

# **L21-Speciation**

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>include '**EEOB 3310**' in subject heading to ensure  
delivery

## ANNOUNCEMENTS!

A total of one-half (75 points) of the points for the 'take-home assignments and quizzes' (150 points) can be earned over the next several weeks.

### >WEEKLY QUIZZES

#### SCORING RUBRIC

75-100% correct answers for the week:	5 points
50-74% correct answers for the week:	3.5 points
0-49% correct answers for the week:	2 points
Answering >1 question for the week:	1 point
Answering <1 question for the week:	0 points

A total of **30 points** can be earned from quizzes over the next 8 wks (Nov 24th and Dec 8 will not be counted as full weeks and will be combined with their preceding weeks, which effectively provides six weeks to earn a maximum of 5 points per week.)

## ANNOUNCEMENTS!

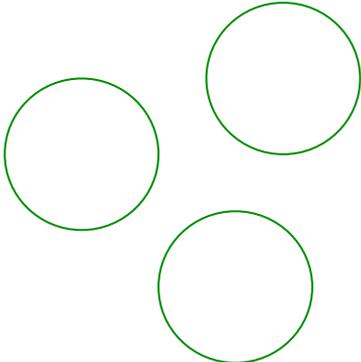
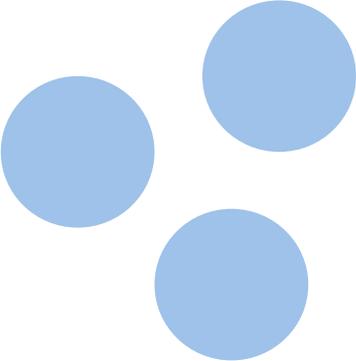
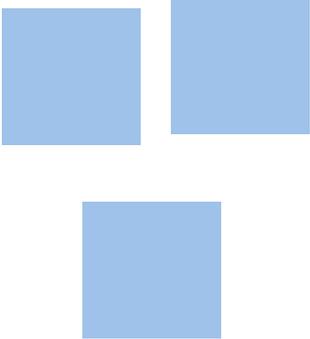
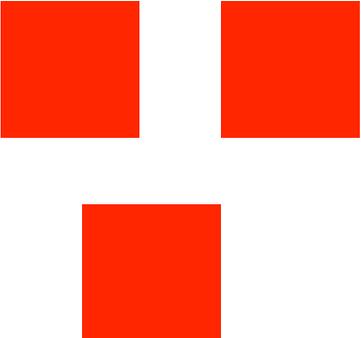
Recitation 8 on “speciation” is available on Carmen  
-please download and bring with you to your recitation section

Lecture slides will be posted after class

**Unsure about a concept? Email me about it!**  
**(‘EEOB 3310’ in the Subject Heading)**  
**-it could show up as a clicker question!**

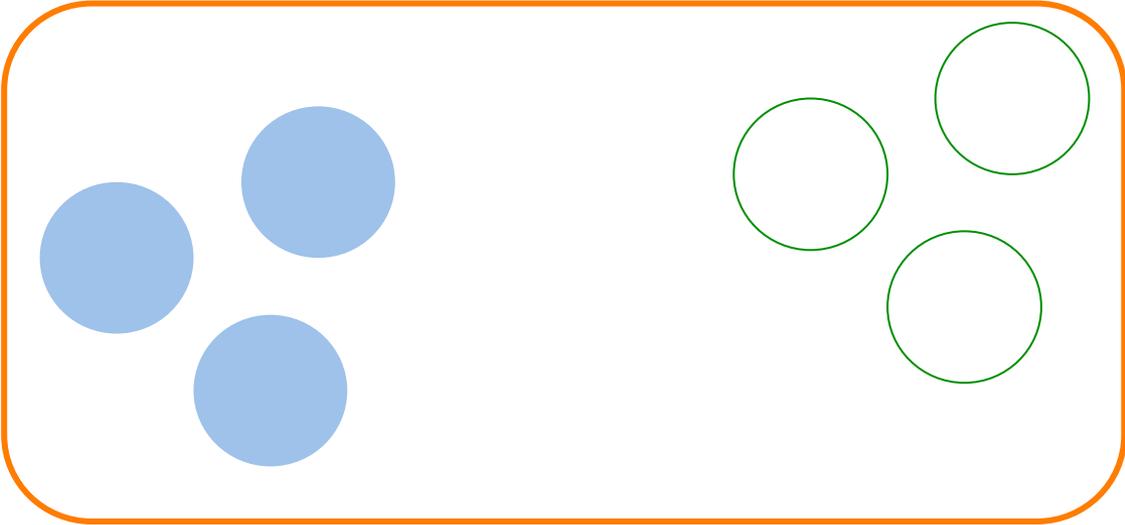
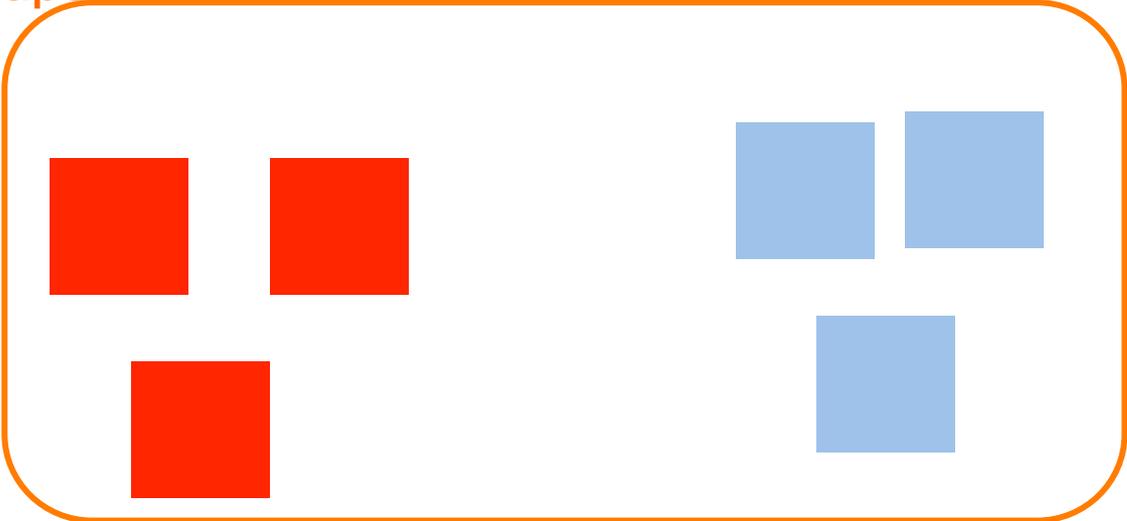
# Speciation

