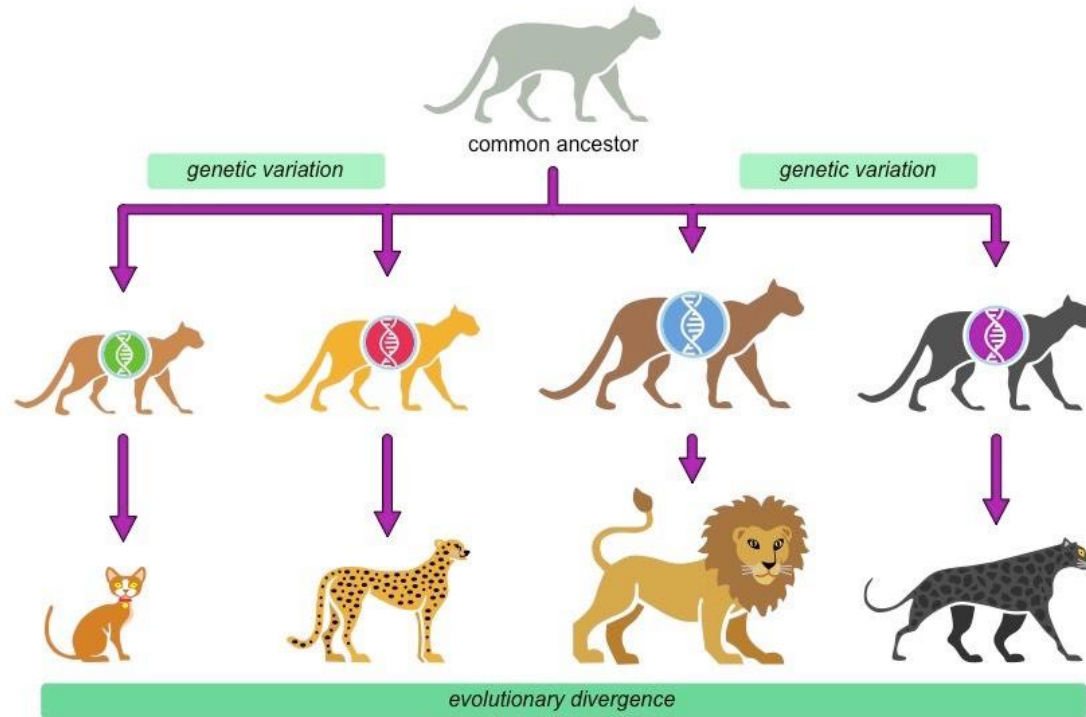


G11.4B 5 – Evolution – Speciation

CIE Biology Jones

p402 to 418

Speciation occurs when populations of the same species evolve to become so different that they can't breed with one another to produce fertile offspring.



Extra help

Bozeman Speciation

<http://www.bozemanscience.com/speciation>

Understanding Evolution Website

https://evolution.berkeley.edu/evolibrary/article/evo_14

Learning Objectives

11.2.6.5 11.2.6.5 classify the main mechanisms of speciation

Success Criteria

1. Define species, speciation and hybrid.
2. State and explain the two parts of speciation with examples.
3. Explain, identify, and give examples of the 4 main mechanisms of speciation

11.2.6.5 Classify the main mechanisms of speciation

niche - is the functional role that it plays within an ecosystem. The **niche** (better refined as the 'ecological **niche**') is determined by the abiotic factors (non-living).

Describe and give examples for each type of speciation

Modes of Speciation a group of organisms that is about to become a separate species from other, related individuals. For a lineage to split once and for all, the two species must have genetic differences that are expressed in some way that causes mating's between them to either not happen or to be unsuccessful. These need not be huge genetic differences. A small change in the timing, location, or rituals of mating could be enough. But still, some difference is necessary. This change might evolve by natural selection or genetic drift. Reduced **gene flow** probably plays a critical role in speciation. Modes of speciation are often classified according to how much the geographic separation of species can contribute to reduced gene flow.

