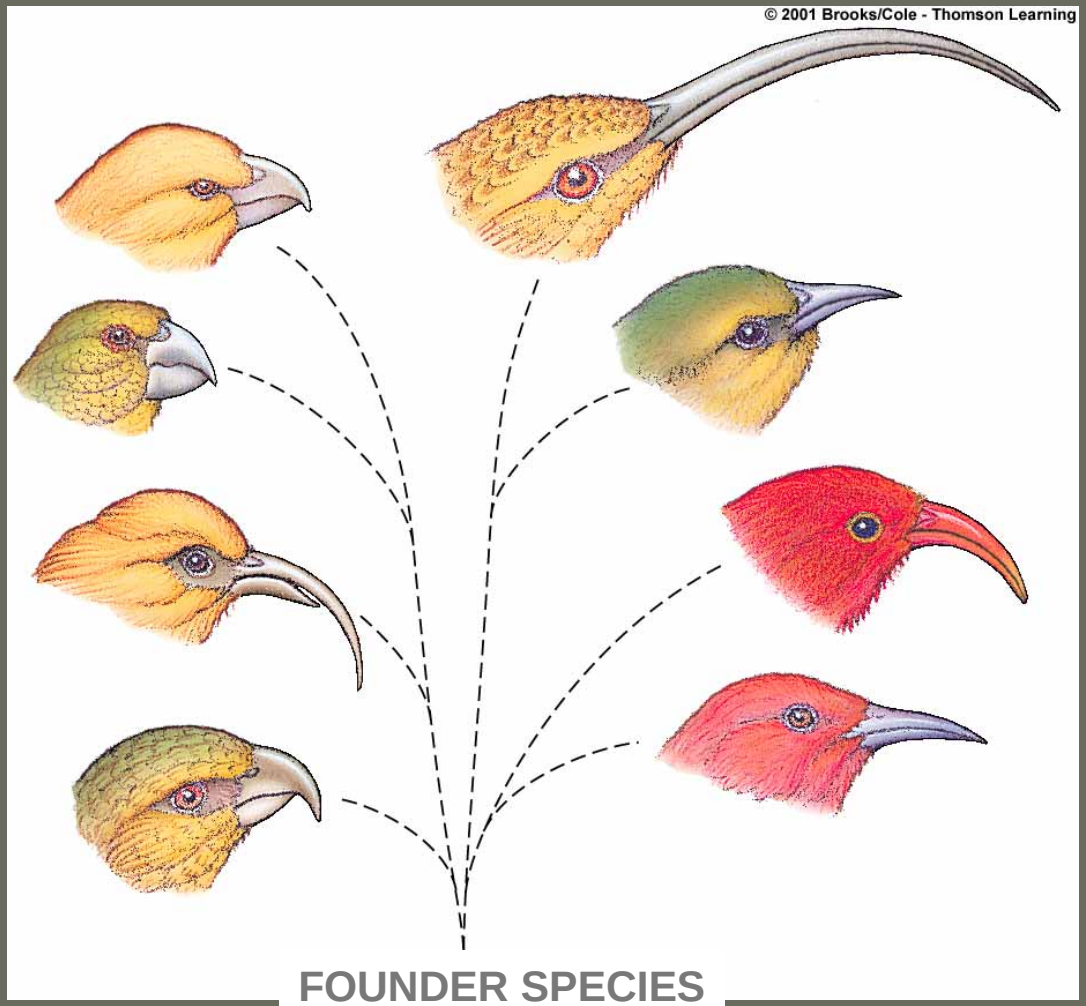
Punctuated Equilibrium

Speciation Theory 2

- Adaptive Radiation (gradualism)
  - Species evolve through a process of slow and constant change
    - isolation
    - different selective pressures
    - adaptation to unique selective pressure
    - new species created
    - long-term zonation

Hawaiian Honeycreepers

An example of adaptive radiation – these species all diverged from a common ancestor (founder species)



http://skeptv.net/post/7276250049/speciation-and-extinction

Speciation in Darwin's Finches

- Speciation of the Galapagos Islands occurred by:
  - Founding of a new population (Founder Effect)
  - Geographic Isolation
    - Led to reproductive isolation
  - After generations: changes in gene pools due to natural selection
    - New traits… where did they come from?

