Natural Selection

What is the Hardy Weinberg Theorem?

- Describes a non-evolving population
- States that the frequencies of alleles and genotypes in a population's gene pool remain the same unless it is altered by some external factor.
- This principle helps determine whether or not gene frequencies have changed in a population and whether evolution has occurred.

Assumptions of the Hardy-Weinberg Theorem

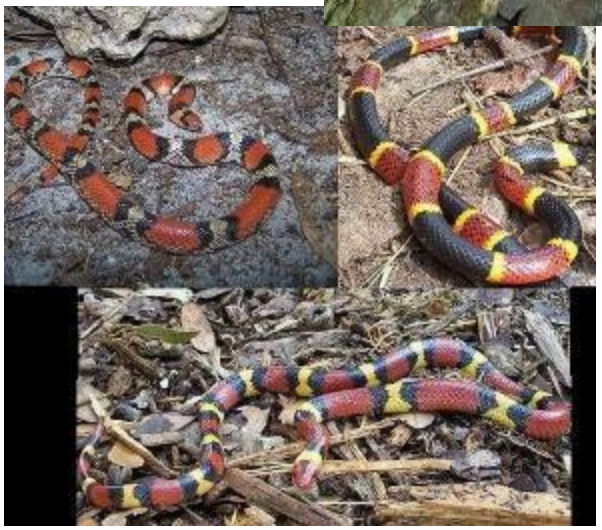
- Very large population size
- no migration
- no net mutations
- random mating
- no natural selection
- All organisms breed & produce same # offspring
- If a population deviates form the Hardy-Weinberg theorem, it is usually because that population is evolving.

What types of situations force evolution & upset Hardy Weinberg Equilibrium?

1. Natural selection
2. Genetic drift- movement of genes into or out of a population.
3. Mutations
4. Non-Random Mating= “Sexual Selection”

1. Natural Selection

a. Predators
   - Can cause a shift in <u>allele frequency</u>
   - Can lead to **<u>coevolution</u>**
   - Coevolution- two organisms evolve in response to each other.
     - Fastest antelopes escape cheetah. Faster cheetahs catch antelopes.
     - Resistant insects survive plant poison. Plant with strongest poison survives insect pests.
   - Use **<u>camouflage</u>** to avoid predators or prey on animals
   - Use **<u>mimicry-</u>** mimic something more harmful or undesirable to avoid predators.
   - Use **<u>warning color</u>ation-** red, black, yellow to warn they are dangerous

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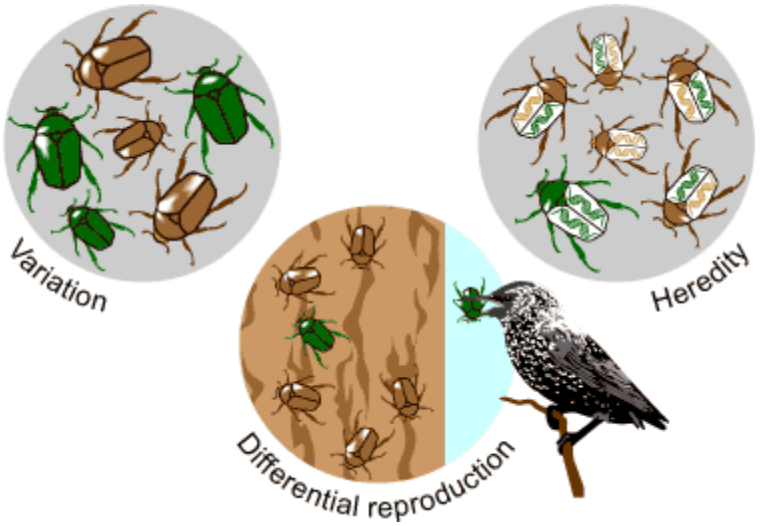
1. Natural Selection (cont'd)

b. Environment
   - Webbed feet, water proof feathers
   - Hooves for walking on hard surfaces

c. Climate
   - Thick fur
   - Large ears dissipate heat
   - White fur- blend in with snow

