

Ch 24 The Origin of Species



Jean-Baptiste Lamarck

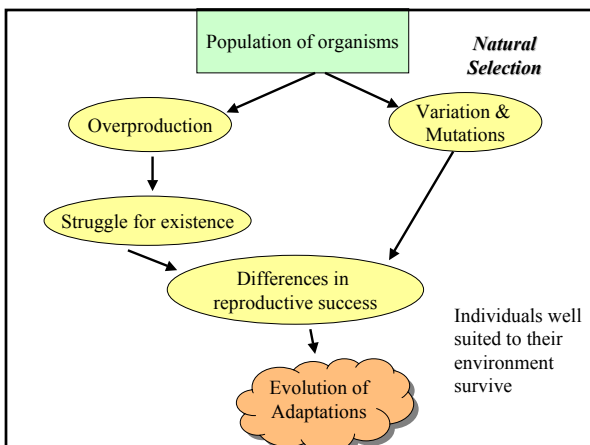
- Lamarck was among the first scientists to recognize that living things have changed over time and that all species were descended from other species
- He also recognized organisms were somehow adapted to their environments.

Charles Darwin

- ***On the Origin of Species***
 - Proposed a mechanism for evolution that he called **natural selection**
 - Presented evidence demonstrating that the process of evolution has been taking place for millions of years, and continues in all living things

Darwin's Two Main Points

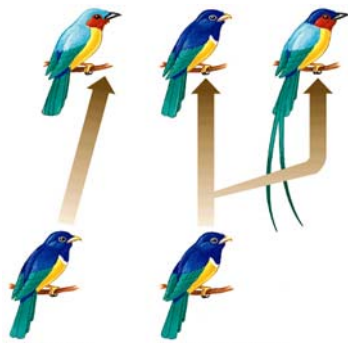
- ***Descent with modification***
 - descendants of earliest organisms spread into various habitats over millions of years.
 - i.e. fur that blends with different environments, protective camouflage
- ***Natural Selection***
 - Process by which individuals with inherited characteristics well suited to the environment leave more offspring on average than do other individuals.



Two Patterns of Speciation

- The boundary between microevolution and macroevolution
- Fossil record indicates that two pattern of speciation have occurred
- ***Anagenesis***-
 - unbranched lineage of organisms (phyletic evolution)
- ***Cladogenesis***-
 - budding of one or more new species from a parent species that continues to exist (branching evolution)

Anagenesis vs. Cladogenesis



(a) Anagenesis (b) Cladogenesis
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Macroevolution

- Origin of new taxonomic groups
- Evolutionary trends
- Adaptive radiation
- Mass extinctions

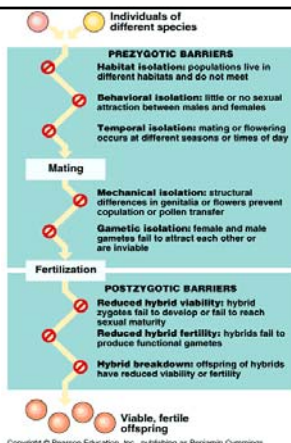
What Is a Species?

- Largest unit of a population in which gene flow is possible
- Reproductively isolated in natural environments
- Exceptions: asexual forms, extinct vs. extant forms
- *Biological species concept* first defined by Ernst Mayr 1942

Population, Species and Isolation

- Prezygotic barriers
 - impede mating or hinder fertilization of ova
- Habitat isolation
- Behavioral isolation
- Temporal isolation
- Mechanical isolation
- Gametic isolation
- Postzygotic barriers
 - hybrid zygote forms but development prevented
- Reduced viability
- Reduced fertility
- Hybrid breakdown

Types of Isolating Mechanism

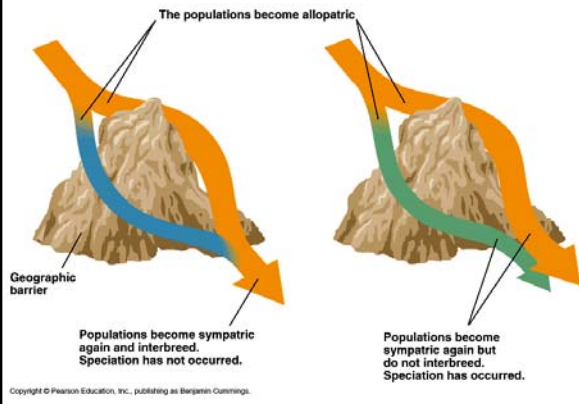


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Modes of Speciation

- **Allopatric speciation**
 - occurs when the initial block to gene flow is a geographical barrier that physically isolates the population
- **Sympatric speciation**
 - formation of a new species within the range of parent populations

Figure 24.8 Has speciation occurred during geographic isolation?