Geographical barriers

Geographic isolation

- Speciation is a two-part process
 - 1. Identical populations must diverge
 - 2. Reproductive isolation must evolve to maintain these differences
- Speciation occurs much more readily in the absence of gene flow
 - This much more likely in geographically isolated populations
- Populations can become geographically isolated for several reasons

Define speciation













Why would absence of gene flow make speciation occur more rapidly.






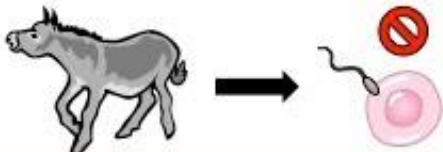

What are the two parts of speciation?

Main mechanisms of speciation

niche - is the functional role that it plays within an ecosystem. The **niche** (better refined as the 'ecological **niche**') is determined by the abiotic factors (non-living). New populations develop around new niches – usually due to an adaptation that allows survival.

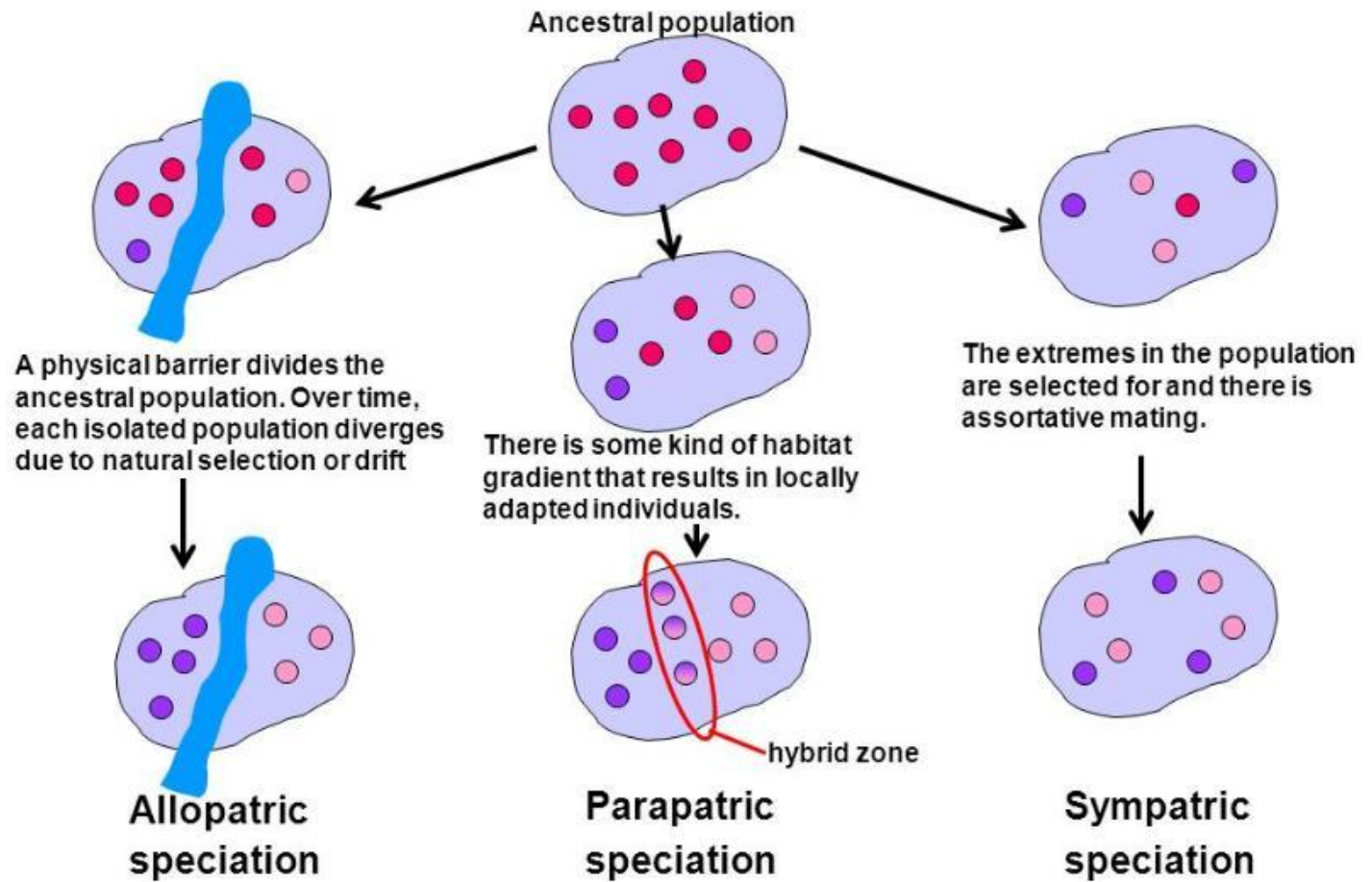
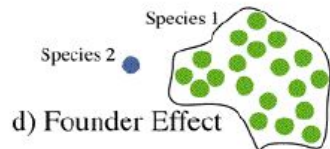
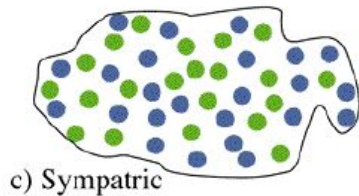
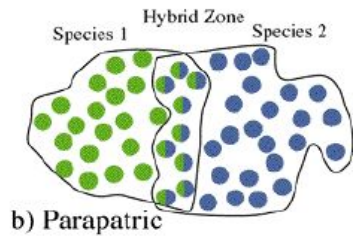
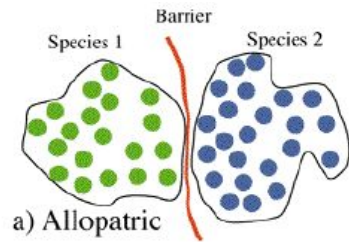
Genetic isolation □ speciation