# What is a species?

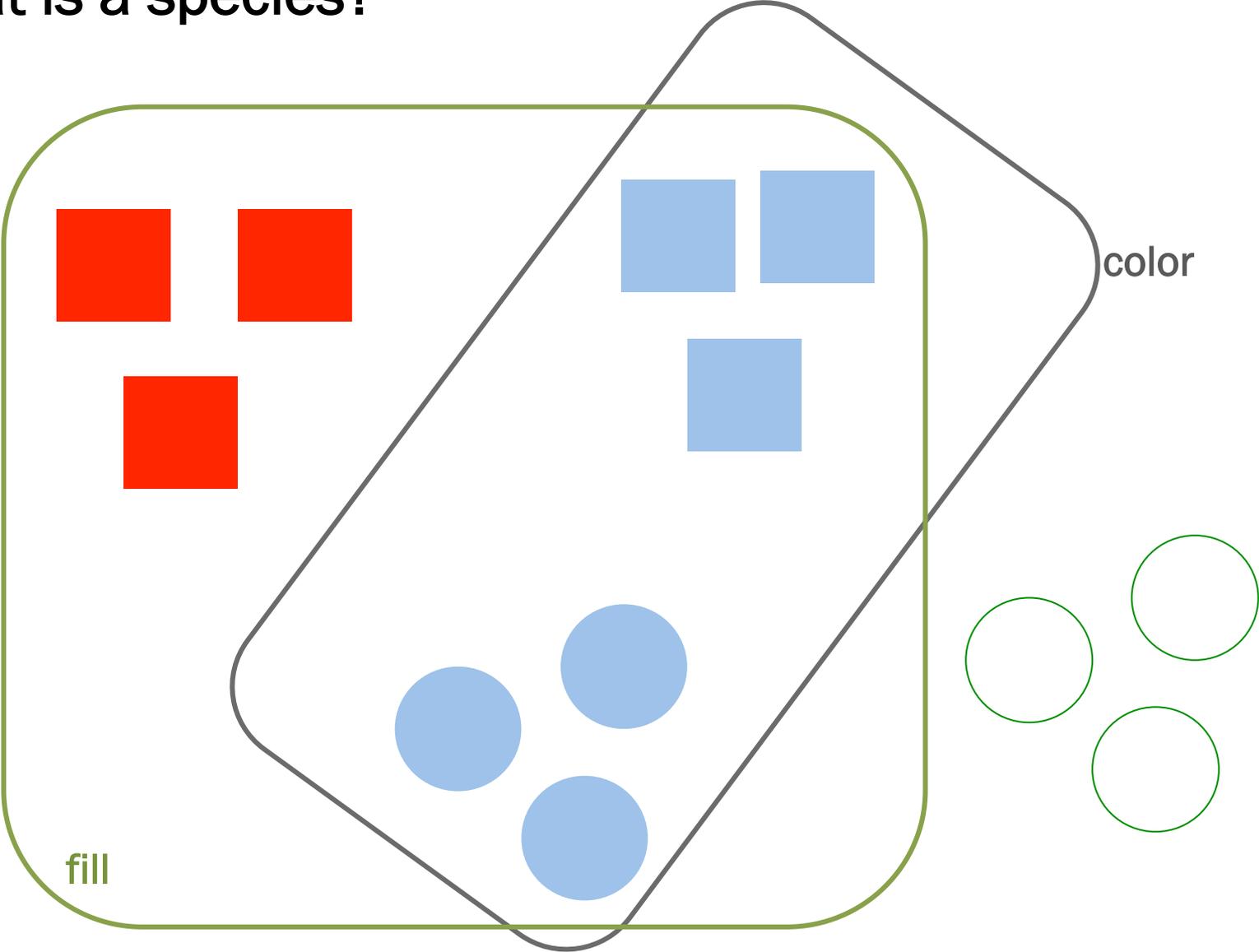


# What is a species?

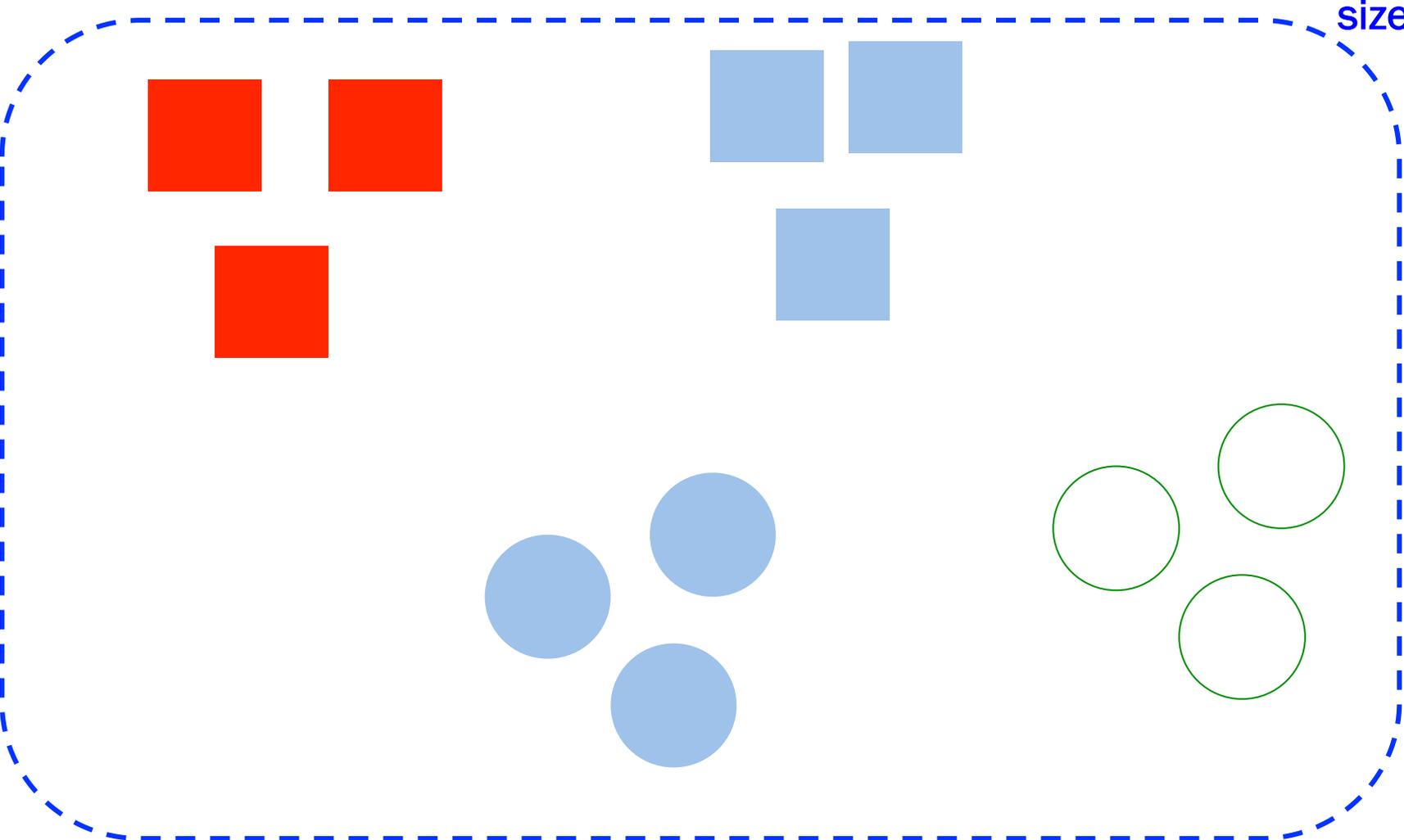
shape



