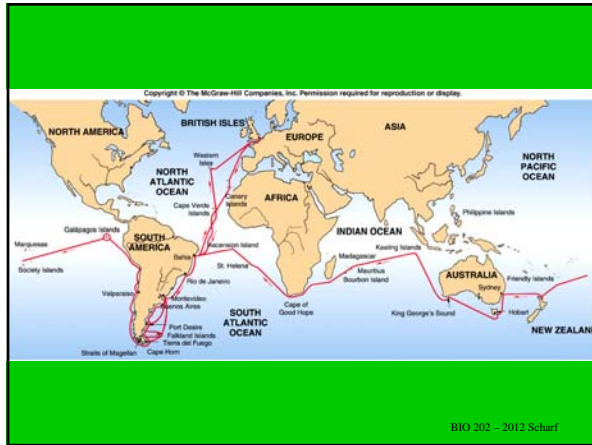


Theory of Evolution

- Charles Darwin – “Darwinism”
- Voyage of the Beagle in 1831 to map South American coast
- Darwin spent time observing flora and fauna
- Notion of Divine Creation dominated thinking at this time

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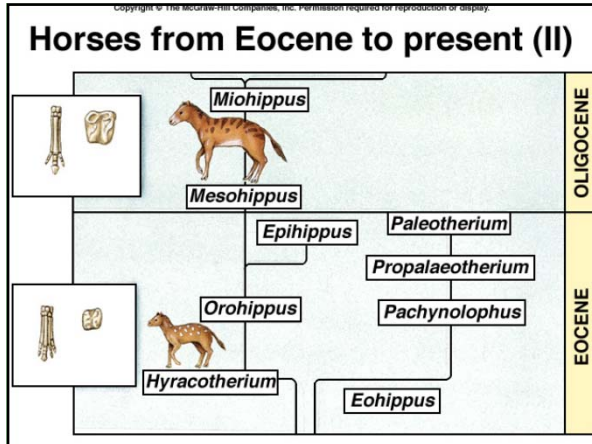


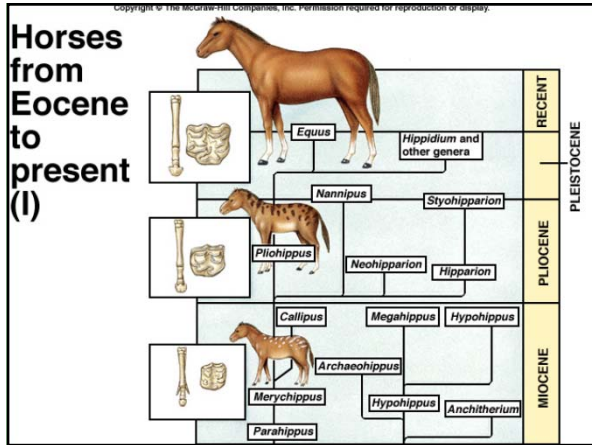
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5 Theories of Darwinism

1. Perpetual change
 - Documented by fossil record

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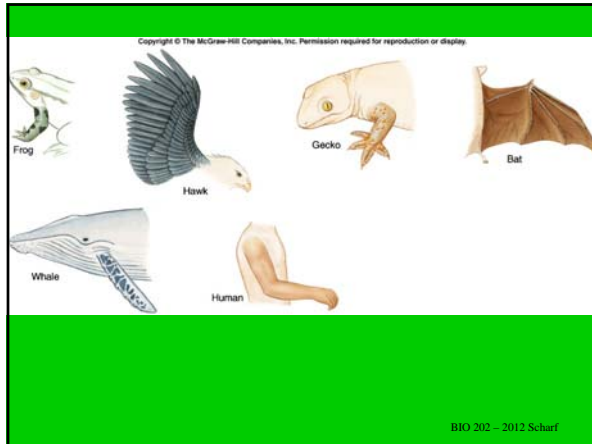


