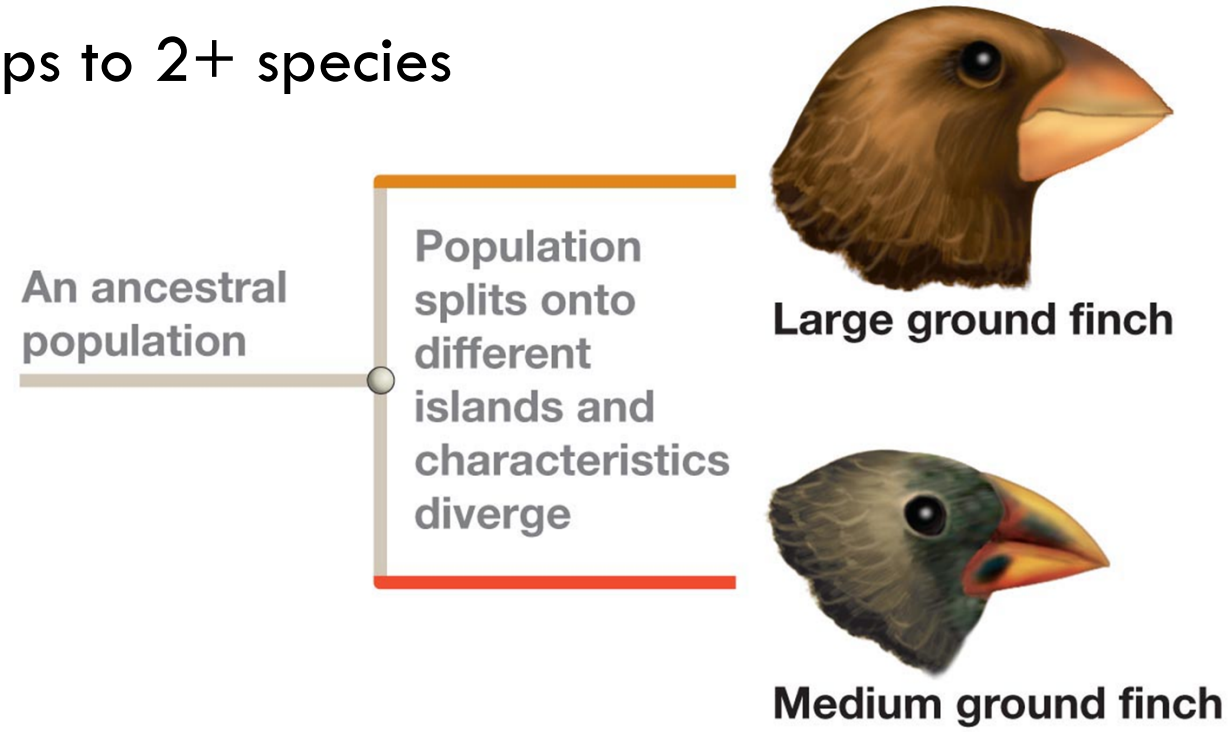
# SPECIATION

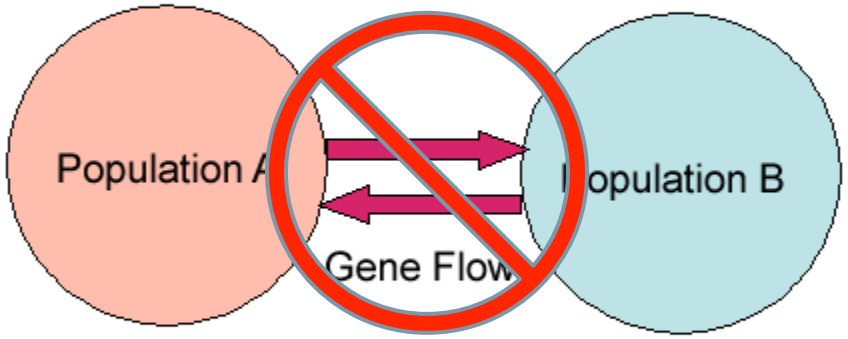
# Speciation

- Divergence
  - If gene flow ends, isolated populations diverge
- Divergence can lead to speciation
  - Ancestral groups to 2+ species



# Biological species concept

- Species are…
  - Populations that are reproductively isolated from each other
- No gene flow b/n populations
  - Do not interbreed
  - Fail to produce viable, fertile offspring