<p>Allopatric (allo = other, patric = place)</p>	<p>geographically isolated populations</p> <p><i>Physical barrier</i></p>	<p>Allopatric</p> <p>Original Population</p> 	<p>Peripatric</p> <p>Original Population</p> 	<p>Parapatric</p> <p>Original Population</p> 	<p>Sympatric</p> <p>Original Population</p> 
<p>Peripatric (peri = near, patric = place)</p>	<p>a small population isolated at the edge of a larger population</p> <p><i>Cut off</i></p>	<p>Initial Step</p>  <p>Barrier Formation</p>	<p>Initial Step</p>  <p>New niche entered</p>	<p>Initial Step</p>  <p>New niche entered</p>	<p>Initial Step</p>  <p>Increased genetic variation</p>
<p>Parapatric (para = beside, patric = place)</p>	<p>a continuously distributed population</p> <p><i>Genetic polymorphism</i></p>	<p>Evolution of genetic isolation (reproductive)</p>  <p>In isolation</p>	<p>Evolution of genetic isolation (reproductive)</p>  <p>In isolated niche</p>	<p>Evolution of genetic isolation (reproductive)</p>  <p>In adjacent niche</p>	<p>Evolution of genetic isolation (reproductive)</p>  <p>Within the population</p>
<p>Sympatric (sym = same, patric = place)</p>	<p>within the range of the ancestral population</p>	<p>Barrier causes isolation that leads to evolution by causing genetic differentiation (change) also Geographic isolation</p>	<p>Isolation leads to a new species in a new niche outside of the original niche – also the founder effect</p>	<p>Formation of a new species due to difference in the same environment forms a (hybrid zone) lives in a new niche adjacent (close) to the original niche. – also genetic polymorphism</p>	<p>Genetic differentiation leads to a new species to evolve within the original niche forming a new niche.</p>

Pre-zygotic Isolating Mechanisms		Example	
Temporal	Occurs when two species mate at different times of year	Frogs live in same pond but breed during different seasons (summer vs spring)	
Ecological	Occurs when two species occupy different habitats	Lions and tigers can potentially interbreed, but usually occupy different habitats	
Behavioural	Occurs when two species have different courtship behaviours	Certain groups of birds will only respond to species-specific mating calls	
Mechanical	Occurs when physical differences prevent copulation / pollination	Certain breeds of dog are morphologically incapable of mating due to size	
Post-zygotic Isolating Mechanisms		Examples	
Hybrid Inviability	Hybrids are produced but fail to develop to reproductive maturity	Certain types of frogs form hybrid tadpoles that die before they can become a frog	
Hybrid Infertility	Hybrids fail to produce functional gametes (sterility)	Mules are sterile hybrids resulting from mating between a horse and a donkey	
Hybrid Breakdown	F ₁ hybrids are fertile, but F ₂ generation fails to develop properly	The offspring of hybrid copepods have less potential for survival or reproduction	

