Unit 7:
Natural Selection

Natural Selection

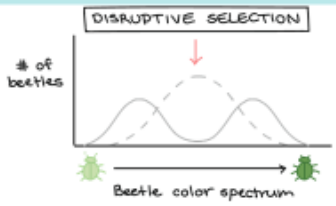
- Developed by Charles Darwin
- Establish due to variation in the population and competition for resources
- Organisms with more favorable trait, more likely to survive and produce more offspring to pass on their traits to next generation
- Examples:
  - Peppered Moths
  - Antibiotic Resistance

Artificial Selection

- Organisms with certain traits are bred until population has that trait
- Humans affect variation in the population
- Examples:
  - Dog Breeds
  - Corn from Maize
  - Wild Mustard → Cauliflower, Broccoli, Cabbage, Kale, & Kohlrabi

Beware of Lamarckian statements

Selection

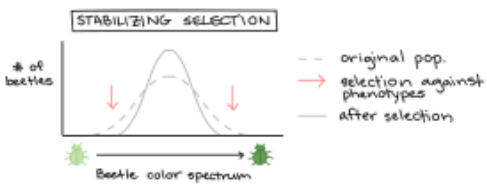


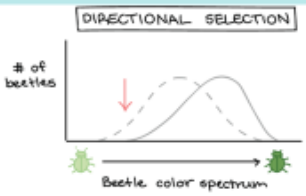
Disruptive Selection

Selection for the two extreme phenotypes
Selection against the intermediate phenotype

Stabilizing Selection

Selection for the intermediate phenotype
Selection against the two extreme phenotypes





Directional Selection

Selection for an extreme phenotype
Selection against the other phenotypes

Hardy-Weinberg

"Five Fingers of Evolution"

1. Extremely LARGE population size
2. Random mating
3. No mutations
4. No gene flow (immigration/emigration)
5. No natural selection

Genetic Drift

Founder's Effect

- Small population is isolated from original population

Bottleneck Effect

- Population is reduced by a natural disaster (fire, flood, etc) where there was no selection based on traits

These reduce the population size and could decrease genetic diversity making them more susceptible to environmental impact or could fix harmful alleles

Equations

Variables

p = frequency of the dominant allele
q = frequency of the recessive allele
p2 = frequency of homozygous dominant
2pq = frequency of the heterozygous
q^2 = frequency of the homozygous recessive

Hardy-Weinberg Equilibrium

$p + q = 1$
$p2 + 2pq + q^2 = 1$

p	q	p^2	2pq	q^2

Counting Alleles

$$p = \frac{2AA+Aa}{2 \times \#\ individuals}$$

$$q = \frac{2aa+Aa}{2 \times \#\ individuals}$$

p^2 = #AA/total
2pq = #Aa/total
q^2 = #aa/total

Did the population evolve?

If the allele/genotypic frequency changes, the population has evolved.

Example Problems

The garden at your school always has red, pink, and white snapdragons. There are 200 red flowers, 300 pink flowers, and 500 white flowers. Determine the allele frequency of the flower allele color.

Red (p^2) = 200/1000 = 0.2
Pink (2pq) = 300/1000 = 0.3
White (q^2) = 500/1000 = 0.5

$$p = \frac{2(200)+300}{2(1000)} = \frac{700}{2000} = 0.35$$

$$q = \frac{2(500)+300}{2(1000)} = \frac{1300}{2000} = 0.65$$

p	q	p^2	2pq	q^2
0.19	0.81	0.04	0.31	0.65

Tip: Always start with q^2 for H-W problems

Phylogeny

Evidence of Evolution

Biochemical
DNA or protein
Comparison of the number of differences

Morphological
Homologous structures: similar structures due to common ancestry
Ex: Bat wing and Cat arm

Ancestral/Derived Traits: characteristics derived from ancestor or from descendants

BEWARE: Analogous structures are due to convergent evolution

Biogeography
distribution of species and ecosystems in geographic space & through geological time

Phylogenetic Tree

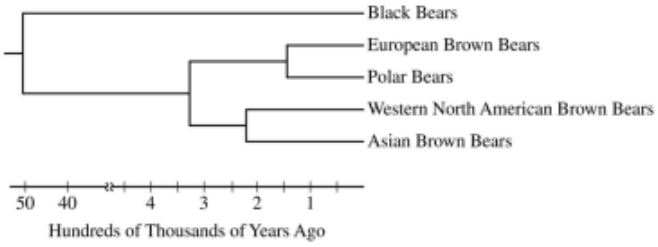
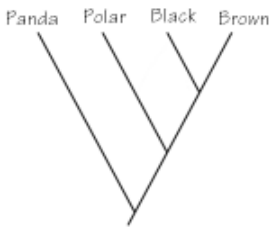


Figure 1. Phylogenetic tree representing the evolutionary relatedness among bear populations based on mitochondrial DNA sequence comparisons

Cladogram

TABLE 1. AMINO ACID DIFFERENCES IN THE LYST PROTEIN AMONG BEAR SPECIES

	Panda	Black	Brown	Polar
Panda	–			
Black	33	–		
Brown	34	1	–	
Polar	40	7	8	–



Prezygotic

Before zygote is created

Behavioral
Two organisms have different mating rituals (dance, song, etc)

Temporal
Two organisms mate at different times (day, month, year, etc.)

Geographic
Two organisms are separated by a geographical barrier

Habitat/Ecological
Two organisms mate in different ecological environments

Mechanical
Two organisms are incompatible anatomically

Gametic
Two gametes are unable to fuse

Biological Species Concept:
two organisms are of the same species if they can INTERBREED and produce FERTILE, VIABLE offspring

Postzygotic

After zygote is created

Reduced Hybrid Viability
Hybrid is not healthy/viable

Reduced Hybrid Fertiliity
Hybrid is not fertile

Hybrid breakdown
First generation hybrid is ok
But second and more generations the hybrid starts decreasing viability and fertility

Speciation

Creation of new species

Sympatric

New species from a surviving ancestral species while both continue to inhabit the same geographic region

Habitat isolation, Behavioral isolation, Sexual Selection, Polyploidy

Allopatric

Occurs when biological populations of the same species become isolated due to geographical changes