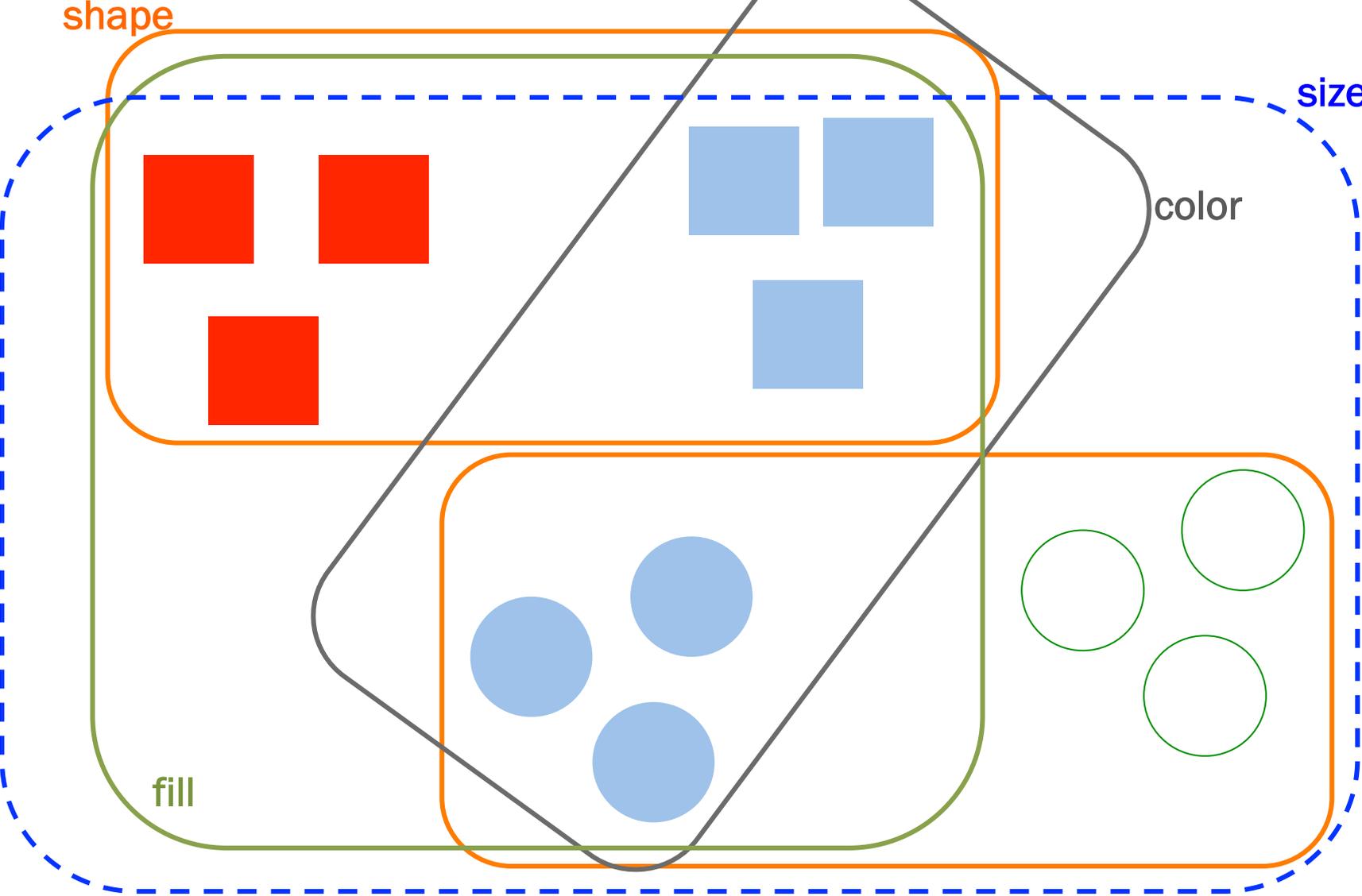
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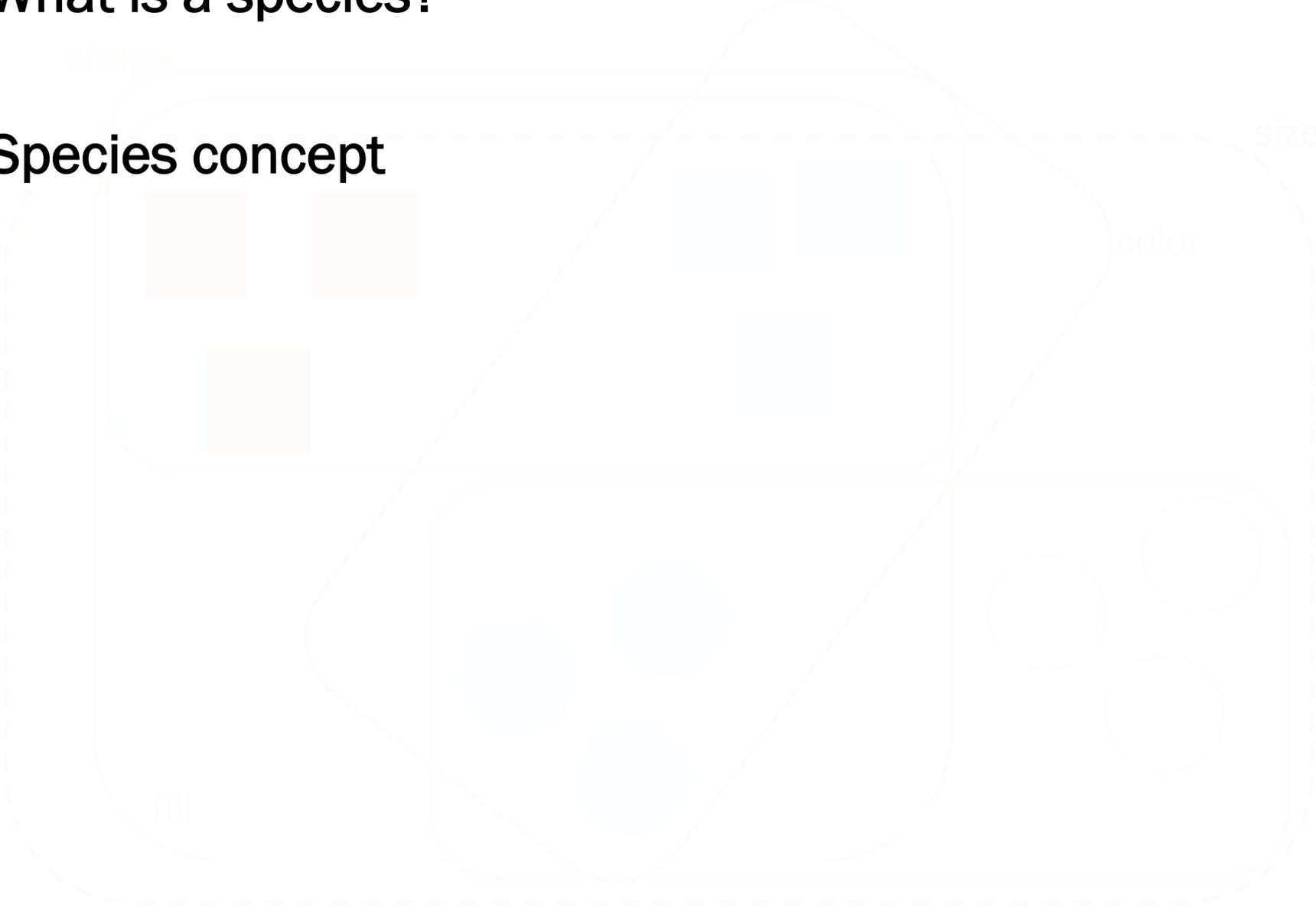