Hybrid –

Mechanisms of Speciation



ISOLATING MECHANISMS



Pre zygotic – (before fertilization/breeding)

HABITAT
(ECOLOGICAL)

SEASONAL
(TEMPORAL)

ETHOLOGICAL
(BEHAVIOURAL)

MECHANICAL

Post zygotic – (after fertilization/breeding)

GAMETIC
MORTALITY

ZYGOTE
MORTALITY &
HYBRID INVIABILITY

HYBRID STERILITY

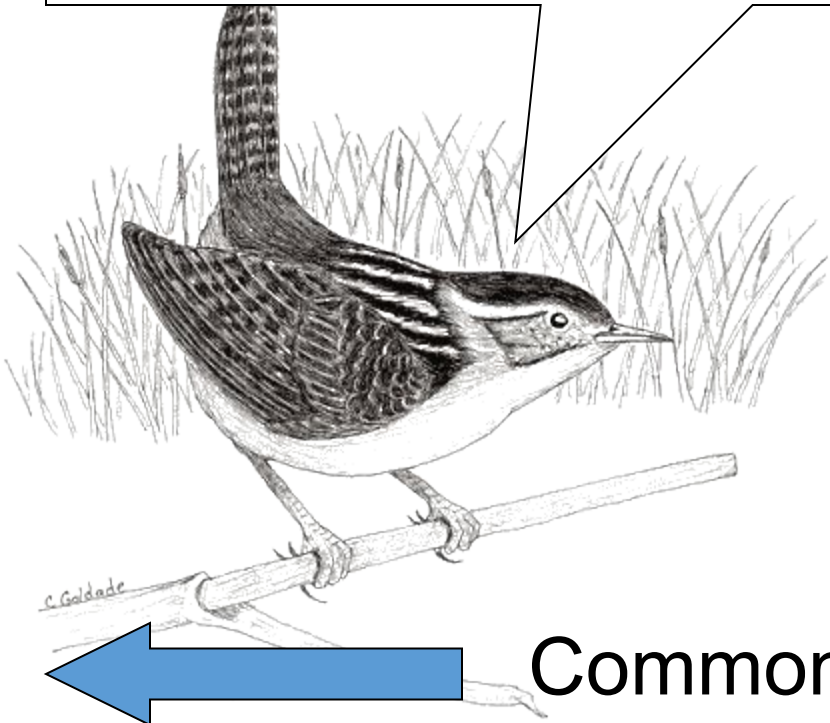
HYBRID BREAKDOWN

Gamete compatibility

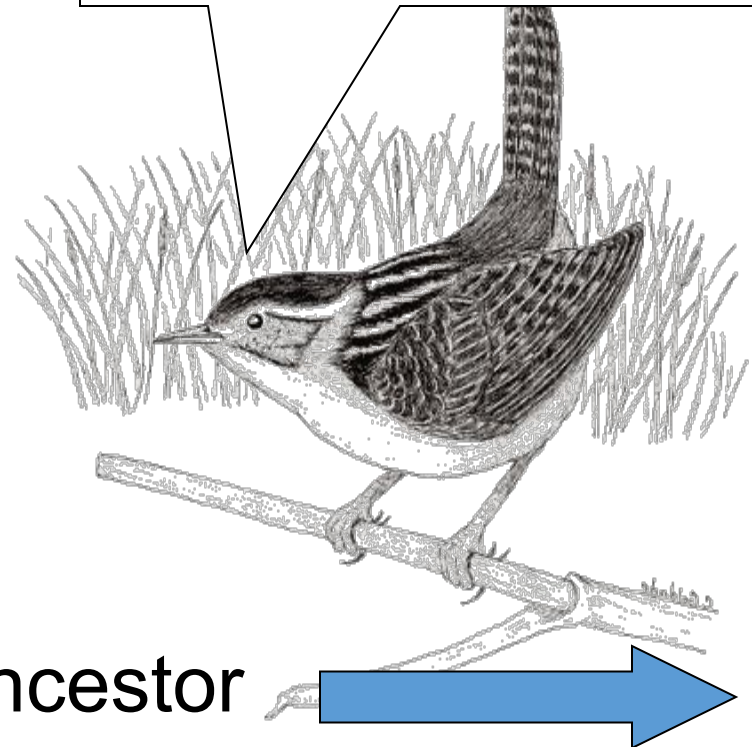
Behavioral Isolation

Occurs when two populations are capable of breeding but have different courtship rituals

I don't understand
!?!?



