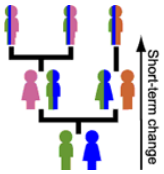
Evolution may be divided into two types

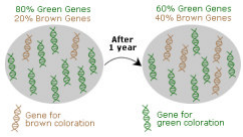
1. Microevolution

Evolution within a single population. That means narrowing our focus to one branch of the tree of life.



Microevolution..

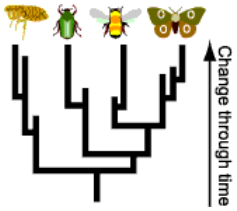
- The change in allele frequency, which occurs within species (i.e., between individual members of individual species, or populations)



-e.g. different morph types of the Knysna seahorse

2. Macroevolution

The processes and patterns that take place between species and larger lineages of organisms and communities in their environments, which also change through time.



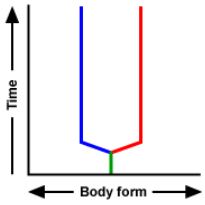
Macroevolution defines the history of life, on a grand scale

Patterns in Macroevolution

1. Statis

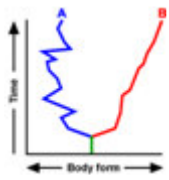
Many lineages on the tree of life exhibit stasis, showing little change over time

•Thought to have gone into extinct about 80 million years ago. But discovered in 1938



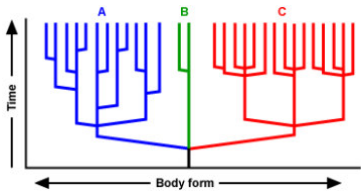
2. Character change

- Lineages can change quickly or slowly. Character change can happen
  - in a single direction, such as evolving additional segments,
  - or it can reverse itself by gaining and then losing segments.



3. Lineage-splitting (or speciation)

Species and clades originate over evolutionary time scales, by the splitting or branching process of lineages



E.g. *Syngnathus* phylogeny

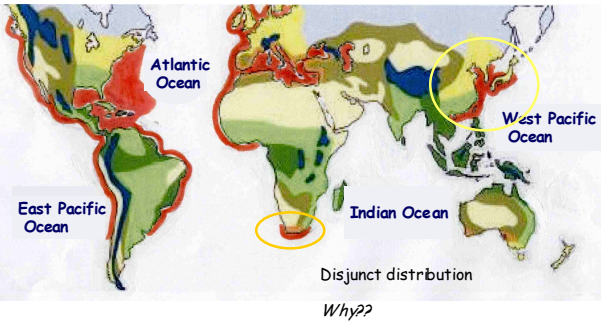
Syngnathus is the largest genus in the family Syngnathidae with 32 species presently defined.

- Reproduction is unique as male pipefishes carry the fertilized eggs in a brood pouch.

Syngnathus watermeyeri - The Estuarine pipefish (Endemic)

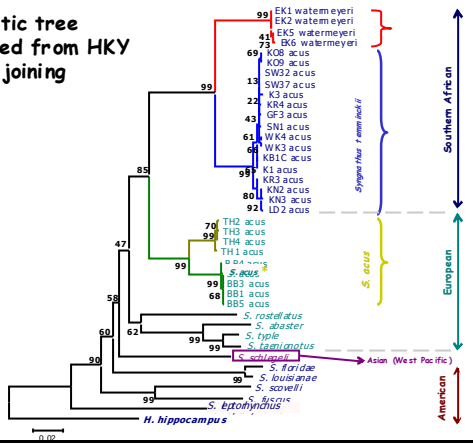
Syngnathus temminckii Kaup, 1856 (long snout pipefish)

General distribution of the genus *Syngnathus*



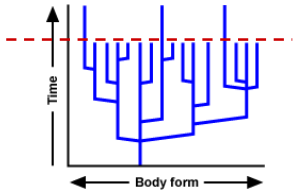
Why??

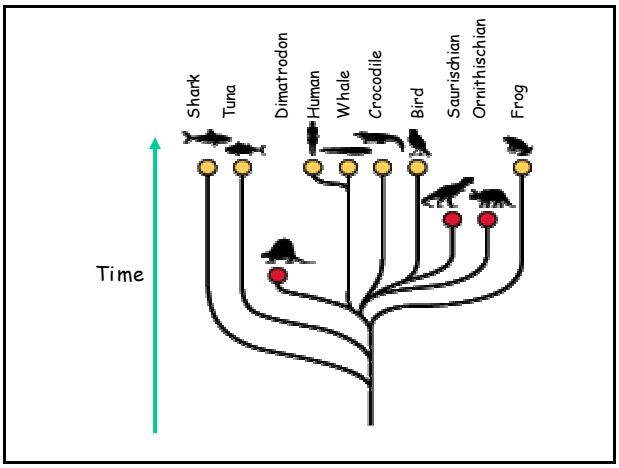
Phylogenetic tree constructed from HKY neighbor-joining distances



4. Extinction

- Can be a frequent or rare event within a lineage, or it can occur simultaneously across many lineages (mass extinction).
- Over 99% of earth's species have have gone extinct.