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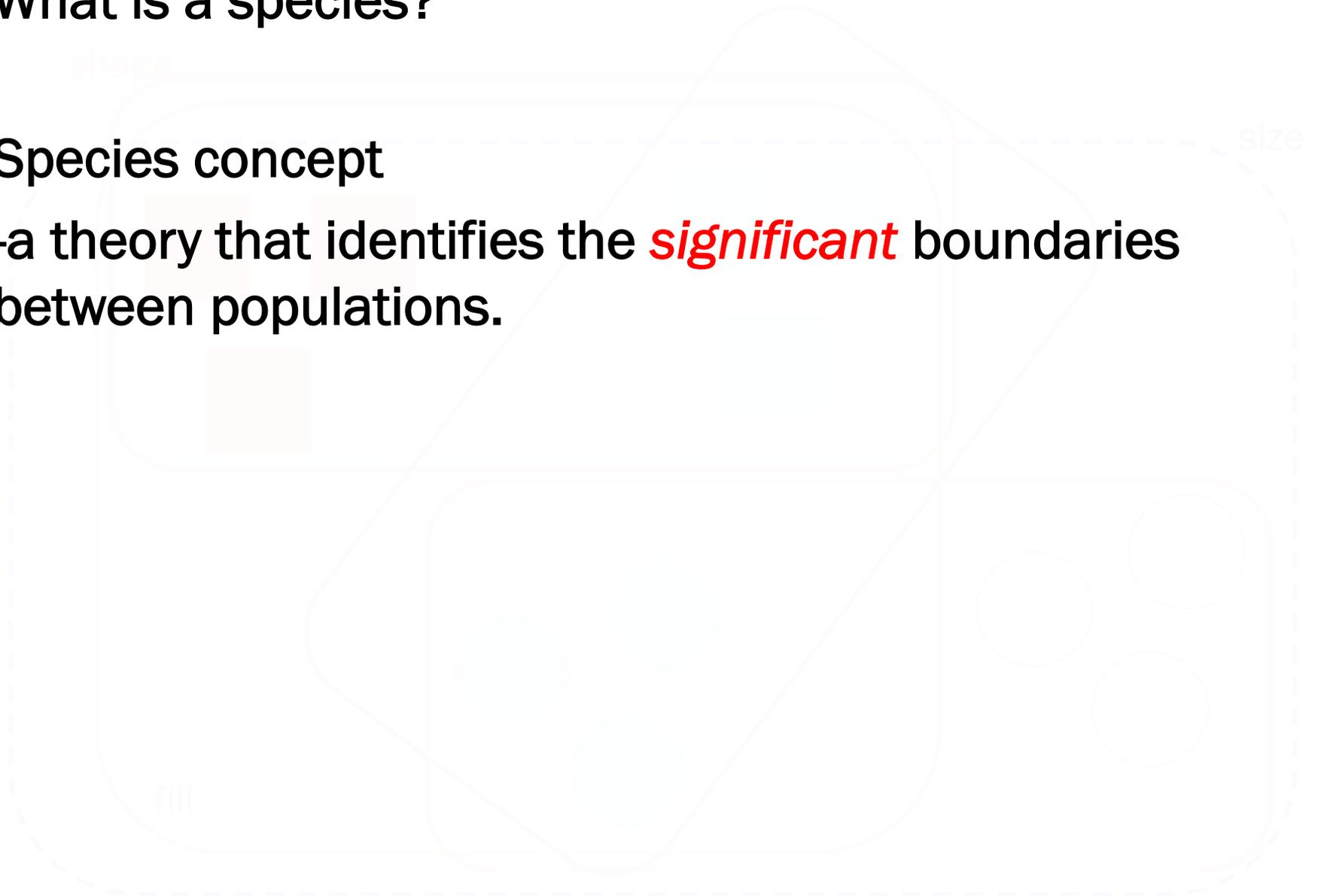
## Species concept



# What is a species?

## Species concept

-a theory that identifies the *significant* boundaries between populations.



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# What is a species?

## Evolutionary species concept (Simpson and Wiley)

Populations with a shared evolutionary history and fate

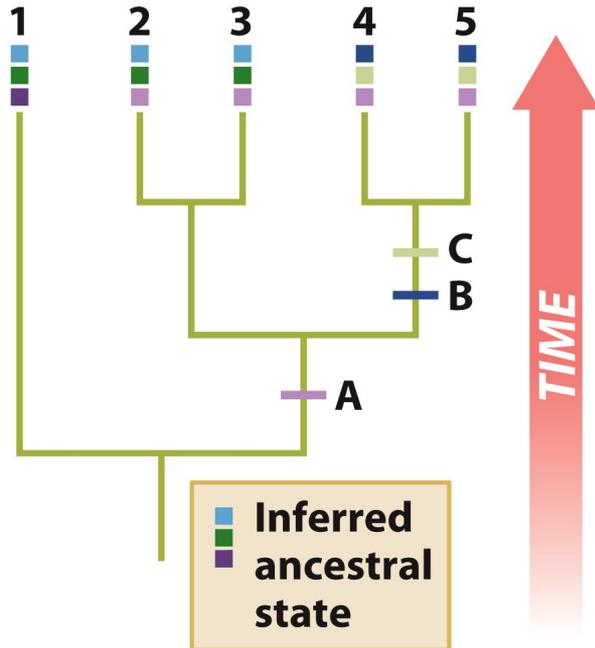


...but how are species delineated?

# What is a species?

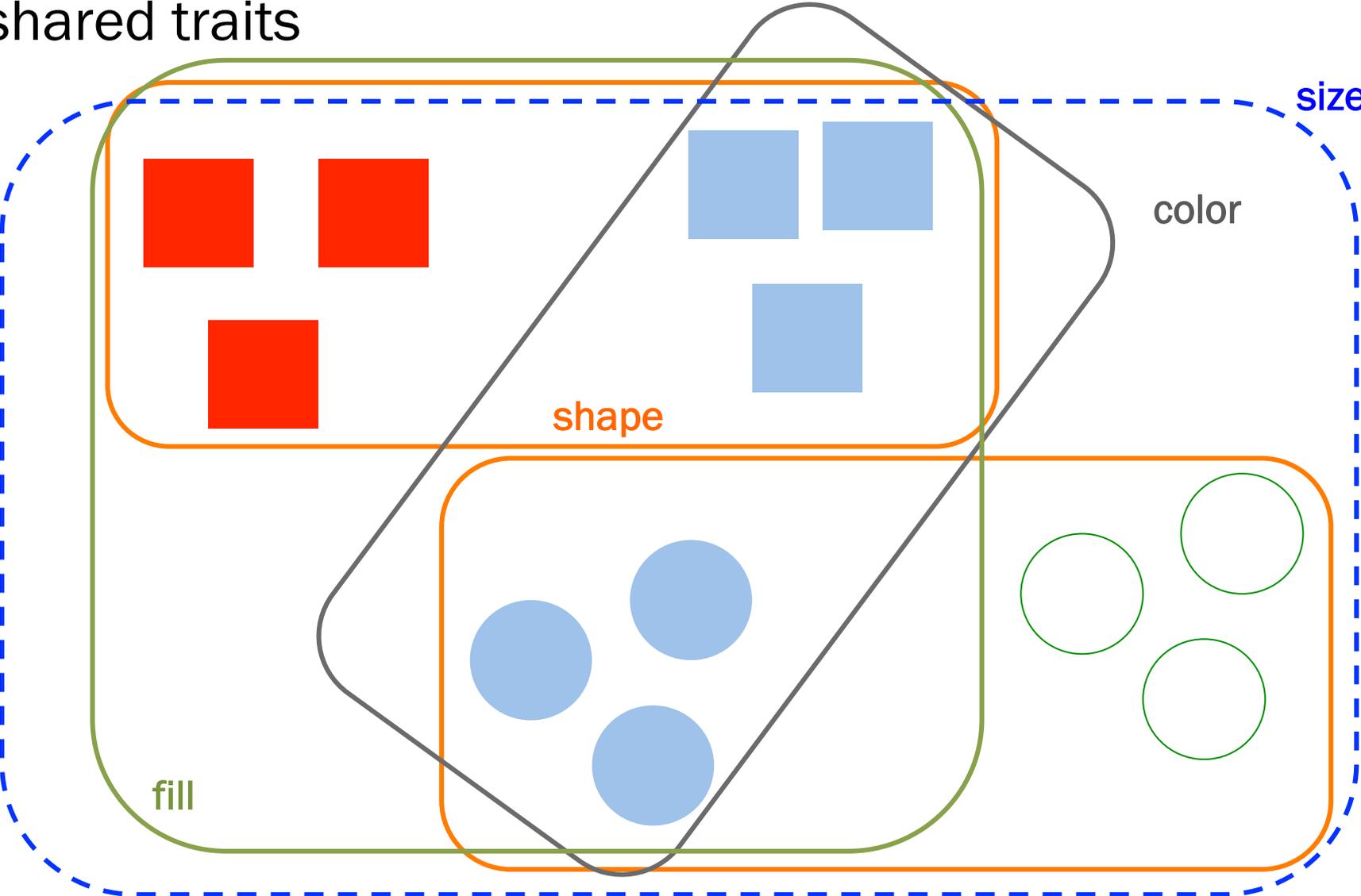
## Evolutionary species concept (Simpson and Wiley)