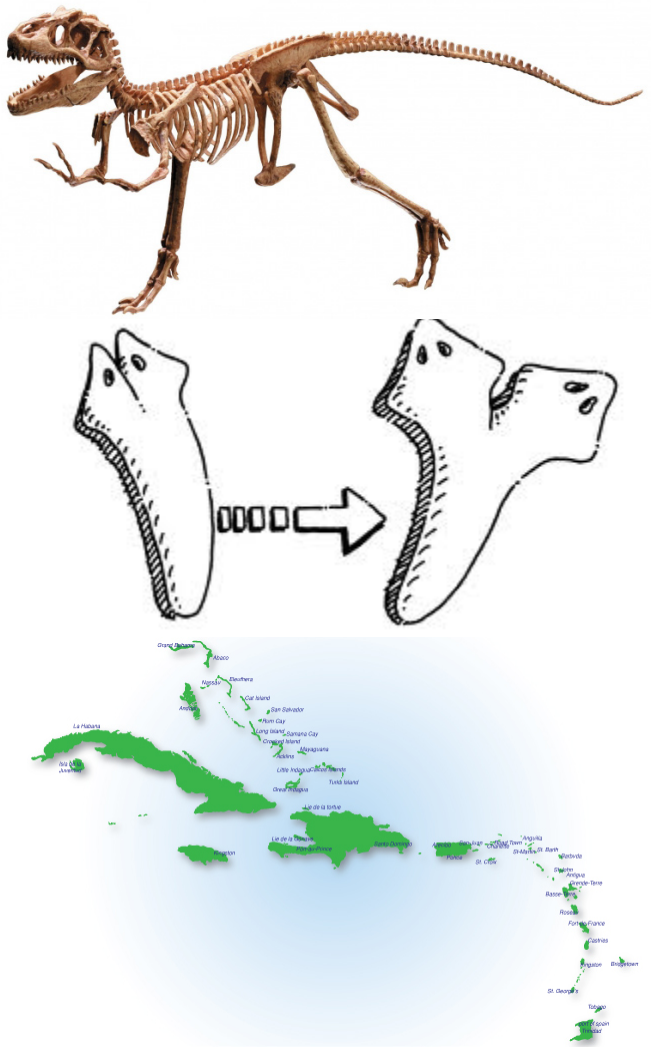


# Biological Species Concept

- Advantages
  - Applicable to many ecological studies
  - Can define different spp. that may be morphologically similar

# Biological species concept

- Disadvantages
  - Can't be evaluated in fossil record
  - Ignores asexual species
  - Only applied to populations that geographically overlap

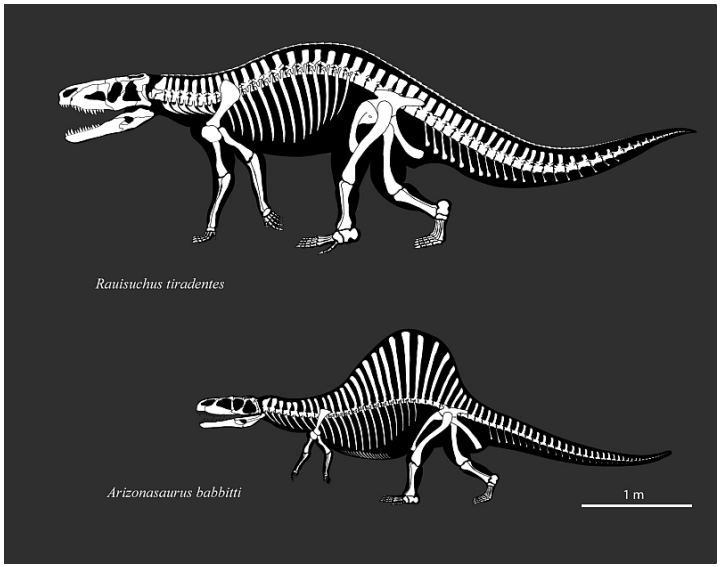


# Morphospecies concept

- Species are…
  - Different in morphological lineages
- Different morphological features arise
  - Populations are independent
  - Isolated from gene flow

# Morphospecies concept

- Advantages
  - Can be used with the fossil record
  - Can easily identify spp. in the field
  - Doesn't require geographic overlap