Я не понимаю
! ? ! ?



Common Ancestor

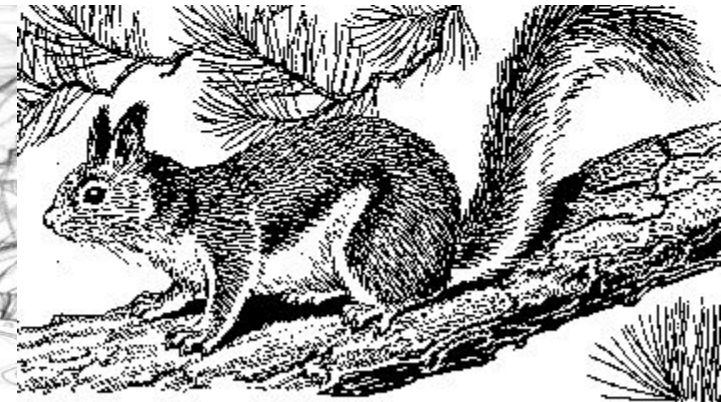
Geographic Isolation

Two populations are separated by geographical barriers such as, Mountains, Lakes, Oceans, Rivers, Deserts...over time speciation will occur.

Kaibab squirrel has a black belly and lives on the North Rim.



Abert squirrel has a light colored belly and lives on the South Rim



Grand Canyon, Arizona

Common Ancestor



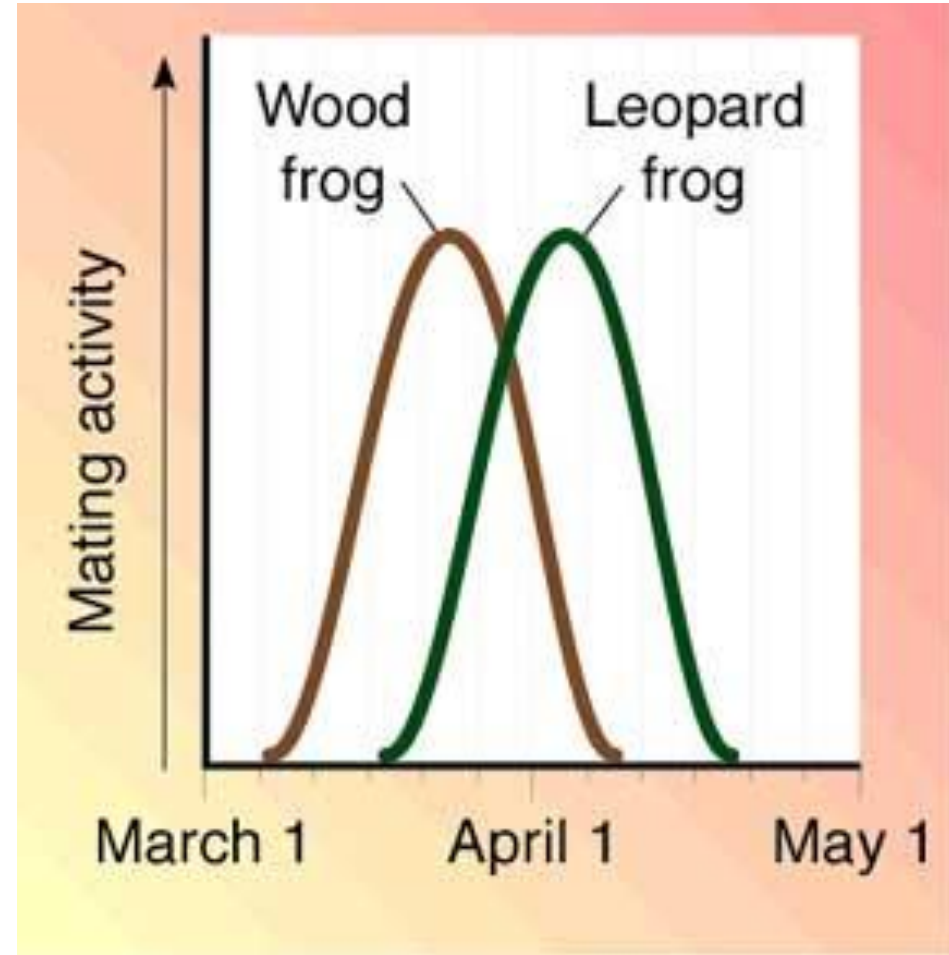
Temporal Isolation



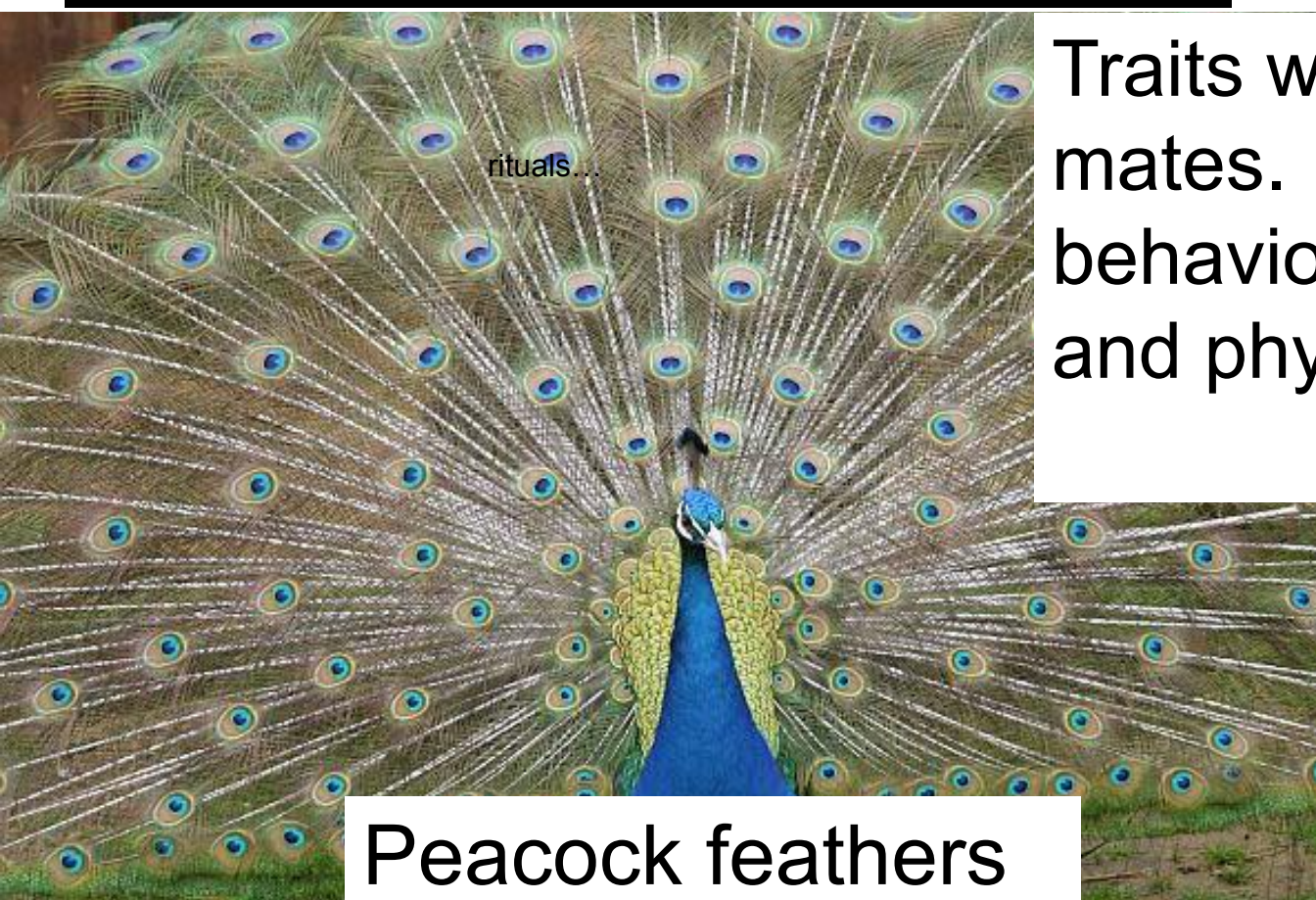
Speciation can occur when reproduction begins to occur at different times of day or night.