Populations with a shared evolutionary history and fate



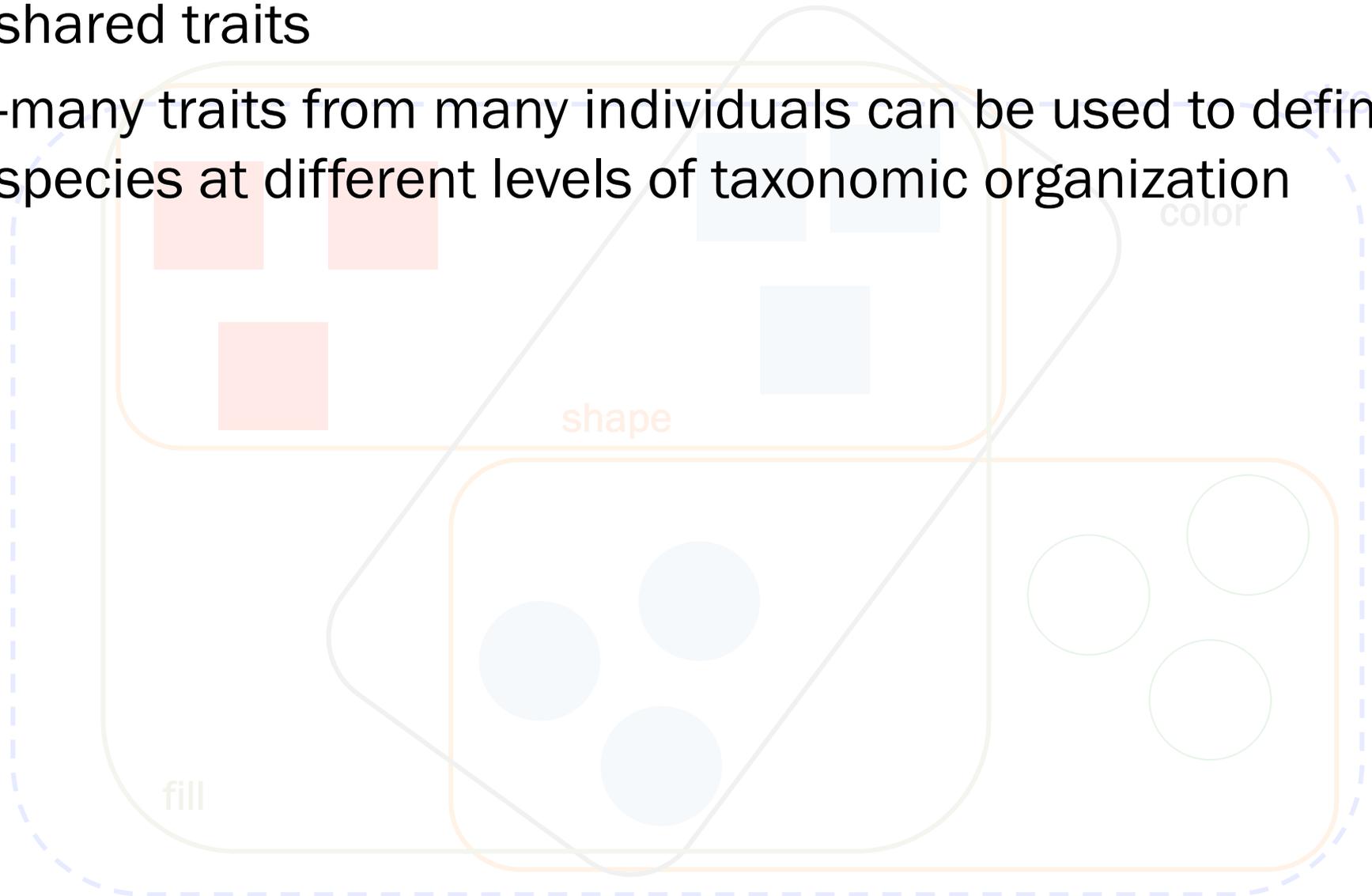
...but how are species delineated?

Phenetic species concept delimits species based on shared traits



**Phenetic species concept** delimits species based on shared traits

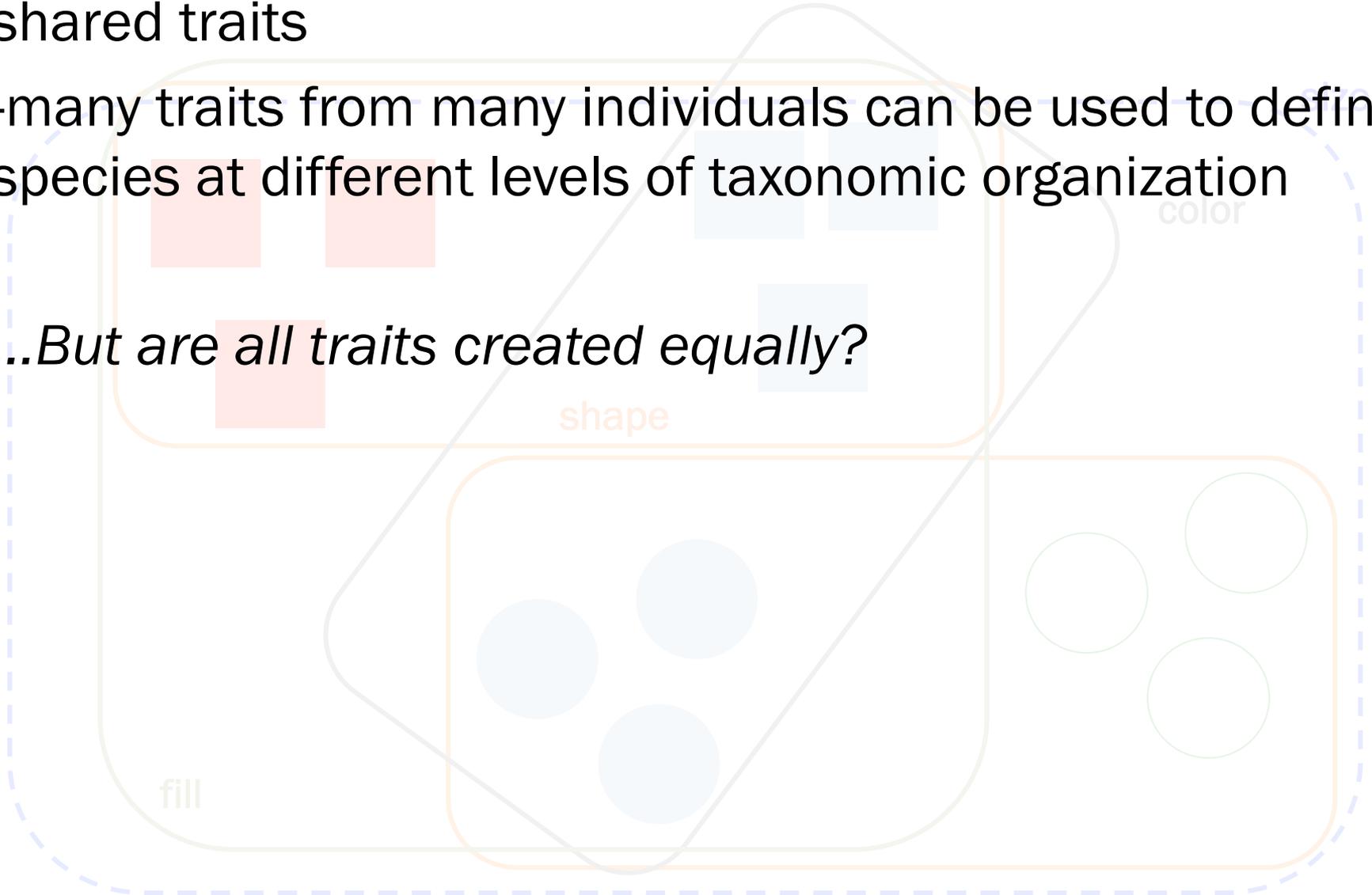
-many traits from many individuals can be used to define species at different levels of taxonomic organization



Phenetic species concept delimits species based on shared traits

-many traits from many individuals can be used to define species at different levels of taxonomic organization

*...But are all traits created equally?*



Would antibiotic resistance genes be optimal traits for defining species boundaries?