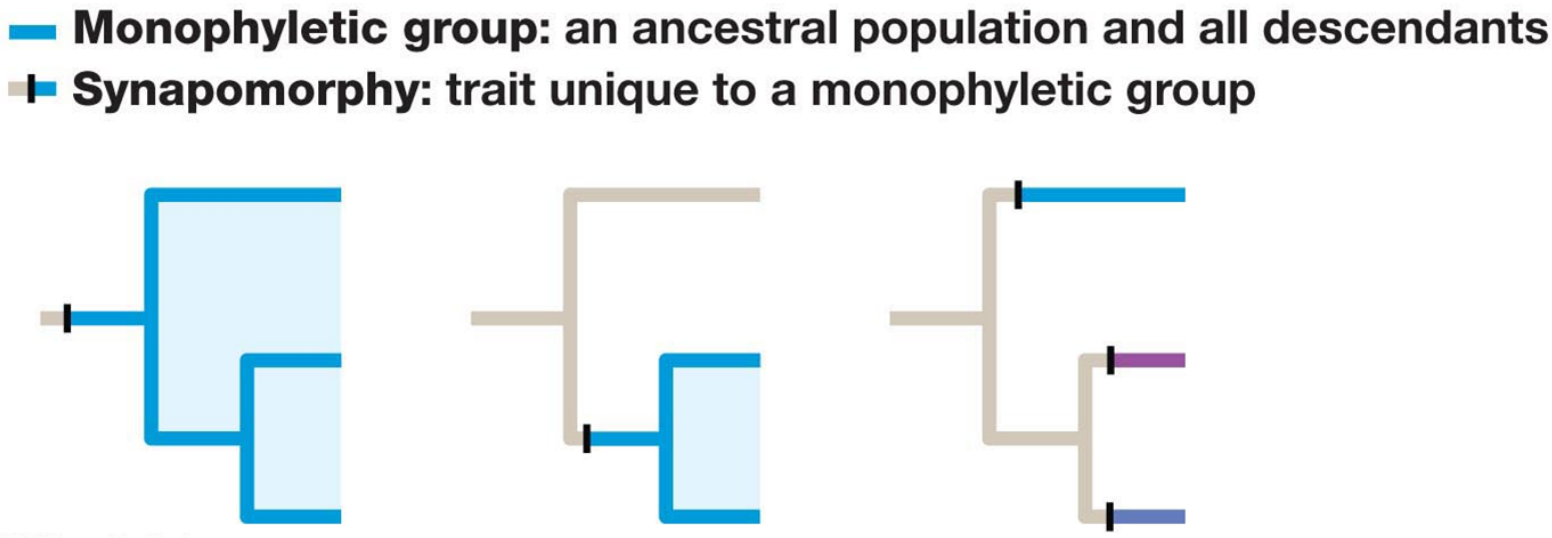

# Morphospecies concept

Disadvantages

- Can't identify species not morphologically different
- Morphological feature are subjective
- Variation exist in populations

# Phylogenetic species concept

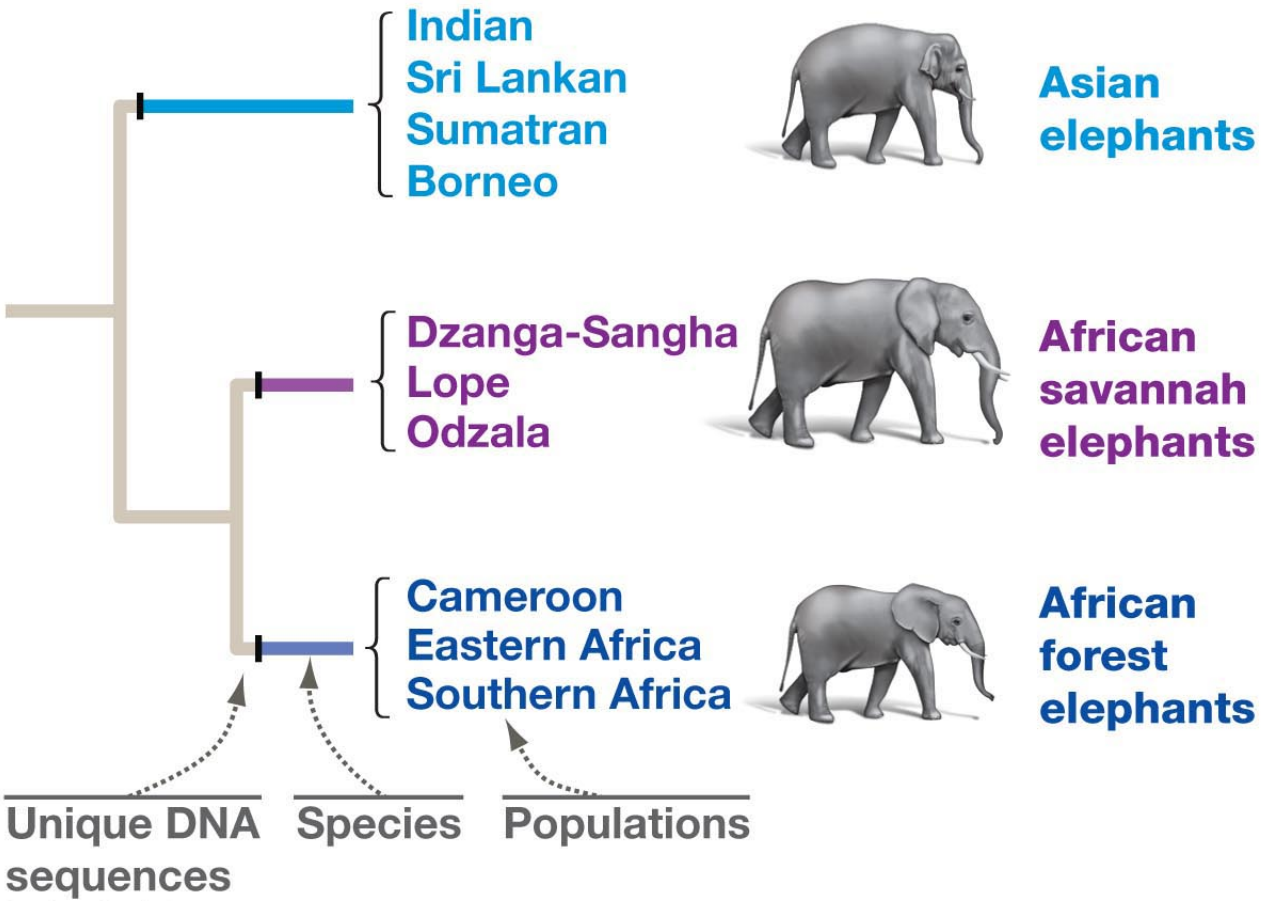
- Based on reconstructing evolutionary history of populations
- Species are defined as the smallest monophyletic group