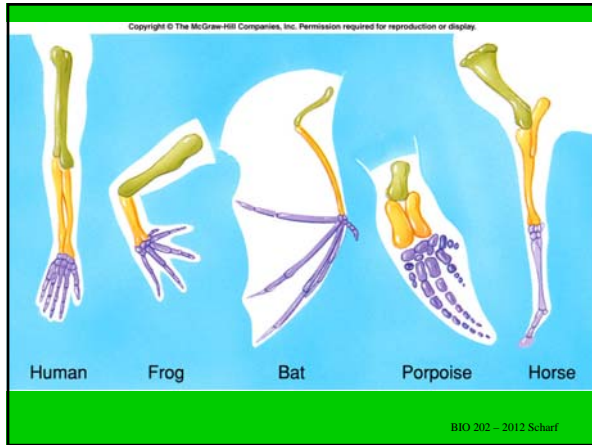


5 Theories of Darwinism

1. Perpetual change
2. Common descent
 - Phylogeny
 - Branching trees form nested hierarchies of species
 - Morphology
 - Homologous structures
 - Character states derived from the same character state in a common ancestor
 - e.g. vertebrate forelimbs (different functions)

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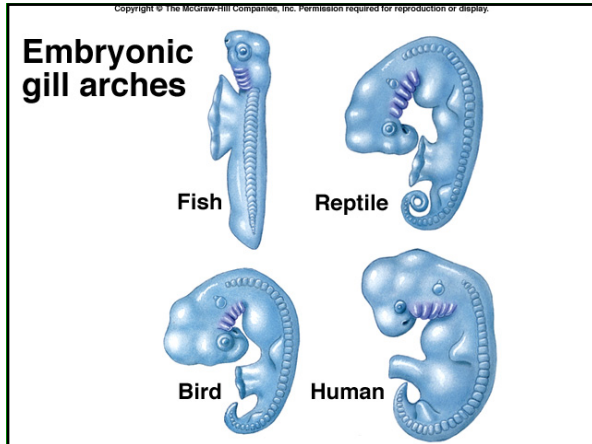


5 Theories of Darwinism

1. Perpetual change
2. Common descent
 - Phylogeny
 - Branching trees form nested hierarchies of species
 - Homologous structures
 - e.g. vertebrate forelimbs (different functions) Fig 1.16
 - Biogenetic Law (Haeckel) believed "Ontogeny recapitulates phylogeny"

Not True

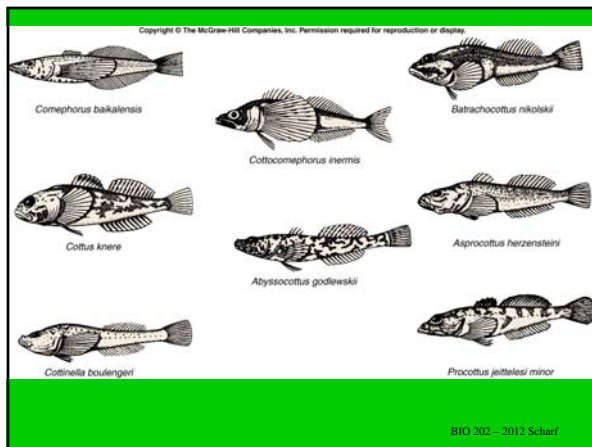
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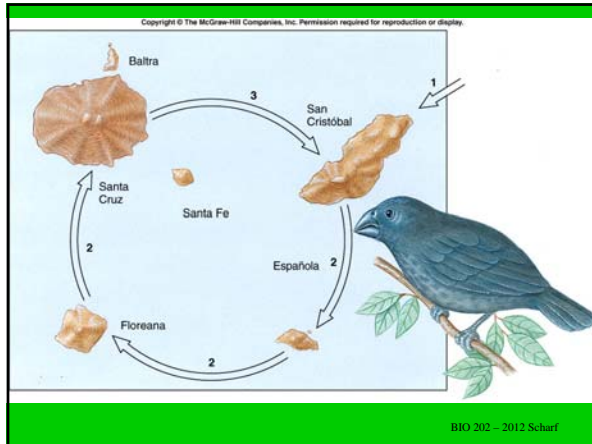