A. Yes

B. No

Phenetic species concept delimits species based on shared traits

-many traits from many individuals can be used to define species at different levels of taxonomic organization

*...But are all traits created equally?*

*-horizontally-transferred traits between distinct species (i.e. antibiotic resistance) can be strongly selected for and widely distributed in a multispecies population*

*-determining 'definitive' traits can be challenging*

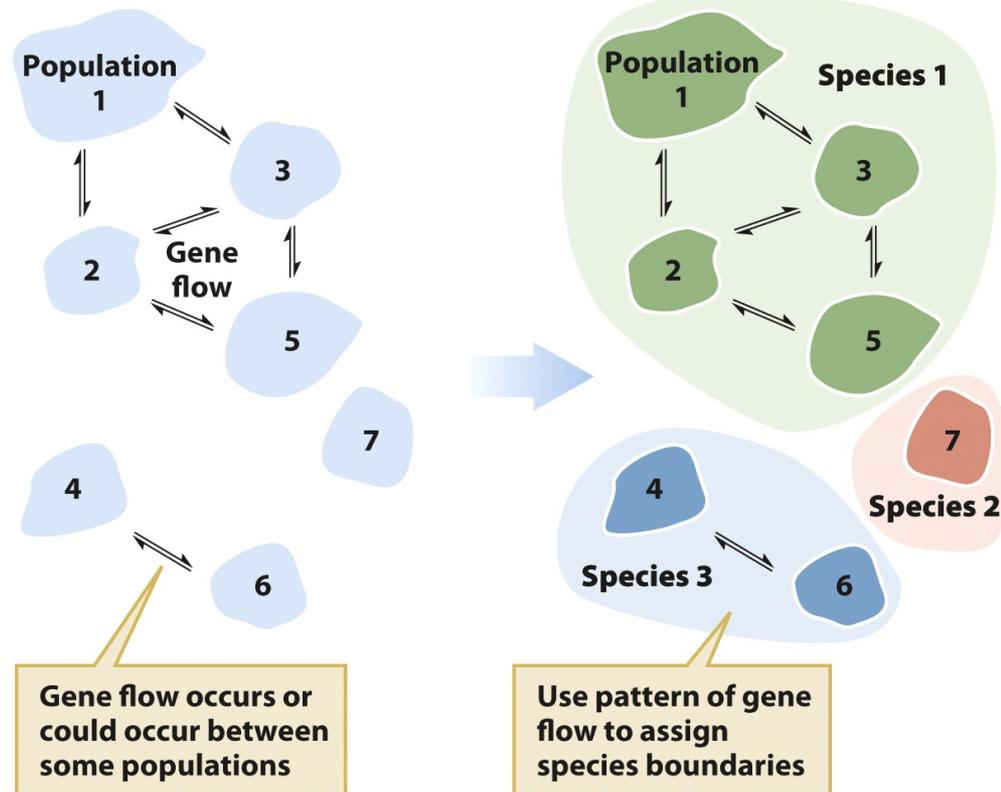
# Biological species concept (Mayr) delimits species based on populations capable of interbreeding

**TABLE 14.1**  
**Differences in the Biology of *Culex pipiens* and *Culex pipiens molestus***

Trait	<i>C. pipiens molestus</i>	<i>C. pipiens</i>
Breeding site	Underground	Above ground
Mating	In confined spaces	Not in confined spaces
Host preference	Bites mammals	Bites birds
Egg production	No blood meal needed to lay eggs	Blood meal needed to lay eggs
Life cycle	Active all year	Dormant in winter

Adapted from Byrne and Nichols (1999).

Evolution, 1/e Table 14.1  
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Evolution, 1/e Figure 14.4  
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# Biological species concept (Mayr) delimits species based on populations capable of interbreeding

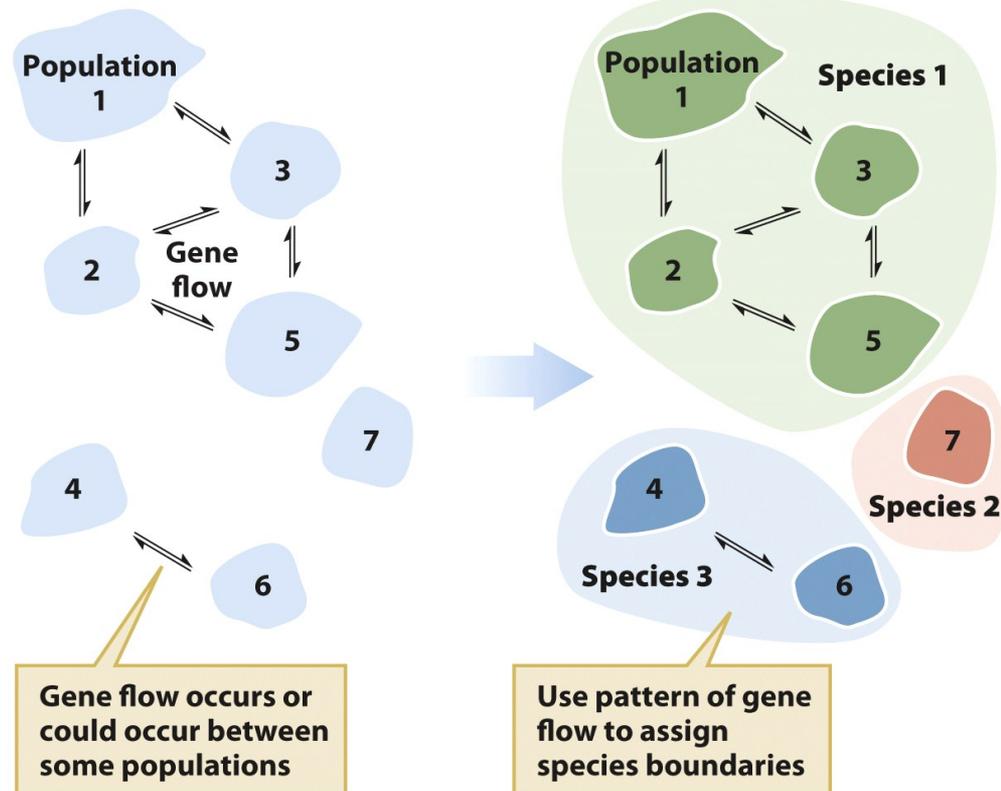
-gene flow defines the 'evolutionary fate'

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Biological species concept (Mayr) delimits based on populations capable of interbreeding

- gene flow defines the 'evolutionary fate'
- morphology only may delineate species  
(are all things with wings birds??)



Biological species concept (Mayr) delimits based on populations capable of interbreeding

-gene flow defines the 'evolutionary fate'  
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(are all things with wings birds??)