# Phylogenetic species concept

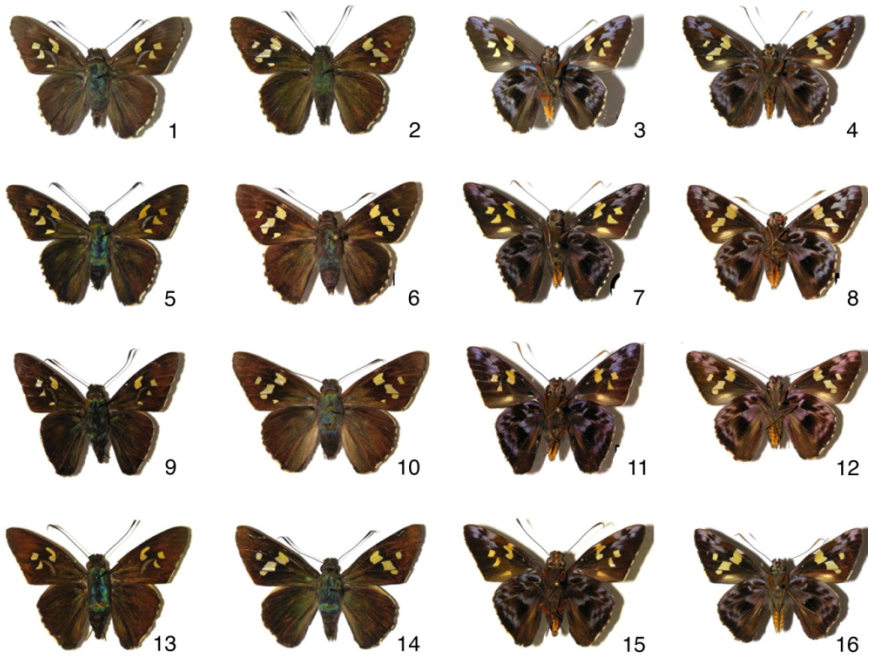
- Advantages
  - Can lead to very precise definitions of taxa
    - Even if they look similar
  - Can validate (or invalidate) previously established taxa
    - Split (into 2+ spp.)
    - Lumped (into 1 sp.)
  - Creates phylogenies based on data (not assumptions)

# Phylogenetic species concept



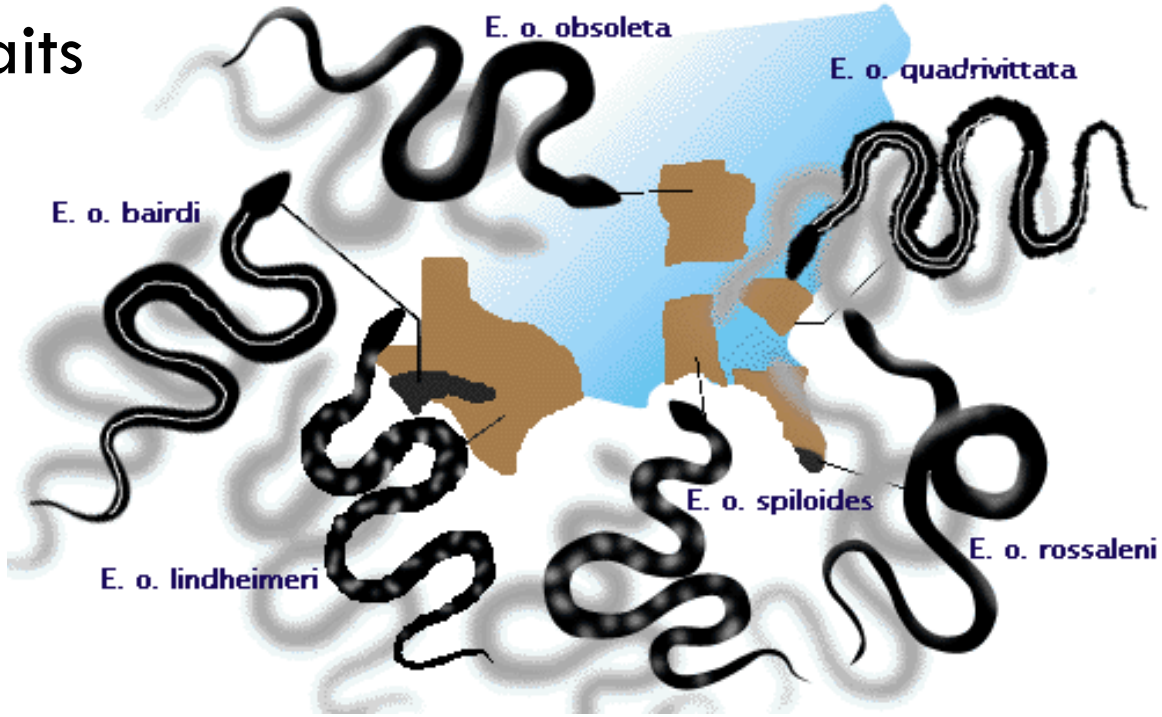
# Phylogenetic species concept

- Disadvantages
  - Leads to recognition of many more species
  - Difficult to identify species in the field
  - Incomplete phylogenies for many groups



