Shaping Evolutionary Theory

Hardy-Weinberg Equilibrium

Defintion

A population's allele and genotype frequencies are constant

$$p + q = 1$$

- where p is the frequency of the dominant allele and q is for the recessive

Held true unless there is some type of evolutionary force acting upon them

Requirements:

1. No Selection
2. No Mutation
3. No Migration
4. Large Population
5. Random Mating

Can be expanded to genotypes as well

$$p^2 + 2pq + q^2 = 1$$

- If the requirements for Hardy-Weinberd equilibrium are held, then there will be
  - Genetic equilibrium
  - No evolution

Mechanisms of Evolution

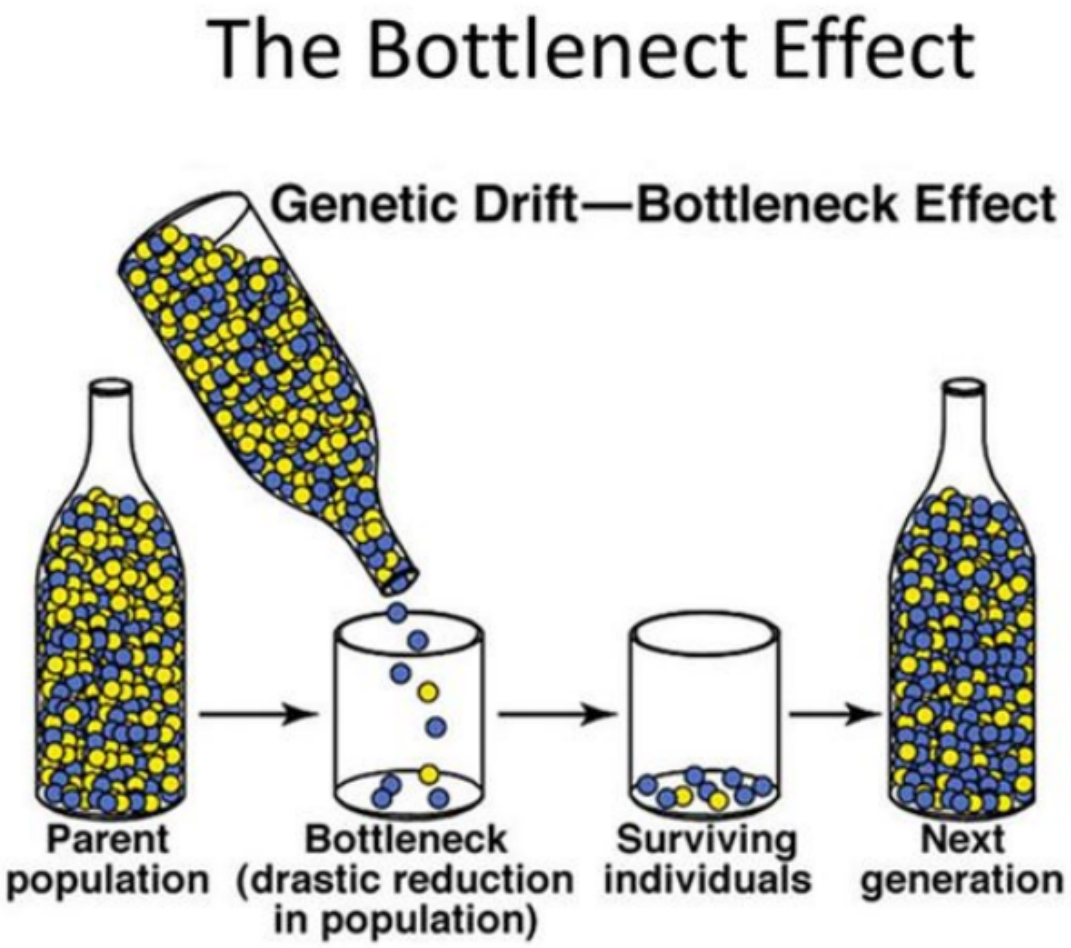
Genetic Drift

Defintion

Changes in allelic frequency due to chance
Most commonly attributed to lack of population size