Modes of Speciation

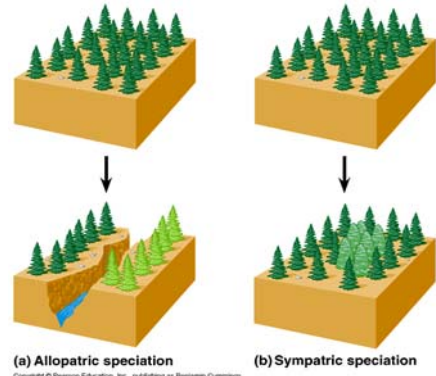


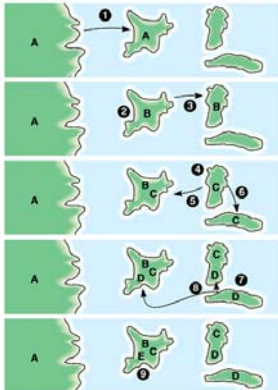
Figure 24.7 Allopatric speciation of squirrels in the Grand Canyon



Allopatric Speciation

- Occurs when isolated gene pool accumulate differences by microevolution that may cause the populations to diverge in phenotype
- *Adaptive radiation*
 - evolution of many diversely adapted species from a common ancestor, common to islands

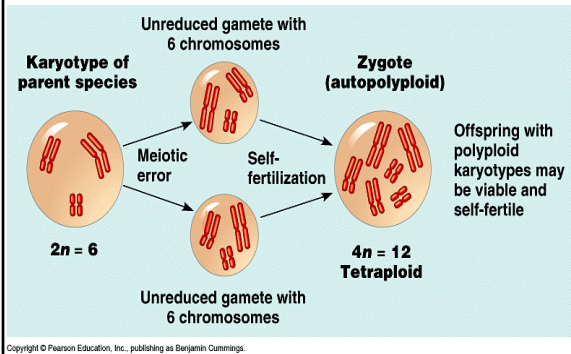
Adaptive Radiation



Sympatric Speciation

- Very Rapid
- More common in plants
- Frequently caused by improper cell division resulting in formation of fertile polyploids
- *Autopolyploidy*
 - an organism that has more than two sets of chromosomes, all derived from a single species, diploid gametes, self-pollination
- *Allopolyploidy*
 - polyploid hybrid created by two different species, fertile forms result of nondisjunction of gametes in one of the species

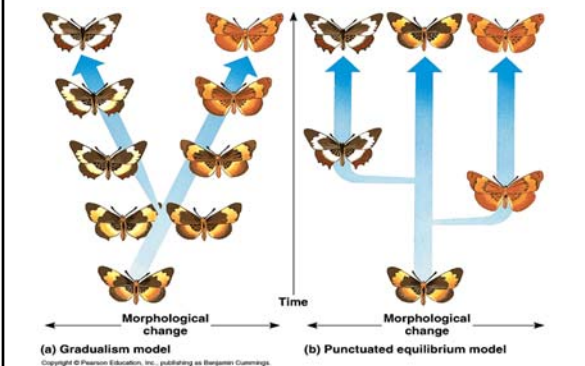
Sympatric Speciation



Punctuated Equilibrium and the Tempo of Speciation

- Proposed by Steven Jay Gould and Niles Eldredge in 1972
- Suggests that most allopatric speciation events are the result of crises or major genetic alterations that “punctuate” long periods of **stasis**
- Rapid evolution (misleading-actually up to 100,000 years)

Two Models of Evolution



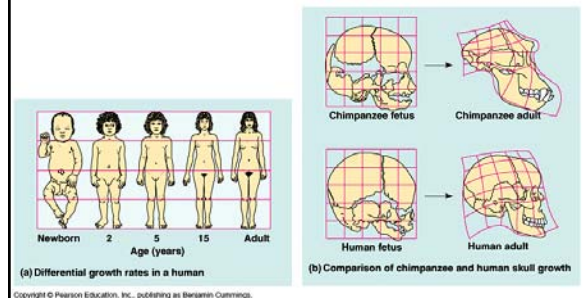
The Origin of Evolutionary Novelty

- How do novel features that define taxonomic groups above the species level arise? (wings as an example)
- Gradual refinement of existing adaptations
- Alternative functions

Genes that control development and evolutionary novelty

- Sometimes a few changes in the genome causes major changes in the morphology.
- A system of regulatory genes coordinates activities of structural genes to guide the rate and pattern of development
- Allometric growth*
- Heterochrony*
- Pseudomorphosis*
- Homeosis*

Allometric Growth-differences in relative rates of growth of various parts of the body



Heterochrony-evolutionary changes in the timing of rate of development



(a) Ground-dwelling salamander



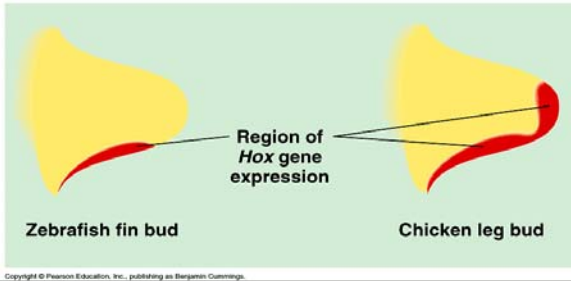
(b) Tree-dwelling salamander

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Pseudomorphosis: retention of ancestral juvenile structures in a sexually mature adult organism



Homeosis-alteration in the placement of different body parts



Hox genes

- Homeotic genes
- Responsible for where structures develop on the embryo
- Responsible for limb formation instead of fin formation