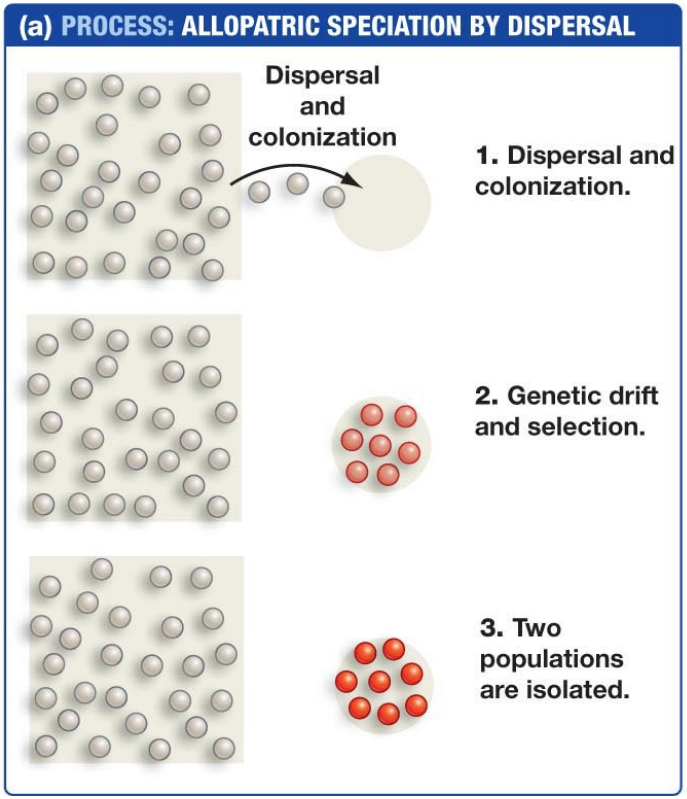
# Subspecies

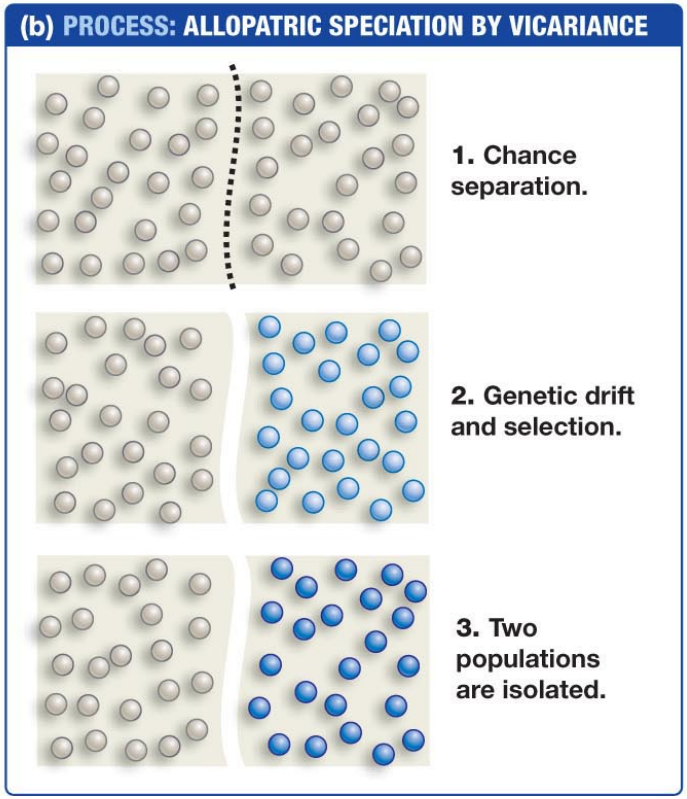
- Populations in discrete geographic areas
- Very little gene flow
- Specific in traits



# Isolation and Divergence

- Genetic isolation from physical isolation
  - Dispersal
    - Population moves to new area
  - Vicariance
    - Physical barrier splits