small ground finch

medium ground finch

large ground finch

sharp-beaked ground finch

cactus finch

large cactus finch

small tree finch

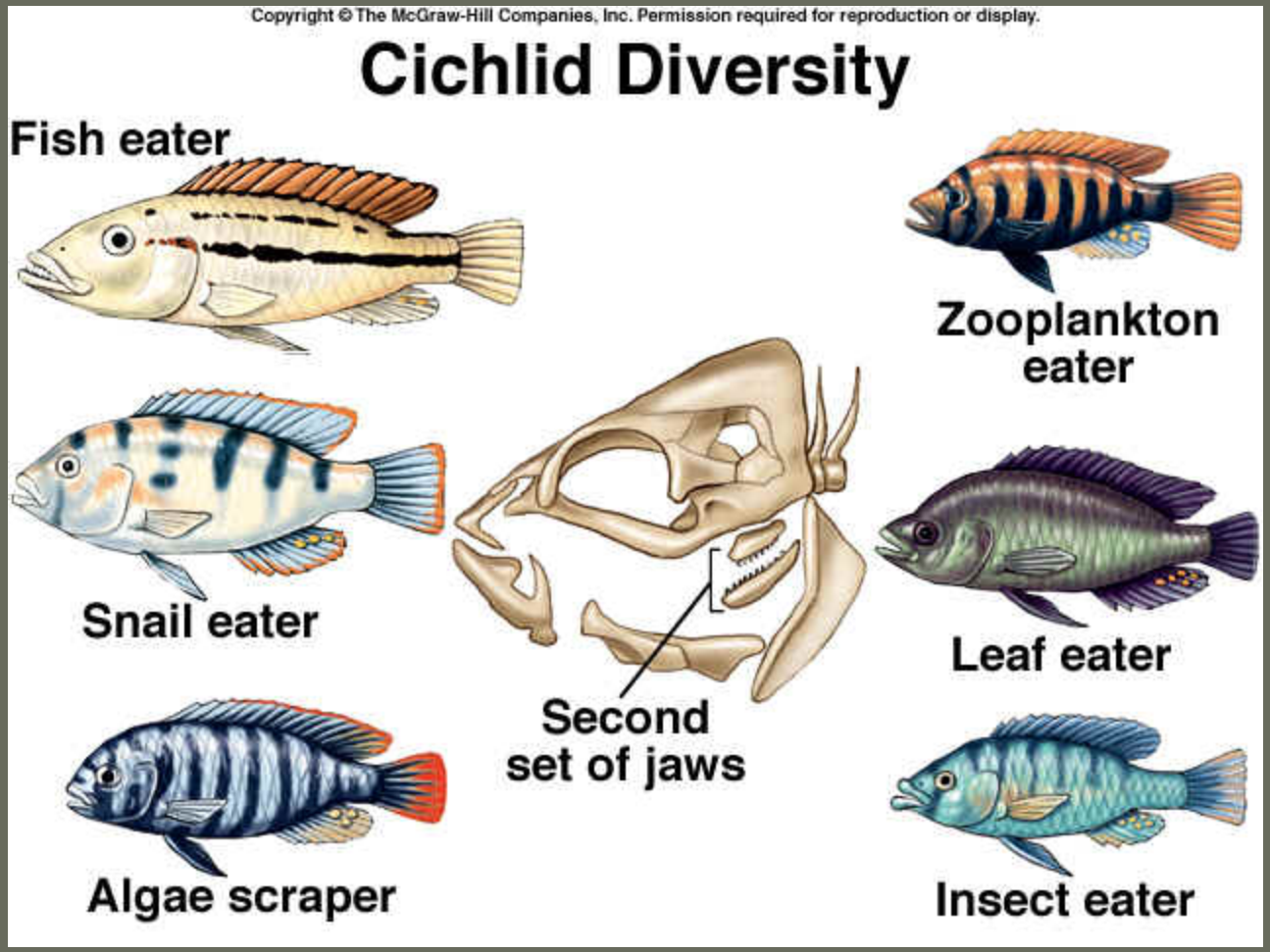
large tree finch?

