15.3a Shaping Evolutionary Theory

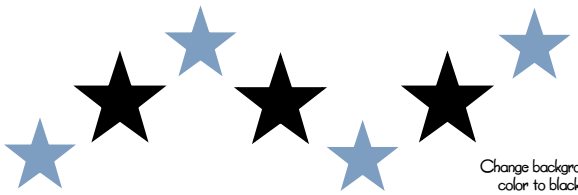
Shaping Evolutionary Theory

Section 15.3

Click for Bee Orchid video

Review

- phenotype - trait produced by one or more genes
- natural selection acts on phenotypes
- population - all the individuals of a species that live in an area
- with a greater variation in phenotypes, it is more likely that some individuals will survive in a changing environment



Change background color to black.

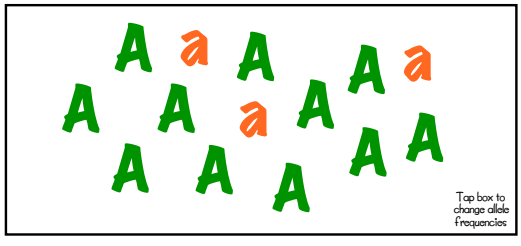
Natural Variation

Sources of Variation

- mutation
  - random change in DNA sequence
  - can be passed to offspring if in sperm/egg
- recombination
  - meiosis = 4 genetically unique cells
  - crossing over
  - sexual reproduction and fusion of gametes

Evolution and Natural Selection

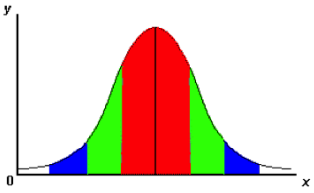
- even though natural selection does not directly affect genes, it can change the relative frequencies of alleles (# of dominant, # of recessive)in a population over time
- evolution = any change in the relative frequencies of alleles in a gene pool over time



Tap box to change allele frequencies

Normal Distribution

- bell-shaped curve
- all phenotypes provide an equal chance of survival
- phenotypes near middle of range most common
- extremes less common



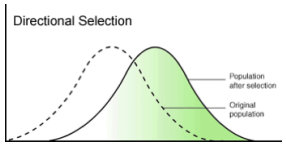
15.3a Shaping Evolutionary Theory

Changes in Distribution

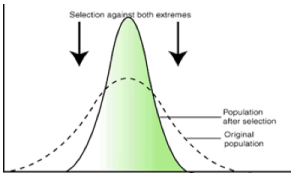
- natural selection can change distribution 3 ways
  - directional selection
  - stabilizing selection
  - disruptive selection
- microevolution - observable change in the allele frequency of a population over time
  - micro = small scale

Directional Selection

- an extreme phenotype increases fitness
- mean value shifts in direction of more advantageous phenotype
  - results in more individuals with this trait



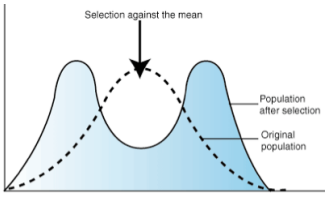
Stabilizing Selection



- intermediate phenotype increases fitness
- narrows the graph
- selects against extremes

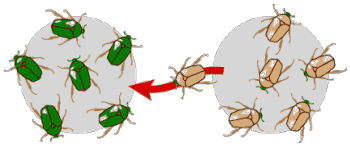
Disruptive Selection

- both extremes increase fitness
- selects against intermediate phenotypes



Gene Flow

- movement of alleles from one population to another
- high gene flow = similar population
- low gene flow → population becomes more genetically different → increases chance that 2 different species evolve



Genetic Drift

- small populations are subject to chance
  - like small sample sizes
- chance can change how common an allele is in a population
- genetic drift - random changes in allele frequencies

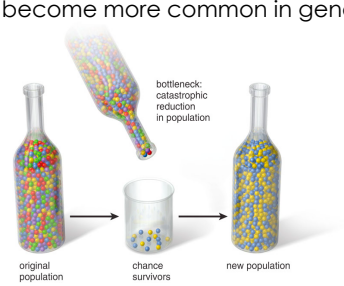
15.3a Shaping Evolutionary Theory

Bottleneck and Founder Effects

- bottleneck effect
  - genetic drift that occurs after an event greatly reduces the size of a population
  - ex. hurricane, drought, isolation, isolation, hunting
- founder effect
  - genetic drift that occurs after a small number of individuals colonize a new area
  - gene pools very different from original
  - represent a small portion of original gene pool
  - ex. Amish community