# Vicariance

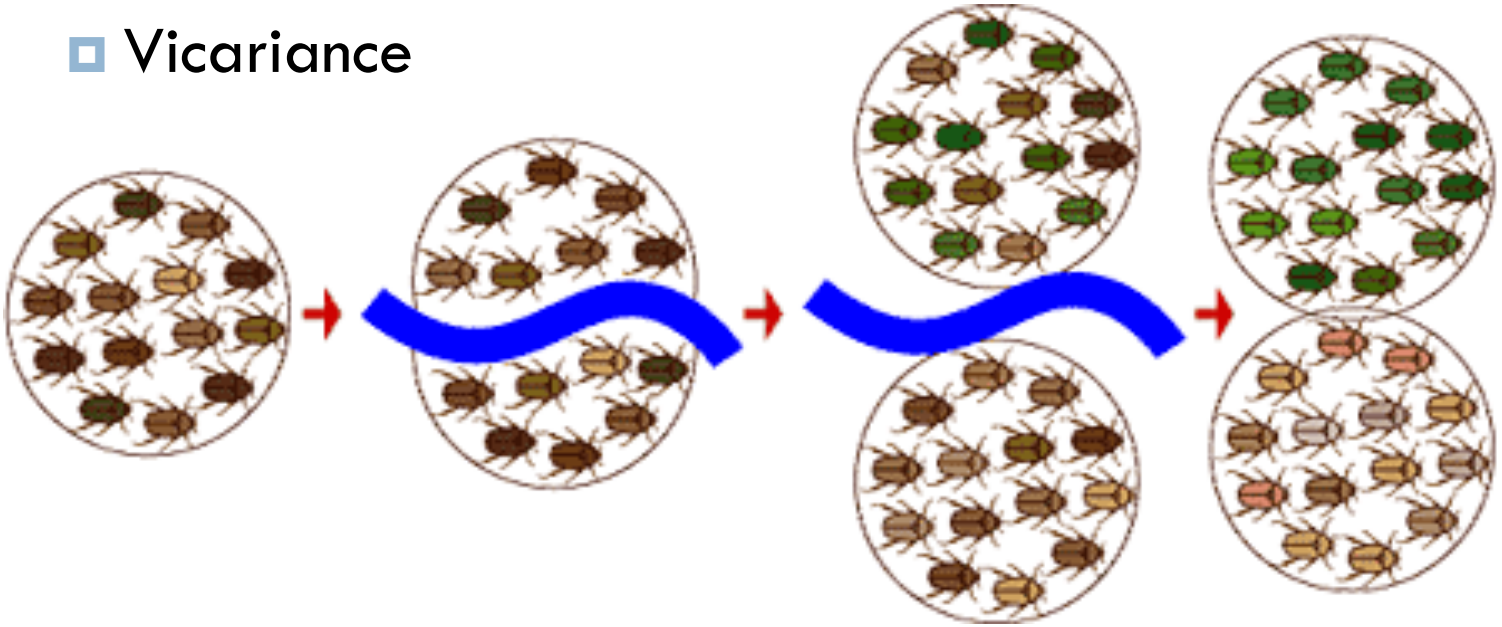
- Physical isolation of populations

Abert's squirrel

Kiabab squirrel

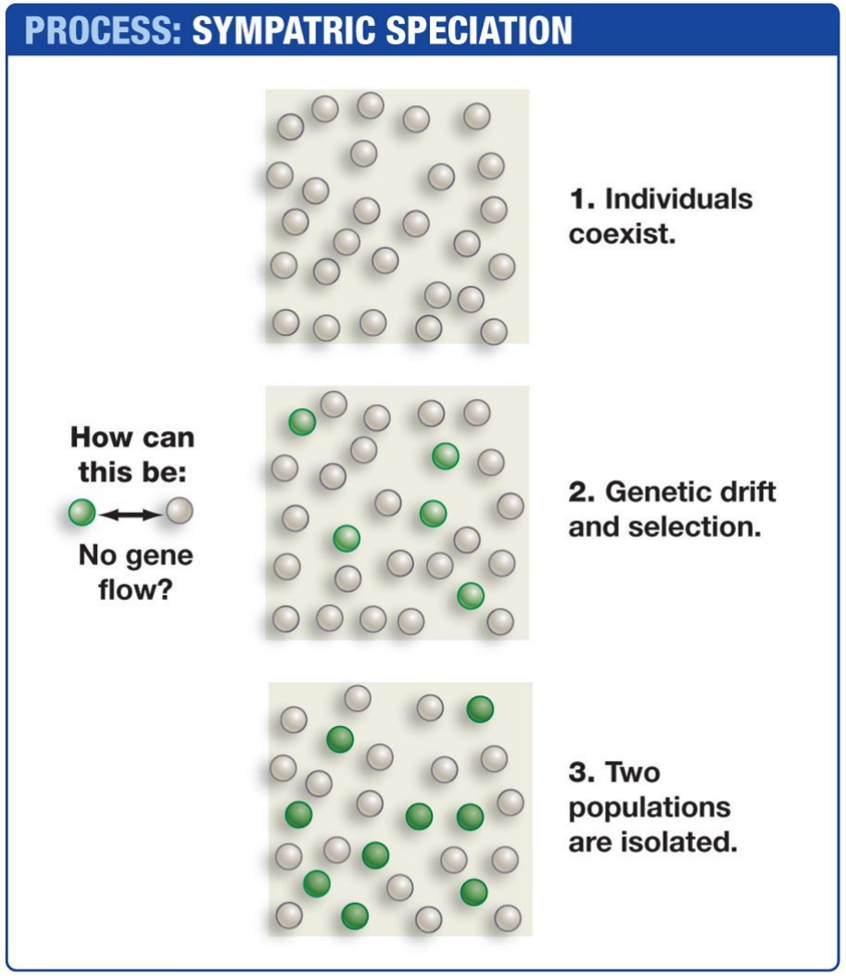
# Allopatric speciation

- Speciation from physical separation
- Mechanisms
  - Dispersal