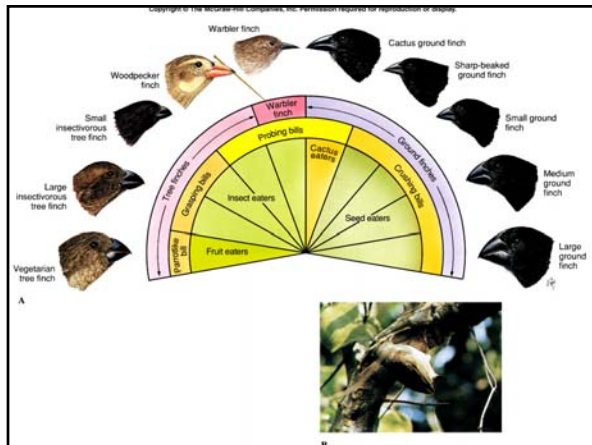
5 Theories of Darwinism

1. Perpetual change
2. Common descent
3. Multiplication of species
 - Reproductively distinct
 - Speciation
 - Allopatric speciation
 - Geographic isolation
 - Founder events
 - Sympatric speciation
 - Adaptive radiation
 - Darwin's finches

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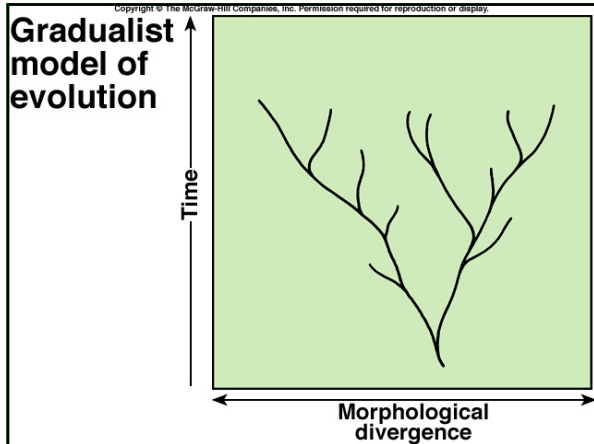


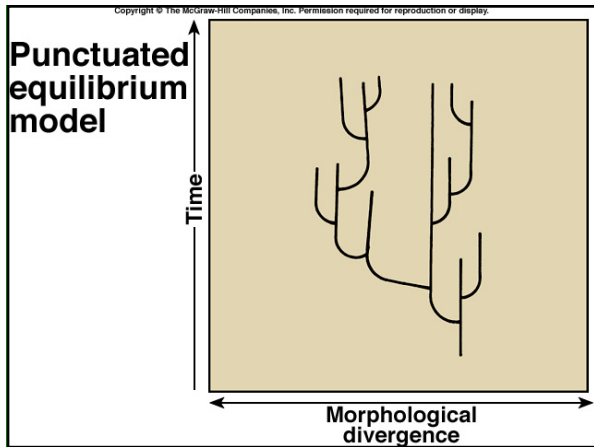


5 Theories of Darwinism

1. Perpetual change
2. Common descent
3. Multiplication of species
4. Gradualism
 - Small changes over long time periods
 - Populational gradualism
 - Gradual spread of trait among population
 - Well accepted
 - Phenotypic gradualism
 - Gradual production of the trait itself
 - Controversial (e.g. selective breeding)

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5 Theories of Darwinism

1. Perpetual change
2. Common descent
3. Multiplication of species
4. Gradualism
5. Natural selection
 - Mechanism for adaptation

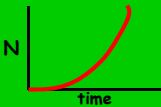
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Natural Selection

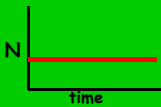
Mechanism for adaptation and biological diversity

4 Observations

1. Potential for exponential increase



2. Population size tends to be stable



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Natural Selection

Inference:

Many more offspring are produced than can survive and reproduce

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Natural Selection

3rd Observation

Variation among individuals is the rule in nature

4th Observation

Some of this variation is inherited

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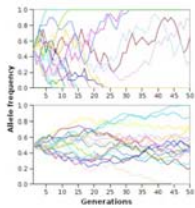
Natural Selection

Inference:

Individuals with inherited states of variable traits that on average confer a higher rate of survival and reproduction will tend to increase generation after generation at the expense of those with less advantageous states

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Evolution



- Change over time
- Change in allele (gene variant) frequencies within a population over time

Genetic variation



- Fundamental to evolutionary change
- Novel alleles can arise from random mutations within existing alleles

Mutations



- DNA sequence changes
- Can be beneficial, neutral, or harmful
- Usually arise because of errors in replication or repair

Evolutionary mechanisms

- Nonrandom mating
- Migration
- Genetic drift
- Natural selection

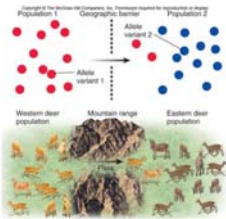
Nonrandom mating



Gouldian finches

- Individuals select mates based on phenotype or genetic history
- Alters relative proportions of homozygotes and heterozygotes
- Usually does not itself affect allele frequencies

Migration



- Movement of genes between populations
- Introduction of migrants could affect allele frequencies

Genetic drift



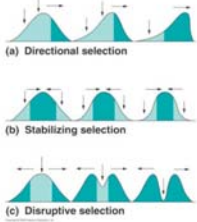
- Change in allele frequencies due to chance
- Important mechanism, especially in small populations

Natural selection



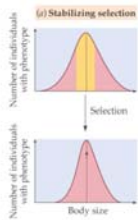
- Process in which individuals possessing a particular heritable trait have greater reproductive success than those lacking the trait
- Beneficial traits (and associated alleles) should become more common
- Detrimental traits (and associated alleles) should become less common

Types of natural selection

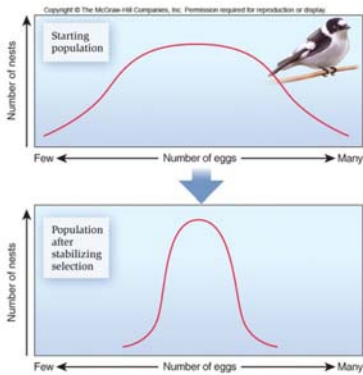


- Stabilizing selection
- Directional selection
- Disruptive selection

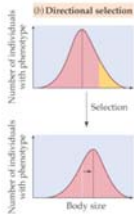
Stabilizing selection



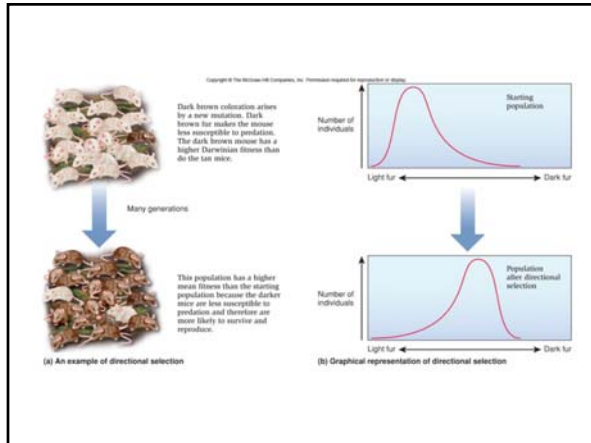
- Favors the survival of individuals with intermediate phenotypes
- Extreme values of a trait are selected against



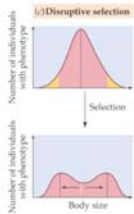
Directional selection



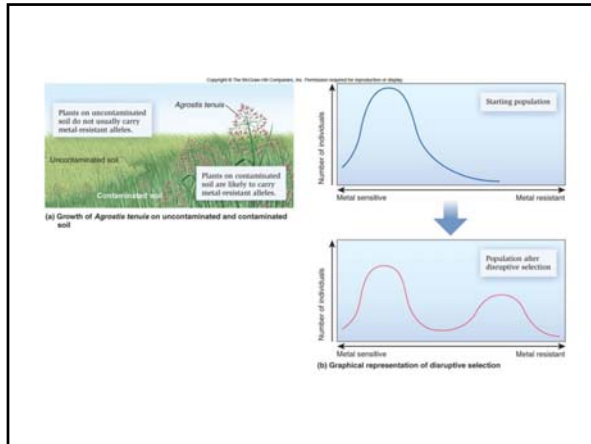
- Favors individuals at one extreme of a phenotypic distribution that have greater reproductive success in a particular environment
- May be initiated by introduction of new, favored allele or prolonged environmental change