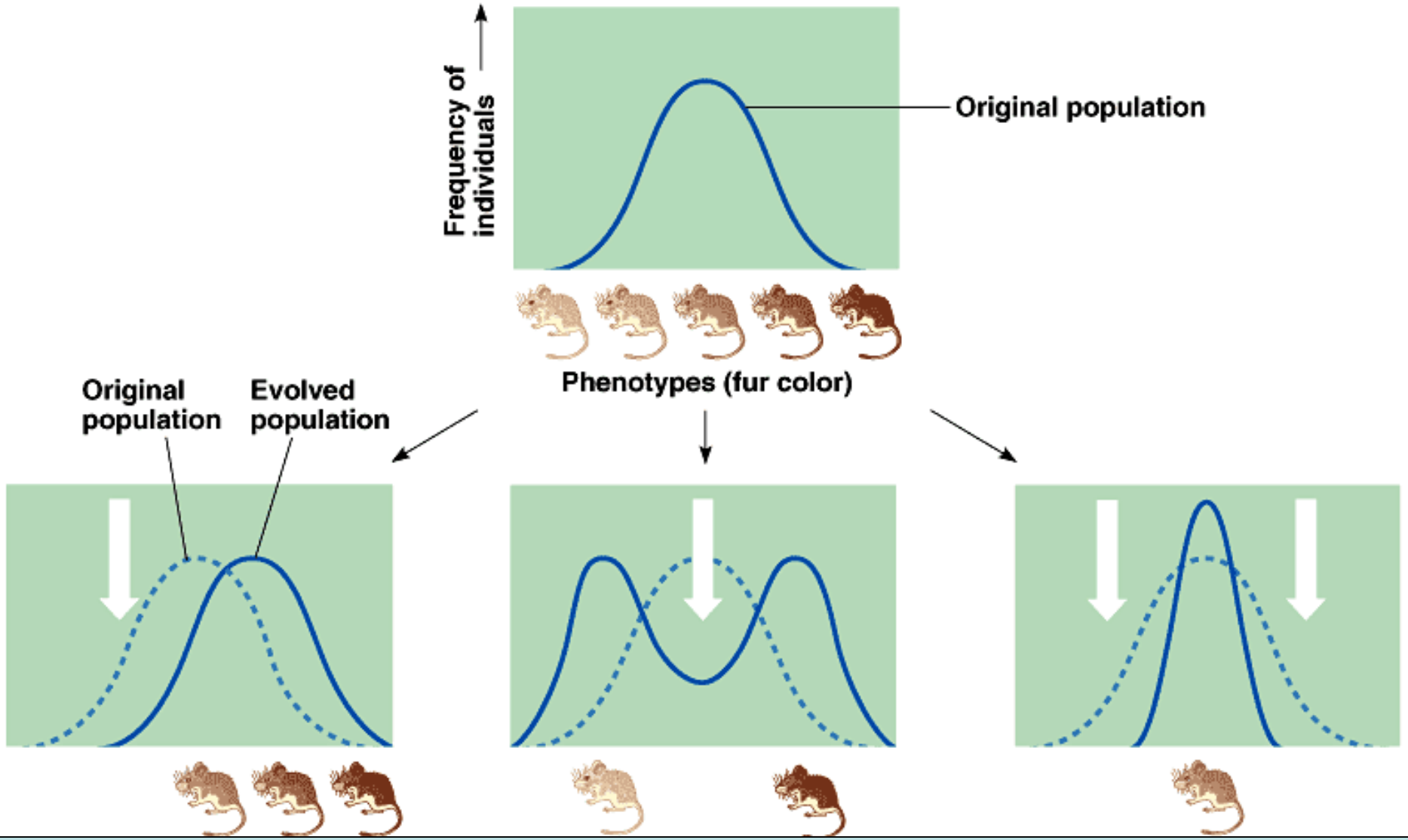
1. Natural Selection (cont'd)

- Natural selection does not cause genetic changes within an individual.
- *An individual cannot evolve.*
- Natural selection acts on the individual based on its traits.
- The population evolves as a consequence of differential reproduction- strongest traits will mate and pass on strong traits.