*...But what about extinct species???*

*...What if matings are rare (mountains, highway, etc.)???*

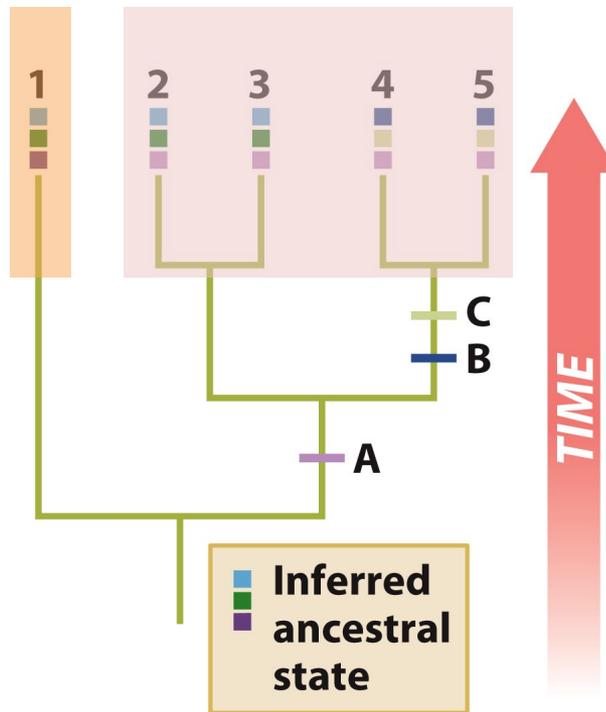
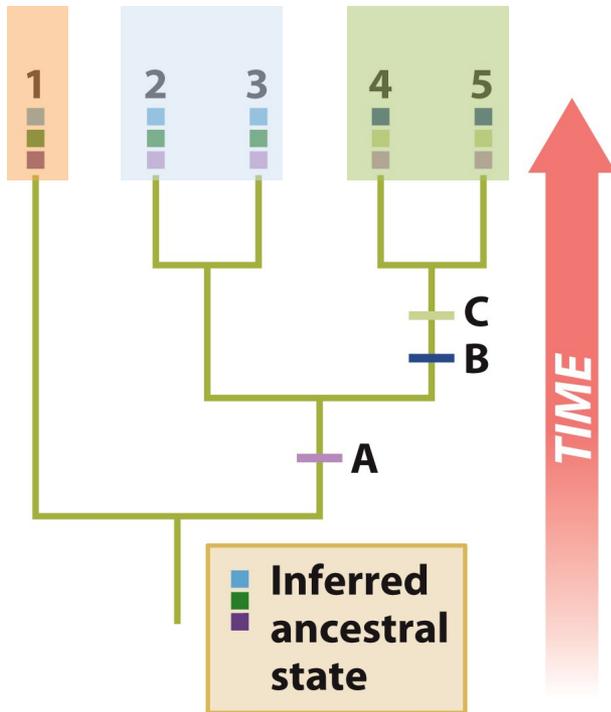
*...What if hybrid species are not sterile but merely have reduced viability or fertility???*

*...Asexual organisms???*

**Phylogenetic species concept** delimits species by resolving the smallest monophyletic clade with members uniquely sharing the derived traits

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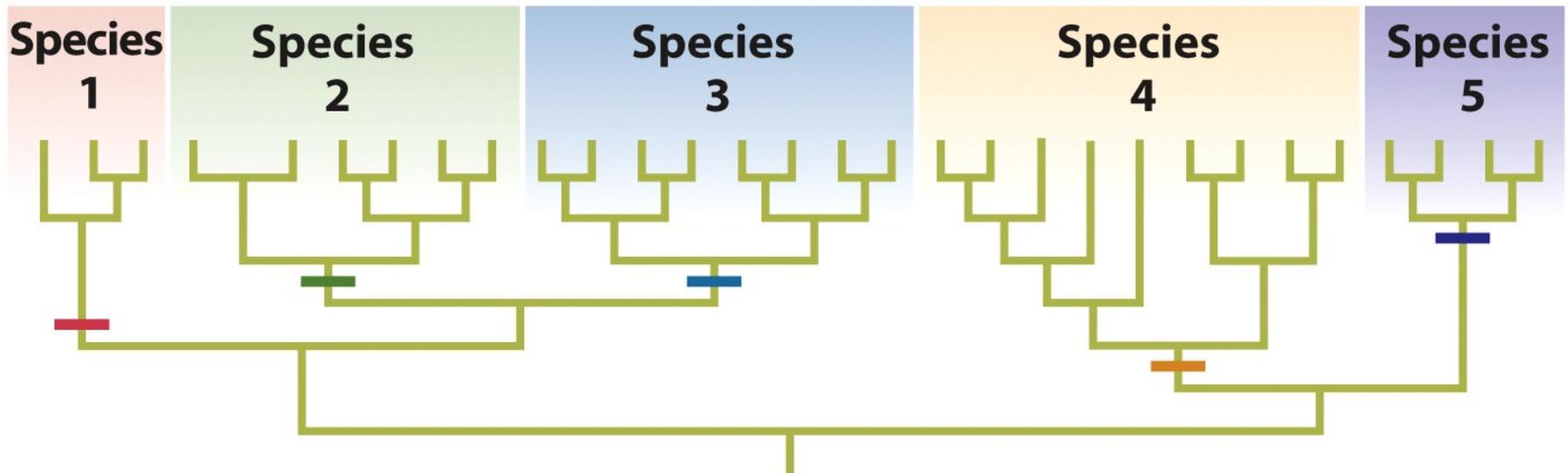
-inherent taxonomic hierarchy



Phylogenetic species concept delimits species by resolving the smallest monophyletic clade with members uniquely sharing the derived traits

-inherent taxonomic hierarchy

-distinct evolutionary histories imply lack of gene flow



What traits can we use to build a phylogeny that reflects the three groupings of shoes?

- A. color
- B. material
- C. laces
- D. style/common usage



Phylogenetic species concept delimits species by resolving the smallest monophyletic clade with members uniquely sharing the derived traits

-inherent taxonomic hierarchy

-distinct evolutionary histories imply lack of gene flow

*...selection of traits for phylogenetic inference is important*

*...contemporary species delimitations may change if unanticipated gene flow occurs*

# Modes of speciation: Allopatric speciation

Reproductive incompatibility occurs in physically separated populations

-genetic drift, accumulation of mutations and natural selection cause populations to diverge as different alleles are fixed within them

Prohibition of gene flow interferes with a common evolutionary fate, resulting in a new species

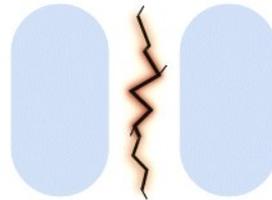
# Modes of speciation: Allopatric speciation

## ' Dumbbell model

Original population

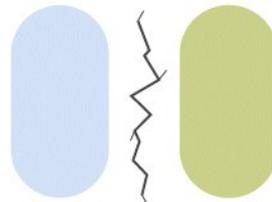


Initial step of speciation



Geographic barrier to dispersal

Evolution of reproductive isolation



In isolation

All mutations are neutral and are occurring at the same rate.  
Red spruce genetic diversity represents a subset of that  
observed in black spruce. This suggests RS arose from BS.

A. True

B. False

A



B



# Modes of speciation: Allopatric speciation

trans-isthmus interactions were more aggressive and resulted in lower fitness.