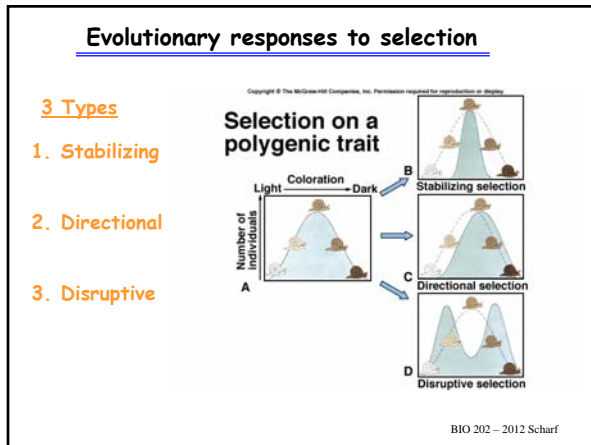


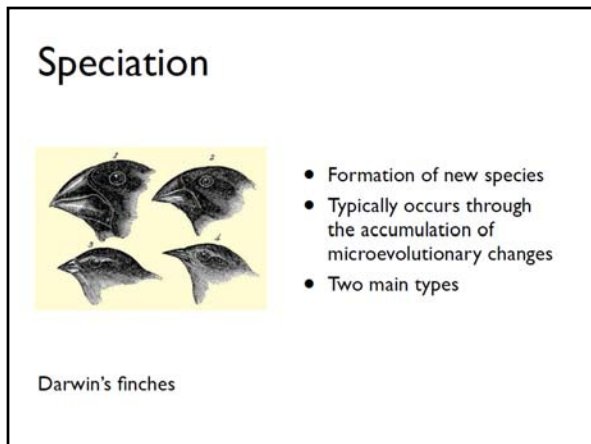
Disruptive selection



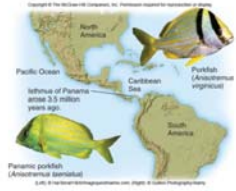
- Favors the survival of two or more different genotypes that produce different phenotypes
- Likely to occur in populations occupying heterogeneous environments
- Note that members of populations can freely interbreed







Allopatric speciation



- Occurs when members of the same species become geographically separated
- Genetic drift and natural selection can lead to differences

Porkfish

Sympatric speciation



- Occurs when members of the same species diverge in the absence of a physical barrier
- May involve adaptation to local environments

Rhagoletis

Isolating mechanisms



- Mechanisms that prevent interbreeding
- Consequence of genetic changes that arise as species adapt to environment

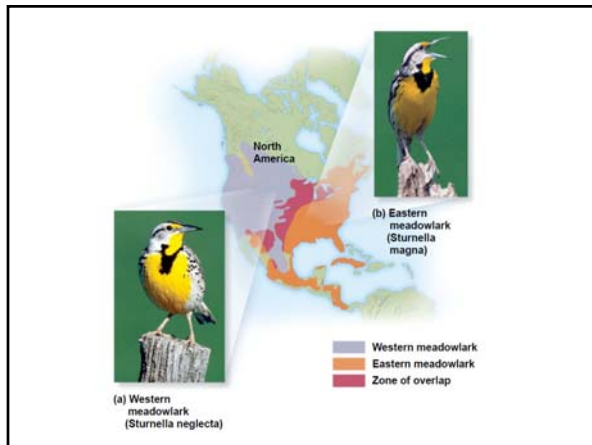
Mimulus

Prezygotic mechanisms



- Habitat isolation
- Temporal isolation
- Behavioral isolation
- Mechanical isolation
- Gametic isolation

Field crickets



Postzygotic mechanisms



- Hybrid inviability
- Hybrid sterility
- Hybrid breakdown

American bullfrog