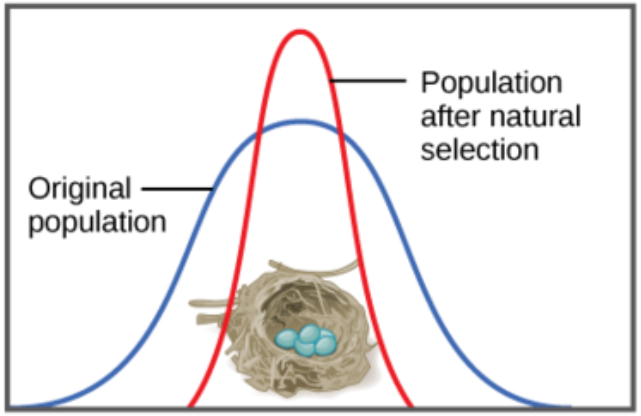


Types of Natural Selection

a. *Directional* - shifts the phenotypic frequency in one direction or another. EX: giraffe neck length
b. *Stabilizing* - acts against extreme phenotypes and favors the more common intermediates. EX: rabbit leg length
c. *Disruptive/diversifying* - extreme phenotypes are favored. EX: squirrels and acorns

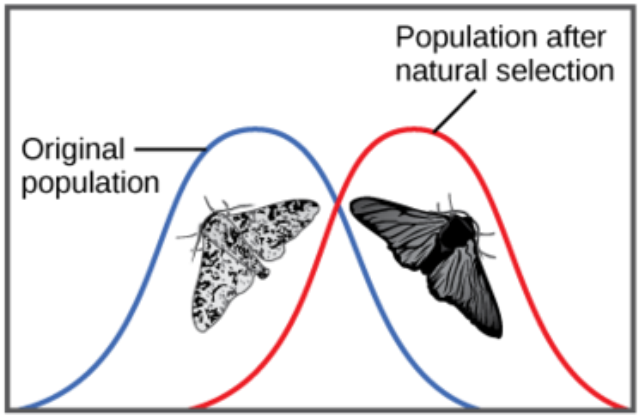

Frequency of individuals
Original population
Phenotypes (fur color)
Original population
Evolved population

(a) **Stabilizing selection**



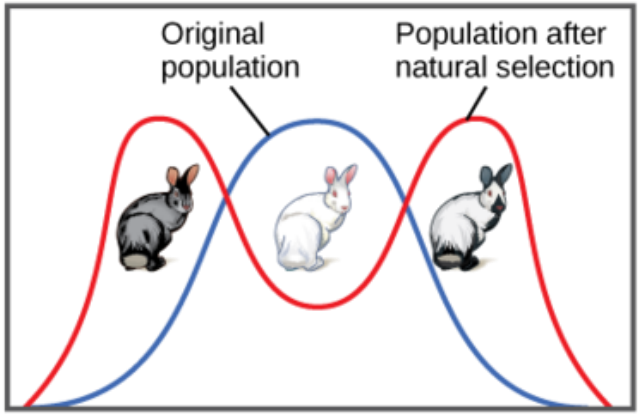
Robins typically lay four eggs, an example of stabilizing selection. Larger clutches may result in malnourished chicks, while smaller clutches may result in no viable offspring.

(b) **Directional selection**



Light-colored peppered moths are better camouflaged against a pristine environment; likewise, dark-colored peppered moths are better camouflaged against a sooty environment. Thus, as the Industrial Revolution progressed in nineteenth-century England, the color of the moth population shifted from light to dark, an example of directional selection.

(c) **Diversifying selection**



In a hyphothetical population, gray and Himalayan (gray and white) rabbits are better able to blend with a rocky environment than white rabbits, resulting in diversifying selection.