Durnal = day

Nocturnal = night



Sexual Selection



Traits which attract mates. Include behavioral, structural and physiological

Peacock feathers

Examples

Attractive coloring of fur, feathers, scents, mating calls, or rituals.

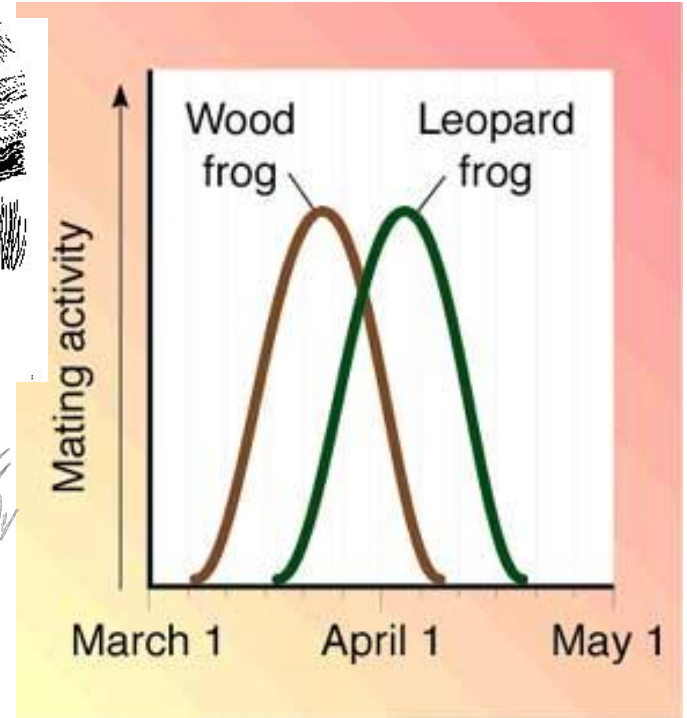
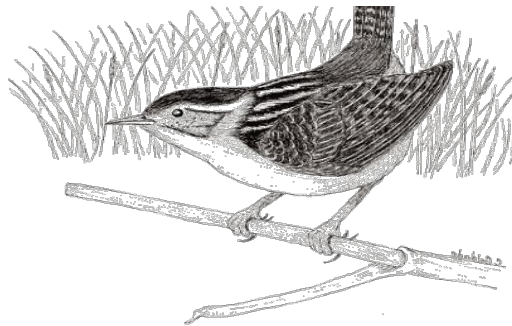
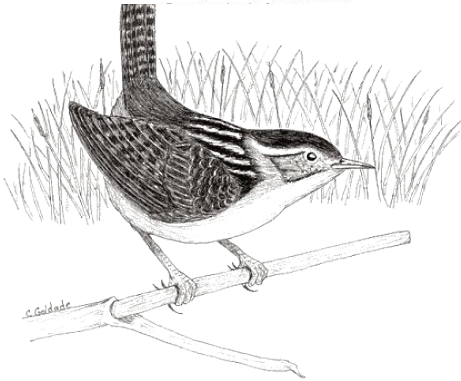
Reproductive Isolation



Kaibab Squirrel (North Rim)



Abert Squirrel (South Rim)
Sciurus aberti



When one species has become so different that it can no longer interbreed to produce successful offspring