  - Vicariance

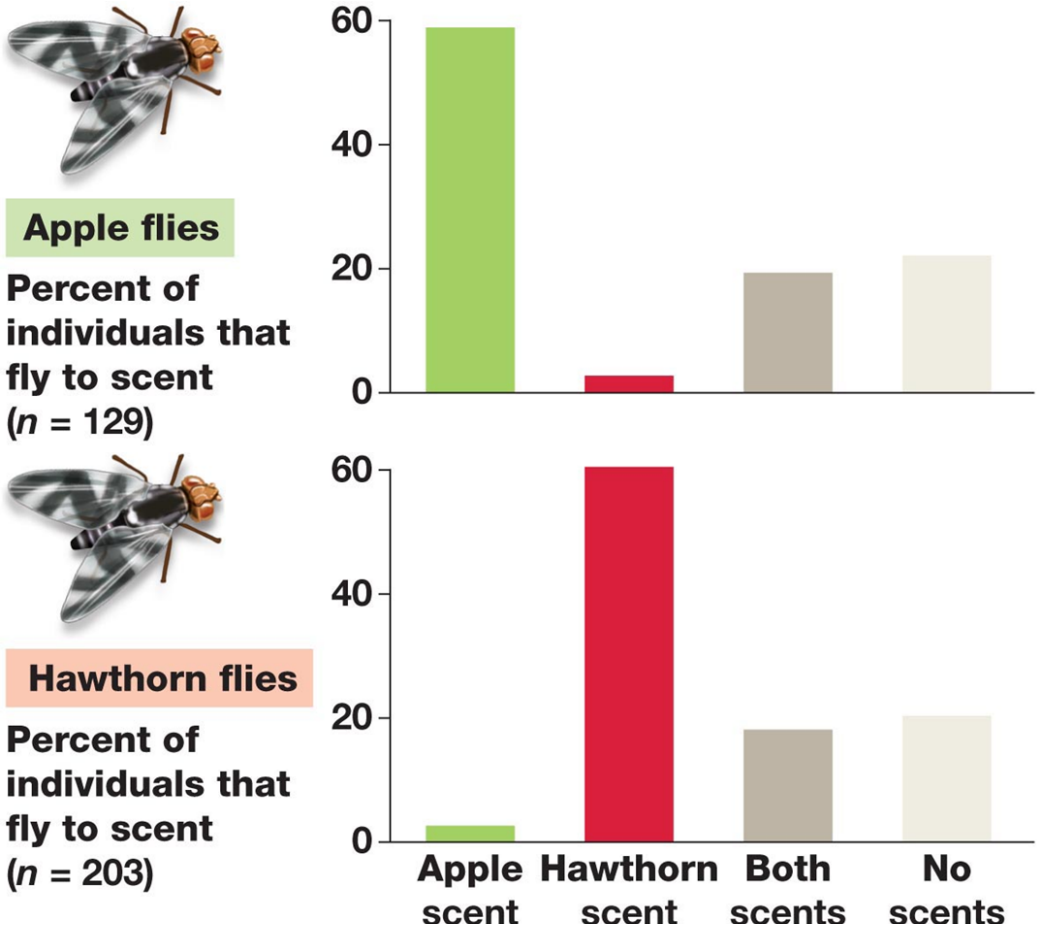


# Sympatric speciation

- Speciation without geographic isolation
- Originally thought to be impossible
  - Gene flow would overwhelm genetic drift
- Can happen
  - Preferences in a habitat