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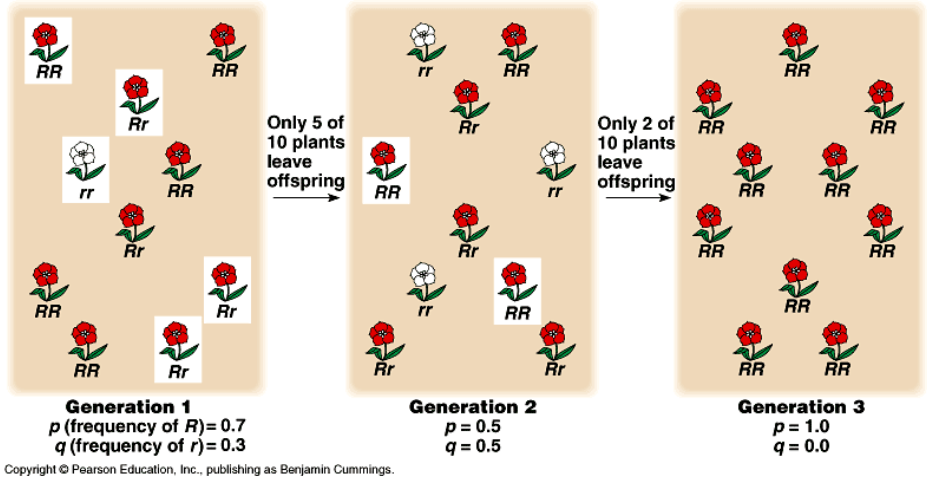
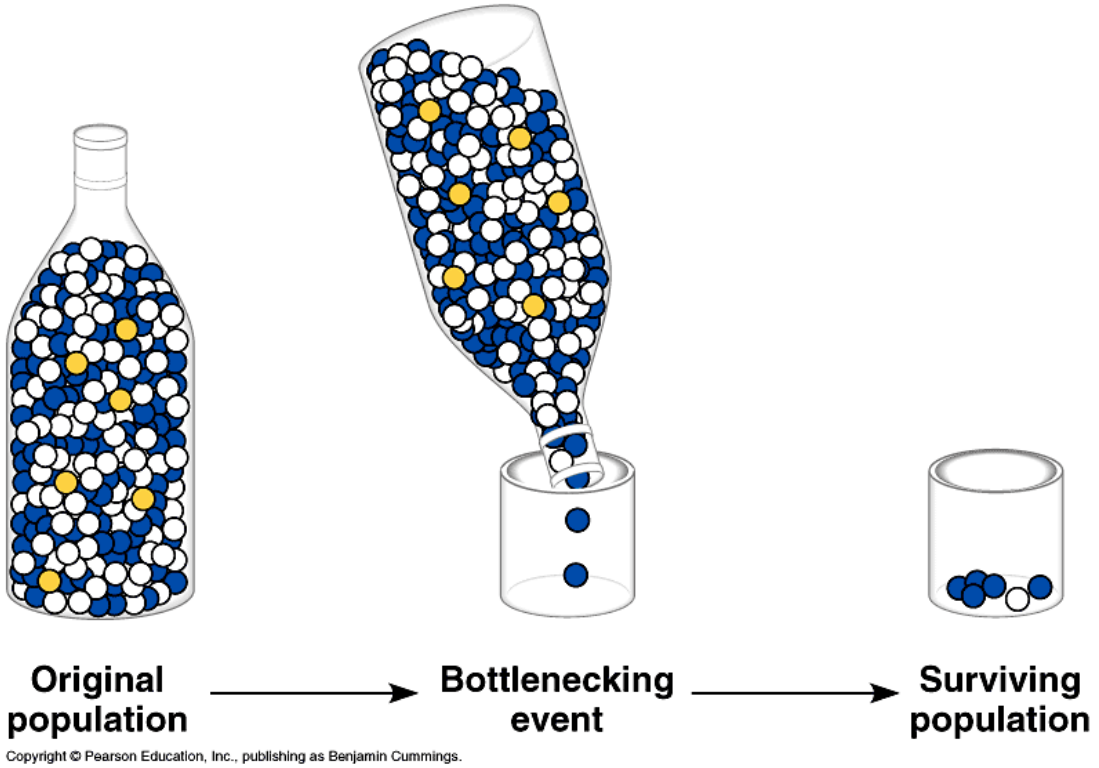
2. Genetic Drift

- Change in allele frequency due to chance.
- EX: Small population of lizards:
  - 3 WW
  - 2 Ww
  - 5 ww
  - Earthquake kills 3 WW, frequency of w allele will increase.
- Two types of genetic drift…



a. Bottleneck Effect

- A change in a population's allele frequencies due to a *large reduction in population size*
- Population does not rebound as well
- Reduced biodiversity may lead to inbreeding
- Ex: Cheetahs killed due to disease or b/c they are pests- population so small they are inbreeding making species weaker so population is slow growing.
- EX: volcanoes, natural disasters

