

Chapt. 24 – The Origin of Species

Species

Biological Species Concept

A population whose members can potentially interbreed in nature to produce viable, fertile offspring

In practice, we recognize two populations as separate species if each has distinguishing characteristics relative to the other, and members of each population lack the potential to interbreed in nature with members of the other population

Reproductive Barriers [See Fig. 24.4]

Reproductive barriers isolate populations from one another

A complete barrier would result in no **gene flow** between isolated populations

An incomplete barrier could still reduce **gene flow**

Pre-zygotic

Habitat isolation
Geographic isolation
Ecological isolation

Behavioral (mate choice) isolation

Temporal isolation

Mechanical isolation

Gametic isolation

Post-zygotic

Reduced hybrid viability

Reduced hybrid fertility; hybrid sterility (in the extreme)

Hybrid breakdown (reduced viability or fertility occurs in the offspring of hybrids)

Speciation

The process by which new species form

Two requirements:

Reproductive isolation of populations (**gene flow** sufficiently reduced)

Genetic divergence (divergent evolution)

Two main modes: [See Fig. 24.5]

Allopatric speciation

Divergence occurs in geographic isolation

Sympatric speciation

Divergence occurs despite lack of geographic isolation

Polyploids

Organisms with extra sets of chromosomes; can result in sympatric speciation in one generation

The origin of a polyploid individual is usually a mistake in meiosis or mitosis

Autopolyploidy [See Fig. 24.8] vs. **allopolyploidy** [See Fig. 24.9]

Autopolyploid – an individual that has > two chromosome sets, all from a single species

Allopolyploid – an individual that has > two chromosome sets, derived from different species

From Micro- to Macro-Evolution

Microevolution - Population and species-level evolution, including speciation

Macroevolution - Speciation and all broader-scale evolutionary patterns and processes

Anagenesis [See Fig. 24.2]

Sufficient microevolutionary changes may occur that the earlier population is considered a separate species from the later population

Cladogenesis [See Fig. 24.2]

Branching evolution occurs as speciation events accumulate

The formation of each new branch is a macroevolutionary event

Broad patterns across the resulting tree are also within the scope of macroevolution

Adaptive Radiation [See Fig. 24.12]

One species gives rise to many others in a geologically short period of time

E.g., Darwin's finches

E.g., Hawaii's silverswords

Islands are good places to find adaptive radiations

Tempo of Evolution [See Fig. 24.13]

Gradualism

Punctuated Equilibrium

Evolutionary Novelties [See Fig. 24.14]

Evolutionary novelties usually arise as modifications of existing traits

Evolutionary Development (Evo-Devo)

Slight alterations in development can have profound effects on adults

Heterochrony = change in the rate or timing of development, relative to an ancestor

E.g., **paedomorphosis** = heterochronic retention of juvenile structures in adulthood

Heterotopy = change in the physical position of a trait during development, relative to an ancestor

E.g., feathers from one part of a bird's body may become expressed on another part

Allometric growth = relative growth rates of different body parts within a species during development

E.g., allometric growth in horned scarab beetles; certain clusters of cells grow faster than others

[See Fig. 24.15, especially for other examples]

Evolution is not “goal oriented”

Evolution is a genetic response to the interaction between the individuals of a population and their current environment (which includes other individuals)

Natural selection can only act on the phenotypic variation present, and selection can only cause evolutionary change if phenotypic variation results (at least in part) from genetic variation

Therefore, even if female tigers in a population would prefer blue males, blue tigers will never evolve if the population lacks variation that includes blue fur