- Genetic Diversity is lost, leading to a change in the allelic frequencies
- Random chance makes a big change when the population is small because a single change effects the frequency of the entire population on a larger scale
    - Ex: If you have 50 black beetles and 50 brown beetles
        - If one black beetle dies, the ratio is still $49:50$ or $4.9:5$ beetles
    - If there were 5 black beetles and 5 brown beetles
        - Although the Initial ratio is the same, $1:1$, a change would greatly change the ratios
        - If one black one died, the ratio becomes $40:50$ or $4:5$

Bottleneck effect



- Occurs when a population shrinks to a small size, then rebounds
- Random chance effects the frequencies, and when it rebounds, the frequencies are stuck different

Founder effect

- A group moves out to start their own population and are separate from the previous population
- Since the group moving out tends to be small, random chance has great effect, leading to genetic drift

Gene Flow

Defintion

Transfer or alleles or genes from one population to another

- Caused by migration

Non-random Mating

Defintion

When mating is not completely random.

- Causes include:
  - Visual stimulation
  - Sounds
  - Smells
  - Strength

Mutations

Defintion

Random change in genetic Material

- Happens completely randomly
- Happens in Eukaryotes on average 0.003 per genome per generation
- Typical Gene mutates on average once every 1000 cell divisions

Natural Selection

Defintion

Nature selects the individuals best adapted for survival and reproduction by their allele

Types:

1. Stabilizing Selection
    - Eliminates extremes of a trait and the average trait leads to higher fitness
2. Directional Selection
    - Where one extreme is selected for, leading to keep going in the extreme direction
3. Disruptive Selection
    - Either extreme is favored
4. Sexual Selection
    - Acts on an organism's ability to find and mate

Reproductive Isolation

Prezygotic isolation

Defintion

Prevents reproduction by making fertilization unlikely

- Includes:
    - Geographic behaviors
    - Ecological Differences
    - Time of mating

Postzygotic isolation

Defintion

Can't develop offspring

- Examples Include:

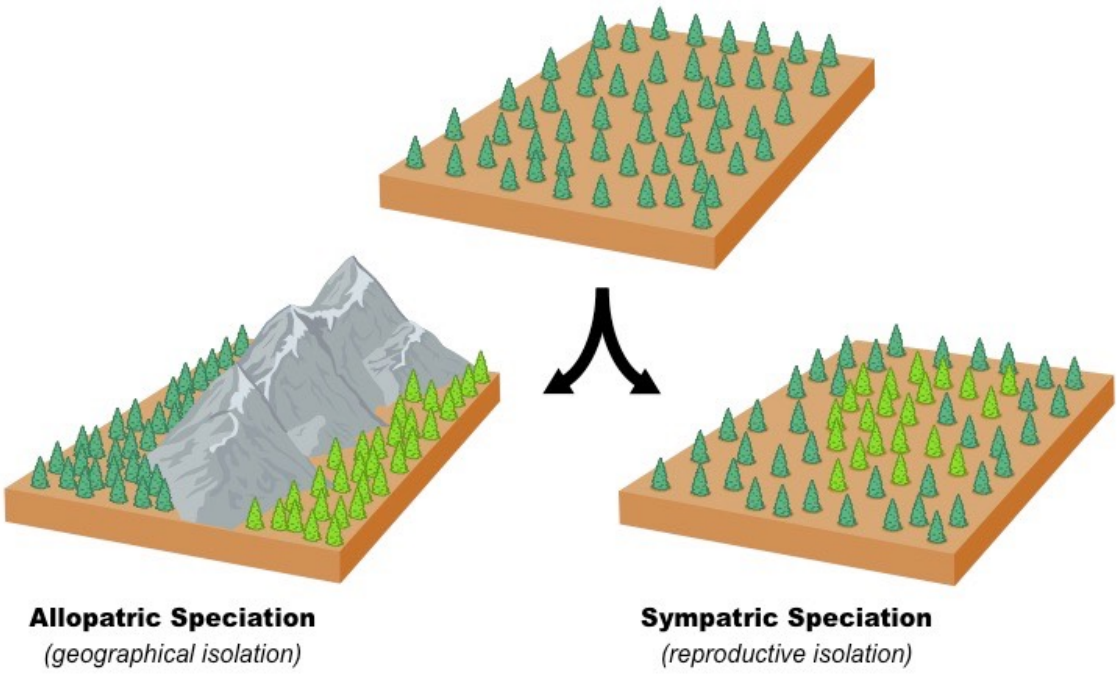
- Liger
- Mule

Speciation

Defintion

When a population diverges and then be reproductively isolated.

Types of speciation



Allopatric Speciation

Defintion

A new species forms because a physical barrier separates a population into multiple parts

- Believed to be the most common type of speciation
- Can be caused by rivers, mountains, etc.

Sympatic Speciation

Defintion

A new species develops from another without a physical barrier

- most common in plants through **polyploidy** (change in chromosome number) impacts a plant's ability to breed with the present type

Rate of speciation

Gradualism

Defintion

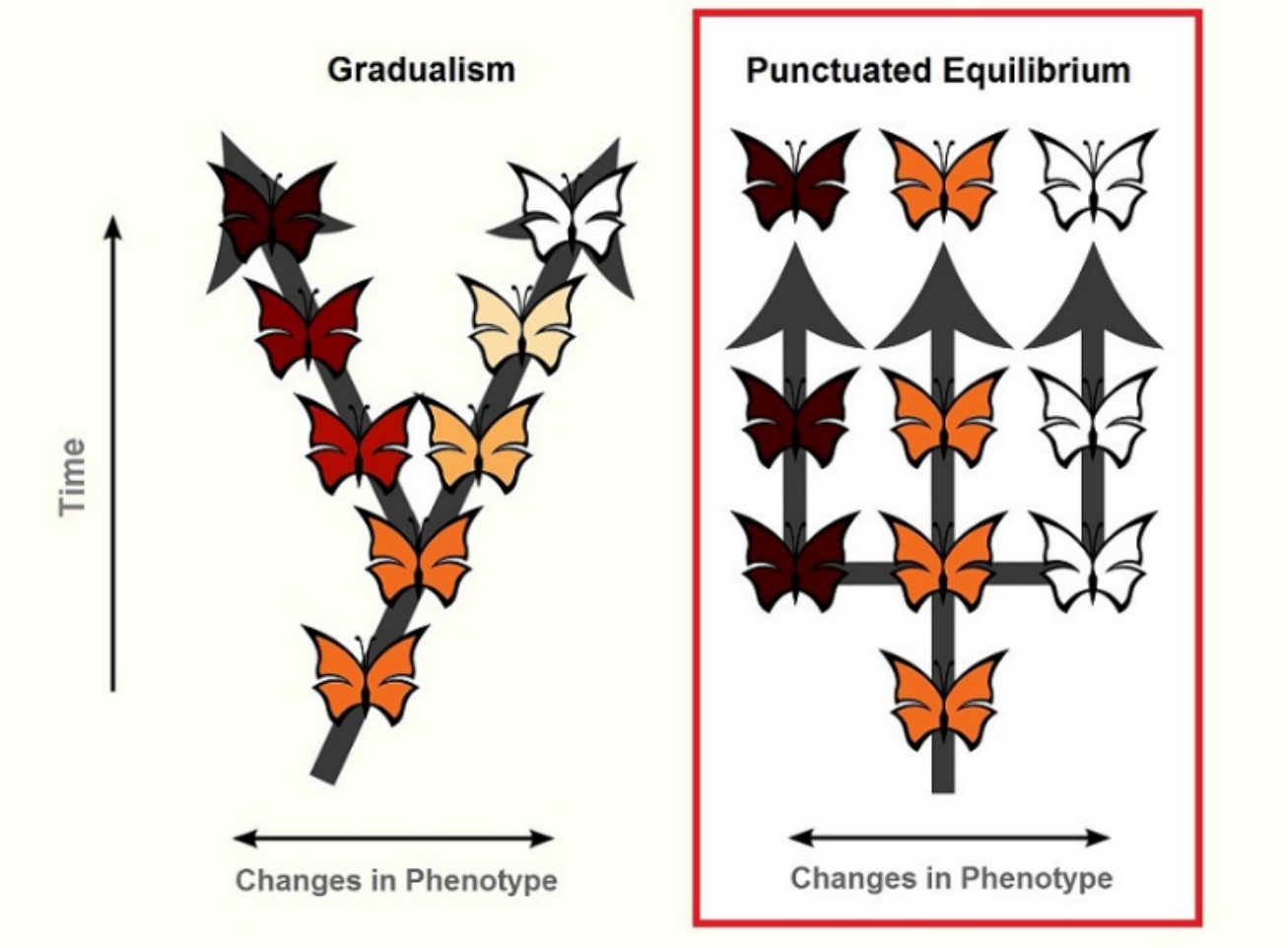
Specization that happens in small gradual steps