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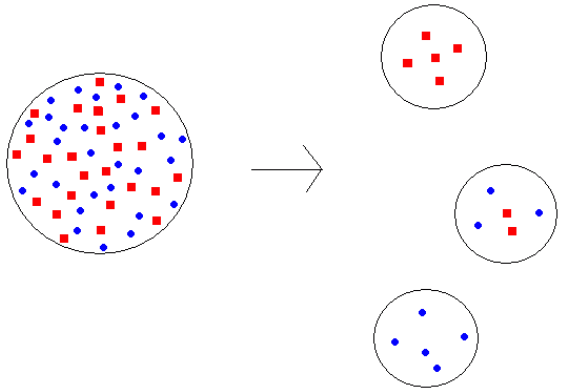
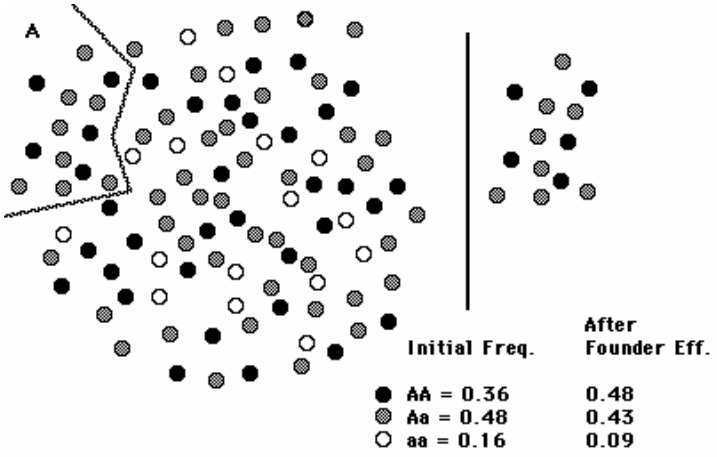
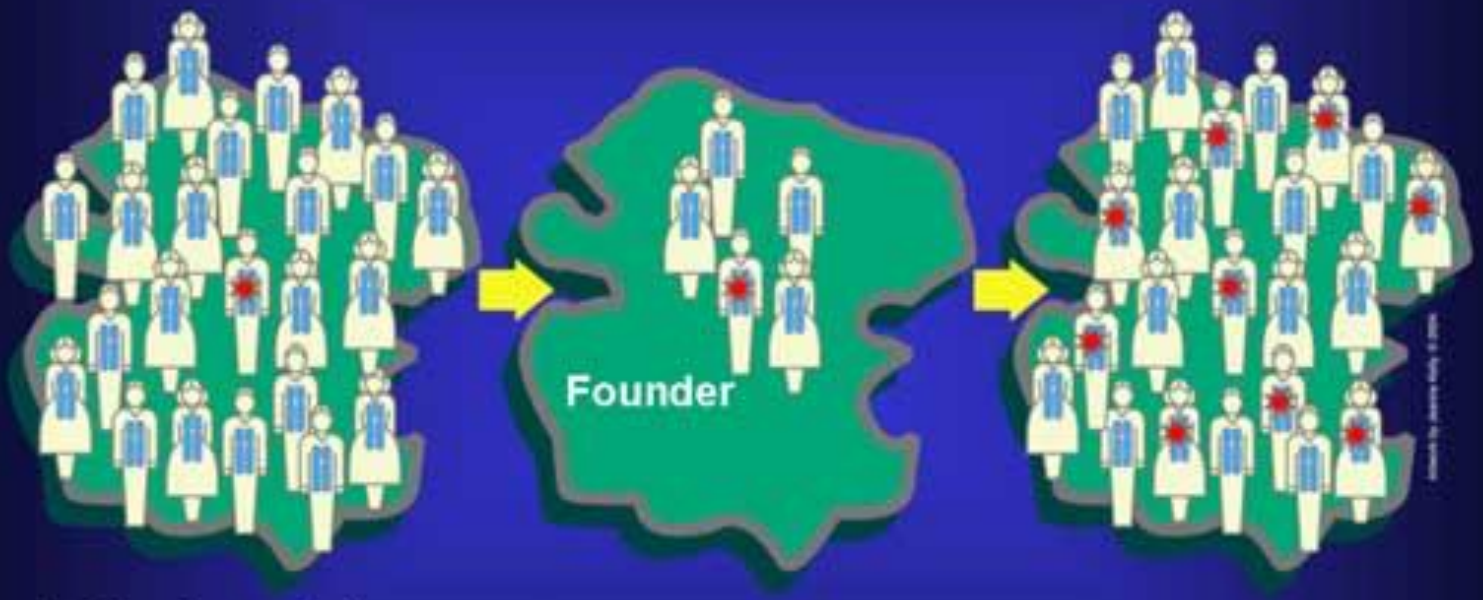
b. Founders Effect-