Examples

Geographic barriers

Change in Anatomy or physiology

Behavior- bird mating calls are different

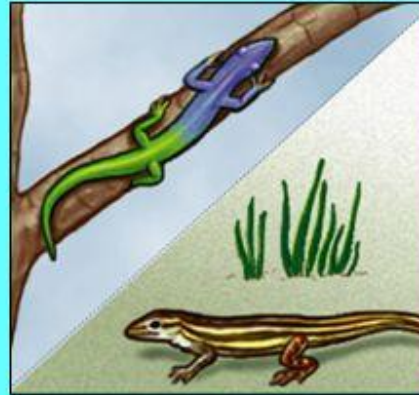
Temporal- mating times have changed seasons, or day to night

Prezygotic barriers:

- Obstacle to mating or to fertilization if mating occurs



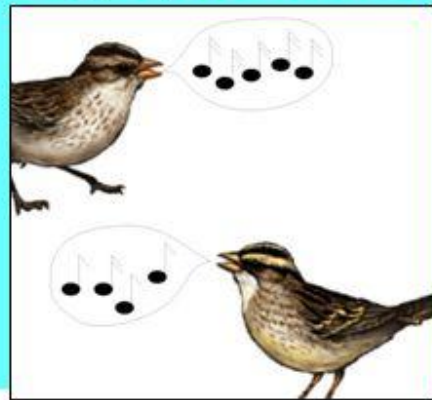
geographic isolation



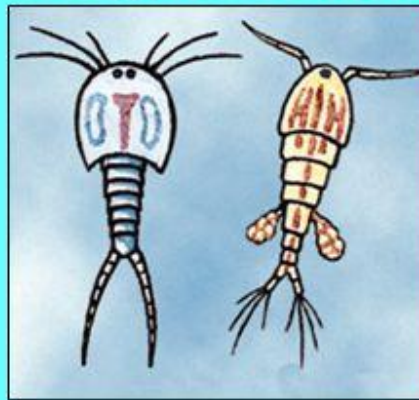
ecological isolation



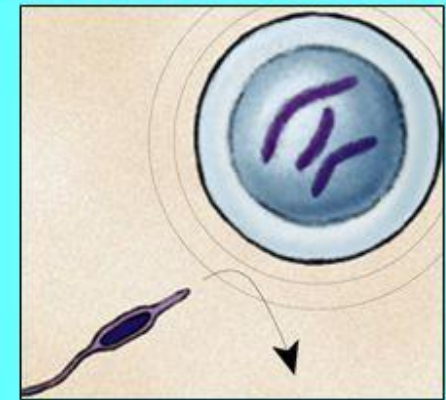
temporal isolation



behavioral isolation



mechanical isolation



gametic isolation

Post-Zygotic Isolation (Barriers)

- **Reduced hybrid viability** - Genetic incompatibility between the two species may abort the development of the hybrid at some embryonic stage or produce frail offspring.

- **Reduced hybrid fertility** - Even if the hybrid offspring are vigorous, the hybrids may be infertile and the hybrid cannot backbreed with either parental species.

Reduced hybrid breakdown – In some cases, first generation hybrids are viable and fertile.

However, when they mate with either parent species or with each other, the next generation is feeble or sterile.

A **species** is a population, or groups of populations, whose members have the potential to interbreed to produce fertile, viable (living) offspring

Members of a species are unable to produce fertile and viable offspring with members of a different species (hybrid)

Hybrids are individuals produced by cross-breeding between two different species, and are reproductively sterile (e.g. ligers, mules)

Reproduction Isolation Barriers

Pre-zygotic – before fertilization occurs

Post-zygotic – after fertilization occurs

Reduced hybrid viability

- Genes of different parent species may interact & impair the hybrid's development

Species of salamander genus, *Ensatina*, may interbreed, but most hybrids do not complete development & those that do are frail.



Reduced hybrid fertility

- Even if hybrids are vital they may be sterile



Horses have 64
chromosomes
(32 pairs)

Mules are vigorous,
but sterile



Mules have 63 chromosomes!



Donkeys have 62
chromosomes
(31 pairs)



- Chromosomes of parents may differ in number or structure & meiosis in hybrids may fail to produce normal gametes

Hybrid breakdown

- Hybrids may be fertile & viable in first generation, but when they mate offspring are feeble or sterile



In strains of cultivated rice, hybrids are vigorous but plants in next generation are small & sterile. On path to separate species.