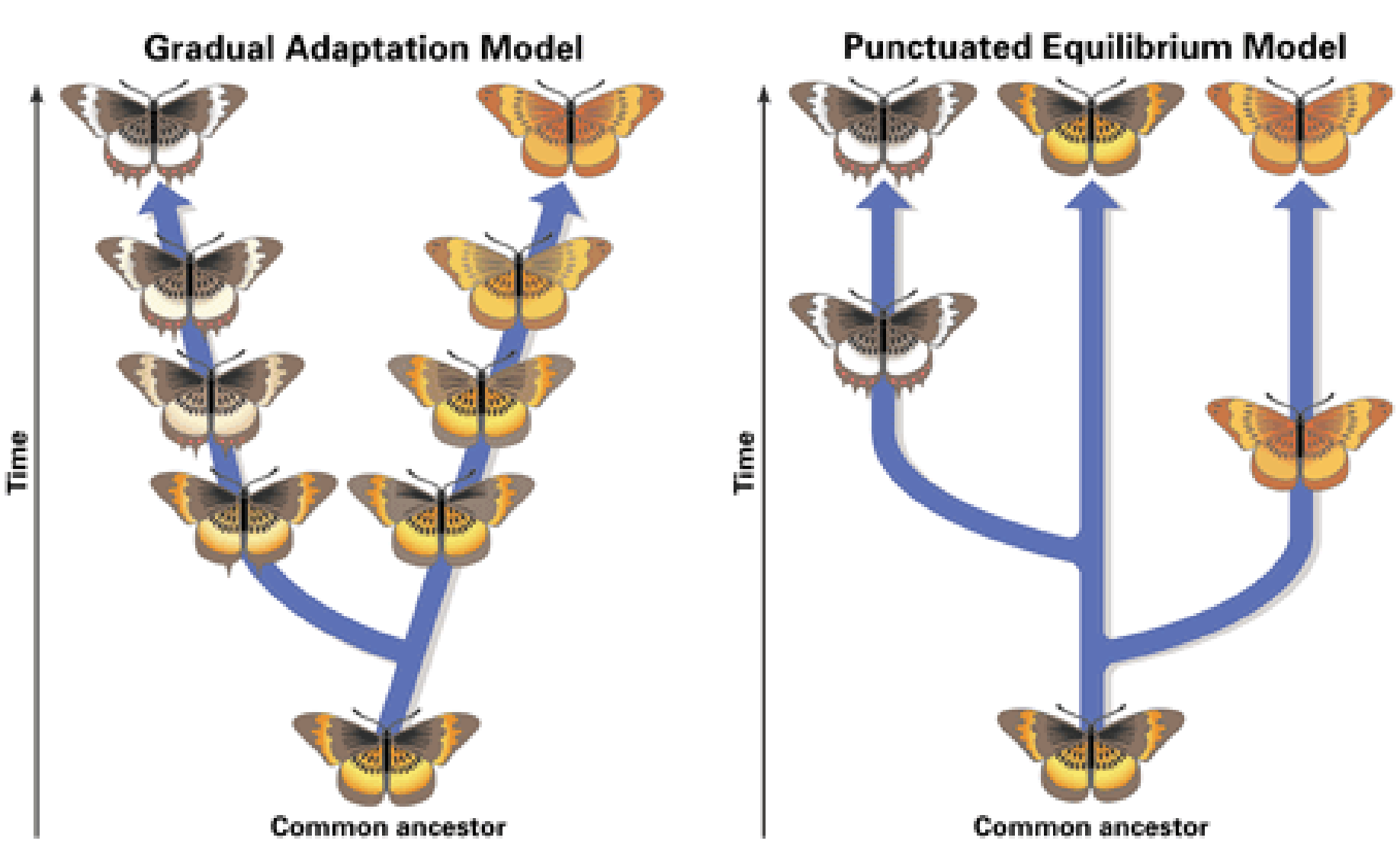
vegetarian finch

woodpecker finch

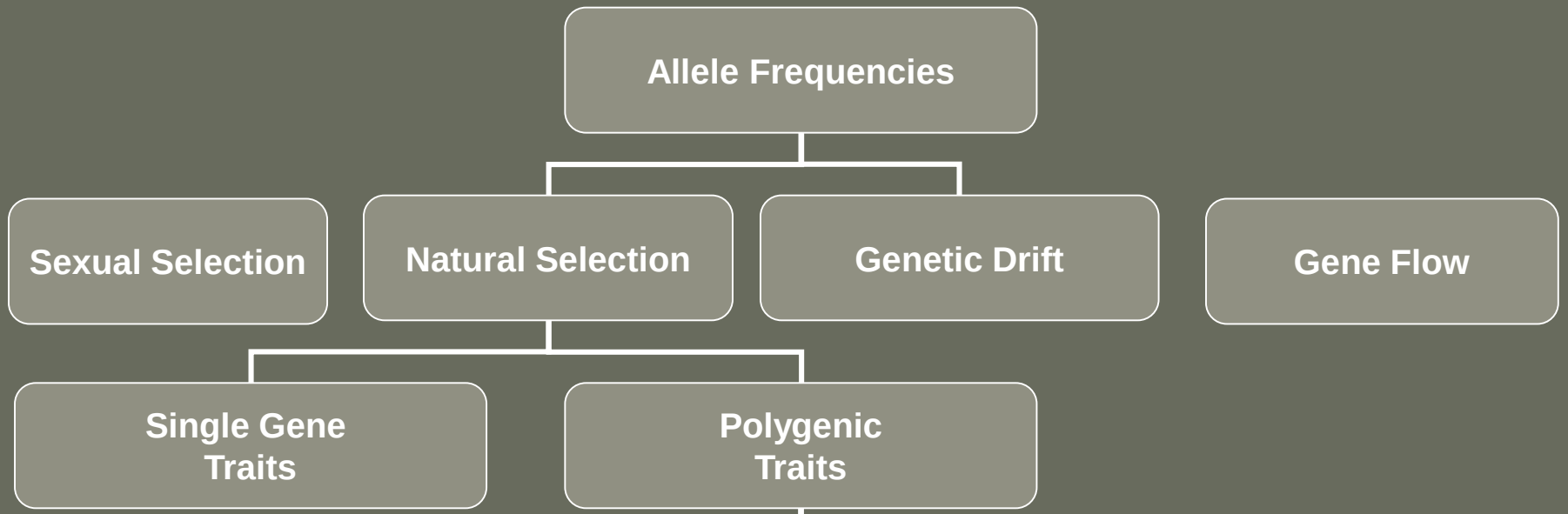
warbler finch

Adaptive Radiation




Gradual Adaptation Model
Time
Common ancestor
Punctuated Equilibrium Model
Time
Common ancestor

Evolution – The Big Picture



Gradualism, punctuated equilibrium and reproductive isolation work together for macroevolution