- A change in a population's allele frequencies due to *colonization by a small number of individuals from a larger population.*
- Creates a "new" population elsewhere
- Allele frequency in "new" population depends on what alleles migrated out.
- EX: Small group of 200 Amish people migrated to US from Germany & Switzerland in 1700's. Do not marry outside religion so interbreed. Many genetic disorders (dwarfism, metabolic disorders) common in their group.





Prevalence and Founder Effect



Original population

Marked population decrease, migration, or isolation

Generations later

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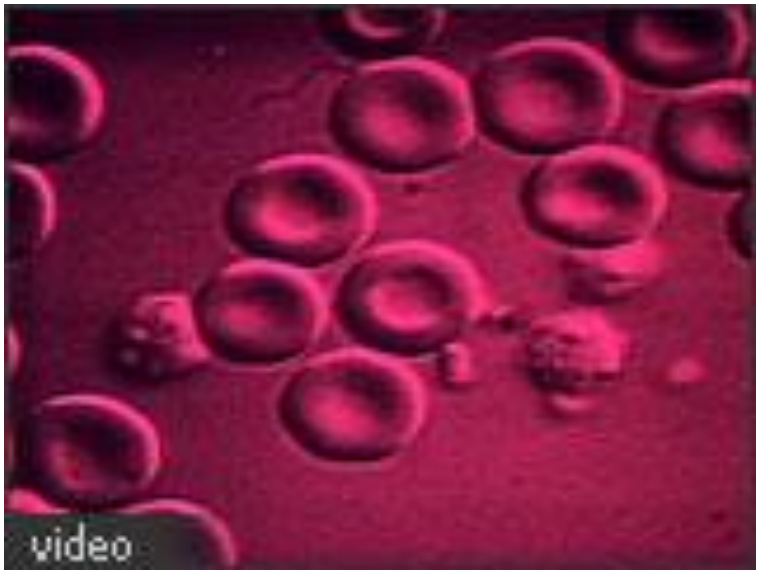
3. Mutations

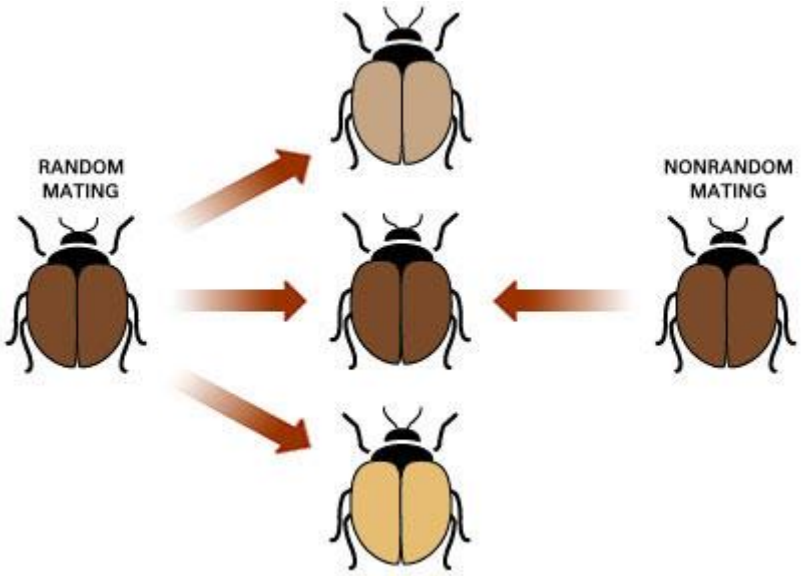
- Can change types of alleles for a gene
- Leads to change in gene frequency
- Some beneficial, some harmful