Punctuated Equilibrium

Defintion

Rapid spurts of genetic change cause species to diverge quickly

Patterns of Evolution



Adaptive Radiation (Divergent)

Defintion

One species gives rise to many species in response to the creation of a new habitat or other ecological opportunity

- Can be
  - Birds evolving to have different colors or songs
  - Fishes evolving colors

Coevolution

Defintion

Species evolve in close relationship to one another

- Includes Mutualism, Parasitism
- Examples include:
    - Orchids and moths
        - Orchids will grow longer to increase the spread of pollen
        - Moths will grow longer to get more nectar

Convergent Evolution

> **Defintion**
>
> Unrelated species evolve similar traits even though they live in different parts of the world

- Could be:
    - Sugar glider and flying squirrel

Vocabulary

Word	Definition
H-W Equilibrium	A population's allele and genotype frequencies are constant
Genetic Drift	Changes in allelic frequency due to chance
Bottleneck effect	(Type of Genetic Drift) Occurs when a population shrinks to a small size, then rebounds
Founder effect	(Type of Genetic Drift) A group moves out to start their own population and are separate from the previous population
Gene Flow	Transfer or alleles or genes from one population to another
Non-random Mating	When mating is not completely random, due visuals, sounds, smells, strength
Mutations	Random change in genetic Material
Natural Selection	Nature selects the individuals best adapted for survival and reproduction by their allele
Stabilizing Selection	Eliminates extremes of a trait and the average trait leads to higher fitness
Directional Selection	Where one extreme is selected for, leading to keep going in the extreme direction

Word	Definition
Disruptive Selection	Either extreme is favored
Sexual Selection	Acts on an organism's ability to find and mate
Prezygotic isolation	Prevents reproduction by making fertilization unlikely
Postzygotic isolation	Can't develop offspring
Speciation	When a population diverges and then be reproductively isolated
Allopatric Speciation	A new species forms because a physical barrier separates a population into multiple parts
Sympatic Speciation	A new species develops from another without a physical barrier
Gradualism	Specization that happens in small gradual steps
Punctuated Equilibrium	Rapid spurts of genetic change cause species to diverge quickly
Adaptive Radiation (Divergent)	One species gives rise to many species in response to the creation of a new habitat or other ecological opportunity
Coevolution	Species evolve in close relationship to one another
Convergent Evolution	Unrelated species evolve similar traits even though they live in different parts of the world