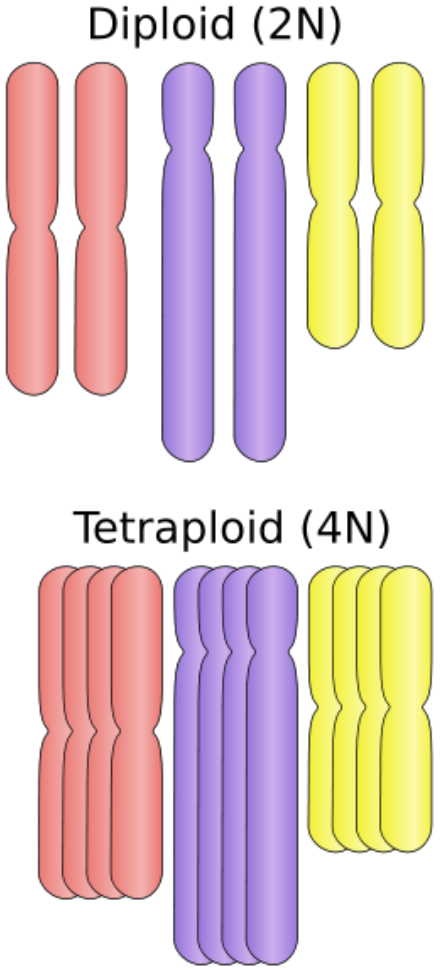


# Sympatric speciation

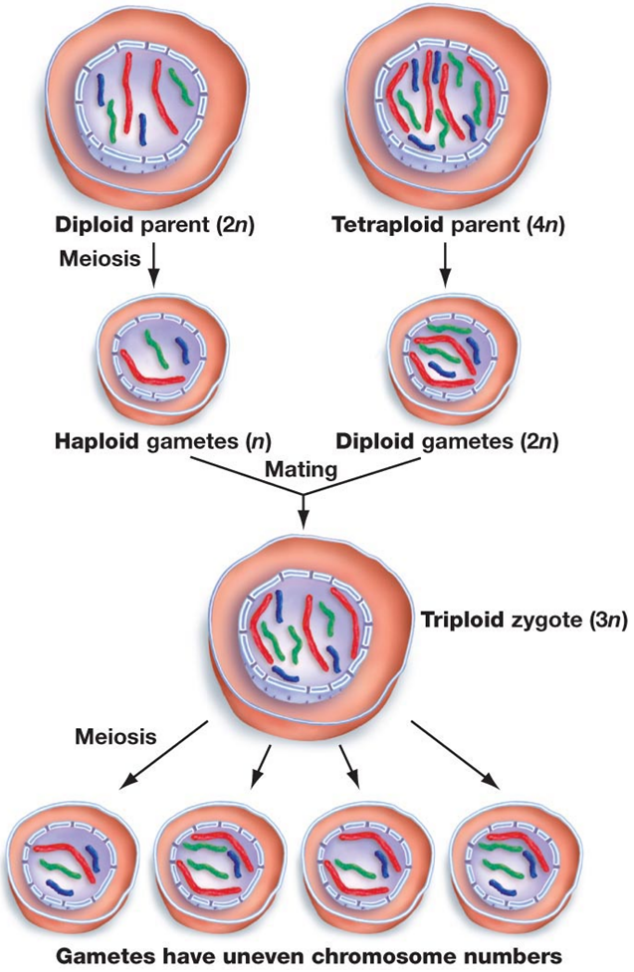


# Polyploidy

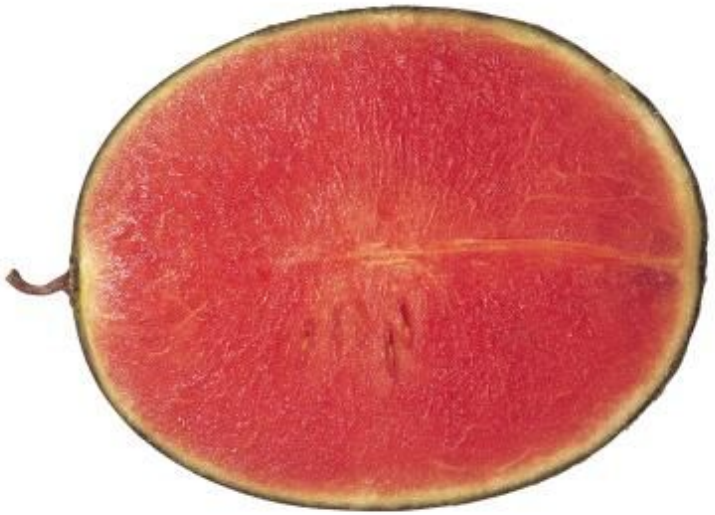
- Mutations that lead to individuals having more than one set of chromosomes
  - *4n* instead of *2n*
  - tetraploid
- Common in plants
- Can cause rapid speciation



# Polyploidy




- Diploids can't mate with tetraploids
  - Produce triploids
  - Reproductively isolated

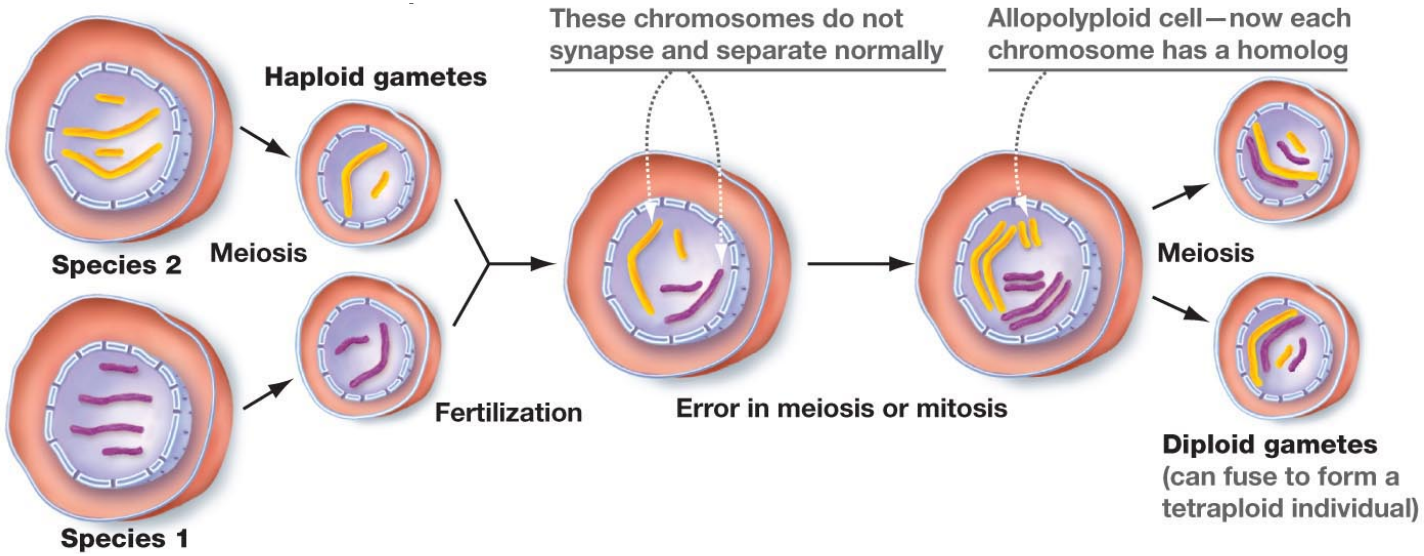


# Autopolyploidy

- Polyploidy of same species
- *4n* maidenhair ferns
  - Produced diploid gametes
- *4n* populations genetically isolated from *2n*
- Divergence begins
- Sympatric speciation possible

# Allopolyploidy

- Chromosomes derived from different spp.
- New tetraploid (*4n*) species (hybrid)
  - From diploid hybridization
  - When diploid gamete fuse



# Why polyploidy in plants?

- Self-fertilize
  - Diploid gametes can fuse
- Hybridization is common
  - Creating opportunity for allopolyploidy

# When isolated populations contact

- Depends how far populations have diverged genetically
  - Large divergence
    - Mating rare
    - Gene flow minimized
    - Populations continue to diverge
  - "Insignificant" divergence
    - Mating frequency increases
    - Gene flow increases
    - Populations converge

# When isolated species contact

- Geographic area where interbreeding of two species occur

- Hybridization
  - Commonly leads to local extinction
  - Sometimes origination of new species