Mutation Video Clip: Sickle Cell Anemia



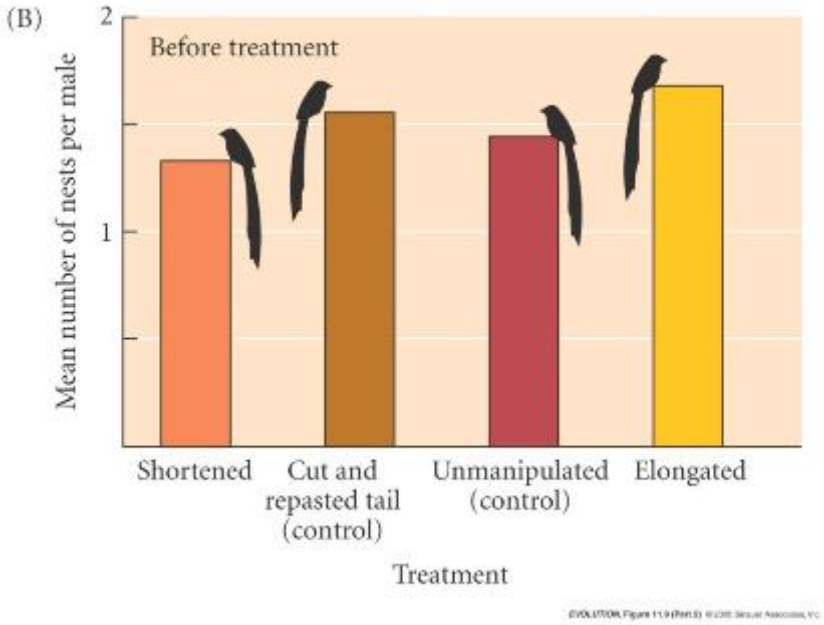
4. Non-Random Mating

- Most times mating is NOT random.
- Males or females CHOOSE a mate based on size, color, best song, etc- SEXUAL SELECTION
- Males & females of the same phenotype tend to mate.
- EX: large beetles mate with other large beetles.

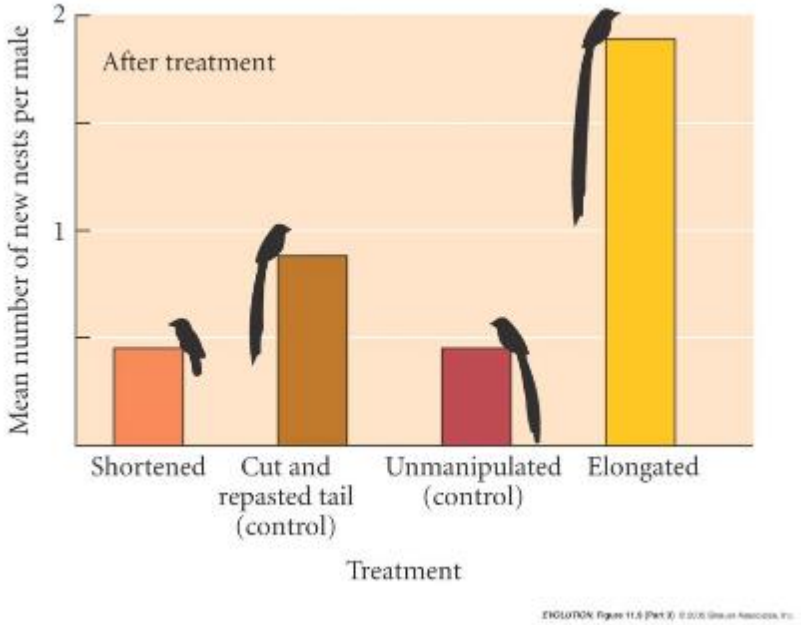


Widowbirds

Before Treatment



After Treatment

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