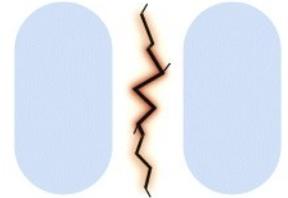


## Dumbbell model

Original population

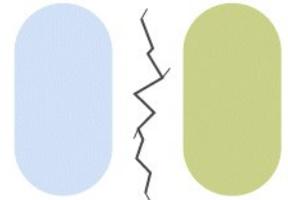


Initial step of speciation



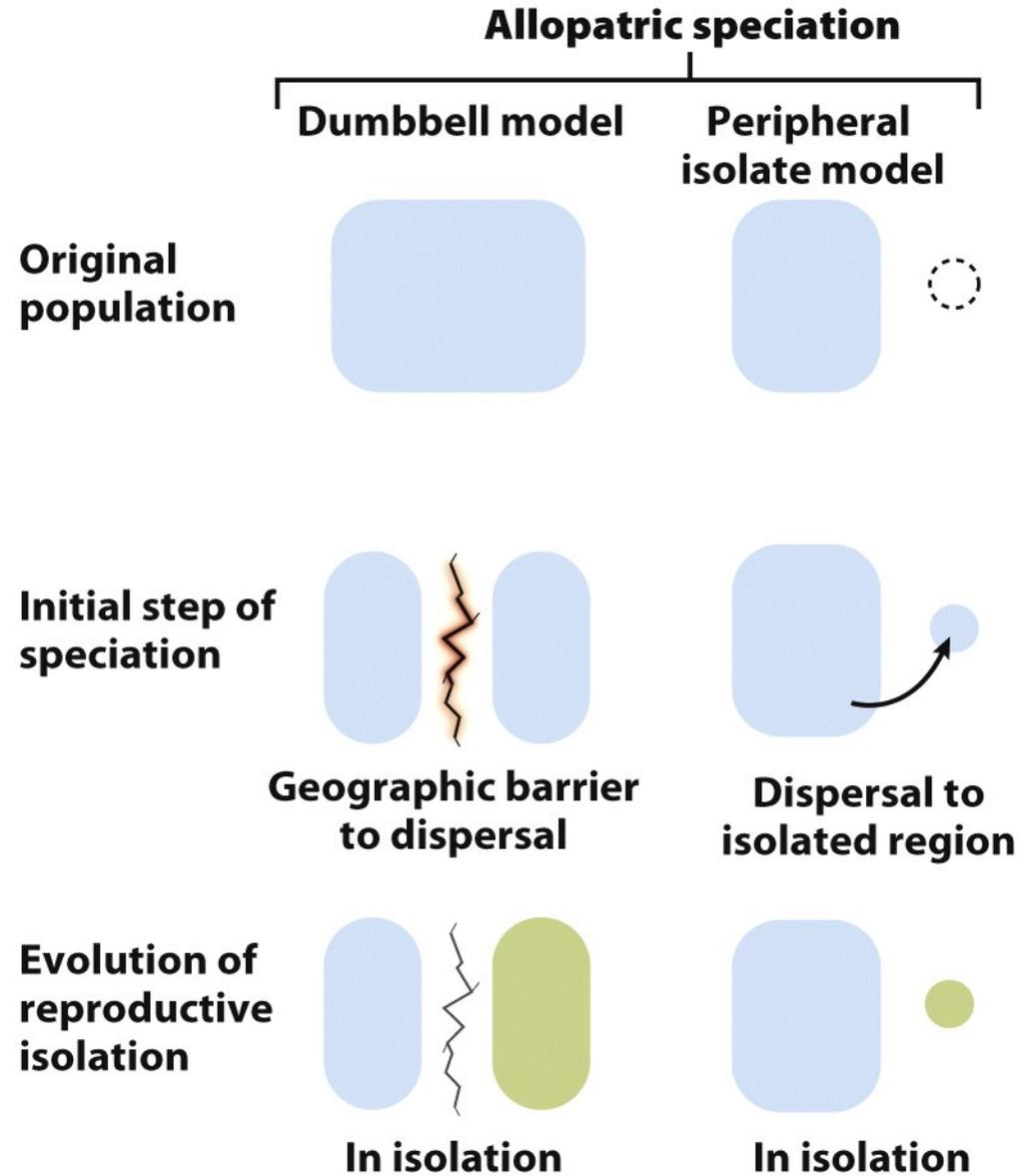
Geographic barrier to dispersal

Evolution of reproductive isolation



In isolation

# Modes of speciation: Allopatric speciation



# Modes of speciation: Allopatric speciation

- black spruce (BS) spread more broadly than red spruce (RS)
- mtDNA haplotypes in RS were a subset of those found in BS
- RS has lower genetic diversity

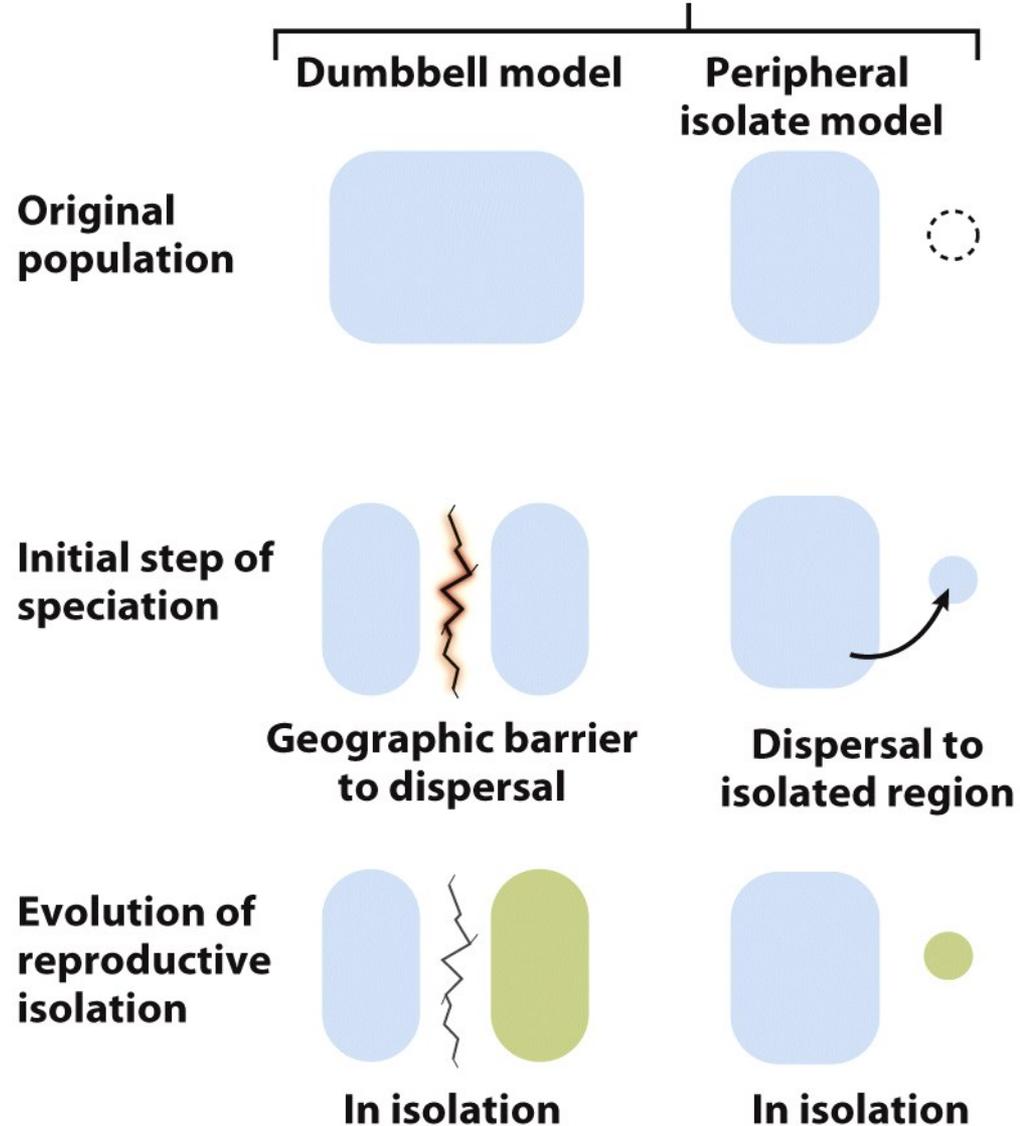
A



B



## Allopatric speciation



*Evolution*, 1/e Figure 14.7

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