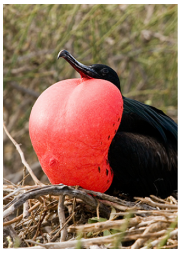
Effects of Genetic Drift

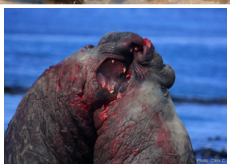
- population loses variation
  - less likely to have some individuals able to adapt to changes in environment
- lethal alleles become more common in gene pool by chance



Sexual Selection

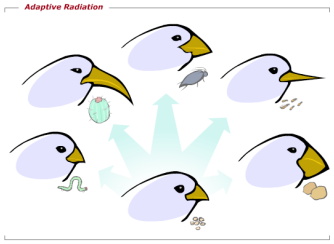
- females choose males and/or males compete for dominance
- increases mating success, but not necessarily ability to survive






Speciation

- isolation - gene flow between 2 populations stops for any reason
  - mutation and genetic drift
  - gene pools change
  - 2 populations may begin to look/behave differently
- speciation - rise of 2 or more species from 1 existing species



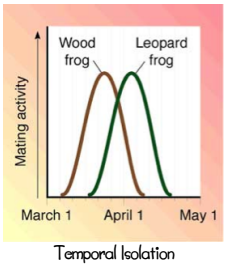
Reproductive Isolation

- occurs when members of different populations can no longer mate successfully
  - successfully = fertile offspring
- 3 barriers can prevent mating between populations
  - behavioral isolation
  - temporal isolation
  - geographic isolation


Bowerbird nests


Isolating Mechanisms

- behavioral isolation
  - capable of interbreeding, but differences in courtship or mating behaviors
  - ex. different songs/dances/scents
- geographic isolation
  - physical barriers divide a population into 2 or more groups
  - genetic changes cannot flow between groups
  - ex. rivers, mountains, oceans
- temporal isolation
  - populations reproduce at different times



Temporal Isolation

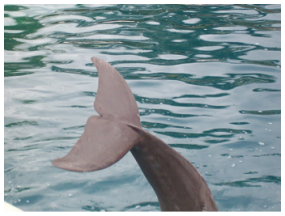
15.3a Shaping Evolutionary Theory

Ex. of Speciation – Darwin's Finches

1. founders arrive - a few finches from S. America came to Galapagos Islands
2. separation of population - finches move to different islands...isolation each population and no longer sharing a gene pool
3. changes in gene pool - over time, each population adapted to their environment
4. reproductive isolation - finches choose their mates carefully...differences in beaks and mating behaviors led to reproductive isolation
5. ecological competition - species evolve in a way that increases the differences in each bird population
6. continued evolution - after many generations 13 finch species have evolved

Convergent Evolution

- evolution toward similar characteristics in unrelated species
- similar environments
- start with different raw materials, but end with similar products due to evolutionary pressures
  - analogous structures
- ex. tail of dolphin and tail of shark

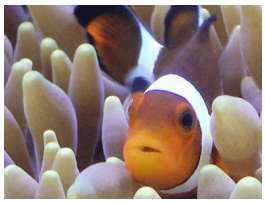



Divergent Evolution


- aka adaptive radiation
- species evolve from a common ancestor and radiate out like the spokes of a wheel
- ex. Darwin's finches; kit fox and red fox

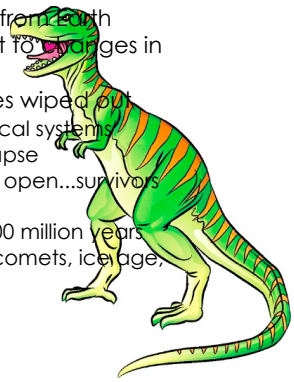
Coevolution

- 2 or more species evolve together over time in response to changes in each
- species closely connected to one another evolve together
- bees/birds pollinating specific flowers ONLY
- can be driven by competitive relationships
  - toxic plants, snails/crabs




Extinction

- elimination of a species from Earth
- species unable to adapt to changes in environments
- mass extinctions - species wiped out
  - global effect - ecological systems destroyed, food webs collapse
  - leaves habitats/niches open...survivors evolve to fill in the gaps
  - 5 mass extinctions in 600 million years
  - catastrophic events - comets, ice age, shifting continents



Punctuated Equilibrium

- long stable periods interrupted by brief periods of more rapid change