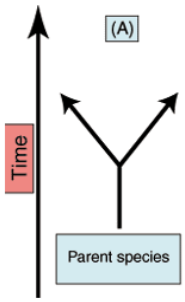
Types of Evolution

Evolution can follow several different patterns over time.

environment and predation pressures have different effects on the way species evolve

- Divergent
- Convergent
- Parallel evolution.

A. Divergent



Occurs mostly when closely related species diversify to new habitats due to selection pressure.

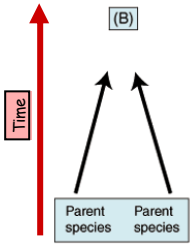
Example

large scale: the current diversity of life on earth from the first living cells

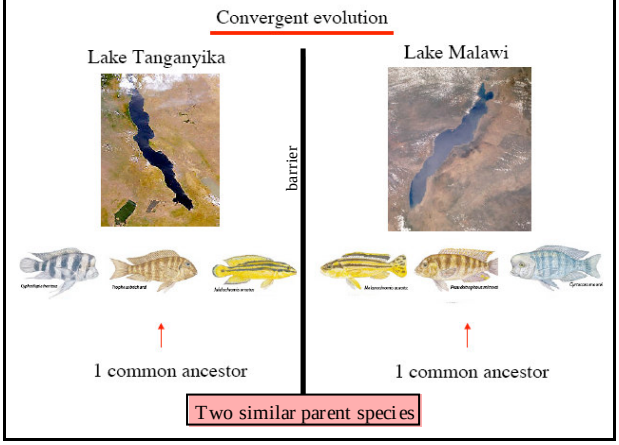
Small scale: differences between humans and apes, vertebrates and invertebrates etc

B. Convergent evolution

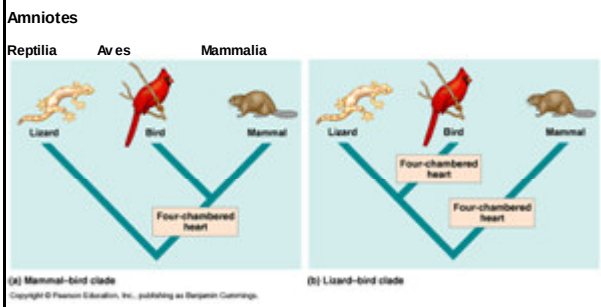
Species of different ancestry or lineages that evolve & begin to share ***analogous*** traits (morphological or physiological) because of a shared environment or selection pressure



Analogy: When similarities result from convergent evolution



The analogy-versus-homology pitfall



Reptiles are amniotes that lack fur or feathers

Examples of convergent evolution;

- Whales vs fish (swimming)

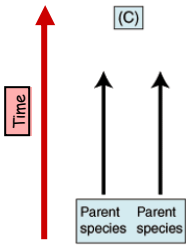
- Birds vs bats vs insects (flight)

- Coloration that serves as a warning to predators and for mating displays in fish as well as other organisms

- Internal fertilization has evolved independently in Sharks, some amphibians and amniotes.

C. Parallel evolution

when two species evolve independently of each other from a specified ancestor, maintaining the same level of similarity of morphological organization (*homoplasy*)



- Particular phenotypic traits often evolve repeatedly when independent populations are exposed to similar ecological conditions

Example: Horses, moths

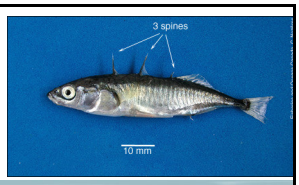
1. The threespine stickleback species complex

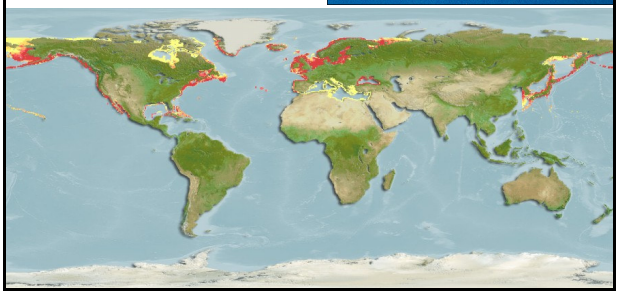
(*Gasterosteus aculeatus*)

- Parallel evolution within this species complex

- occurred in countless freshwater lake and stream environments colonized by marine sticklebacks after widespread melting of glaciers 10,000 to 20,000 years ago.

The threespine stickleback





2. African Cichlids

parallel adaptive life-history evolution

• Independent adaptation of many cichlid fish species endemic to the African Great Lakes (Malawi, Tanganyika, and Victoria) to pelagic, benthic, and rocky shore habitats

• Cichlid lineages colonizing rocky shores and pelagic habitats in the lakes have independently evolved larger eggs and lower fecundities than *benthic lineages*

Note:
Other pelagic teleost fishes in both marine and freshwater habitats, including African lakes, typically produce large numbers of very small eggs

African Cichlids

Lake Victoria

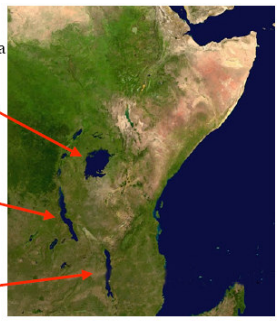
Lake Victoria about 200-250, very shallow: 750,000 years old.

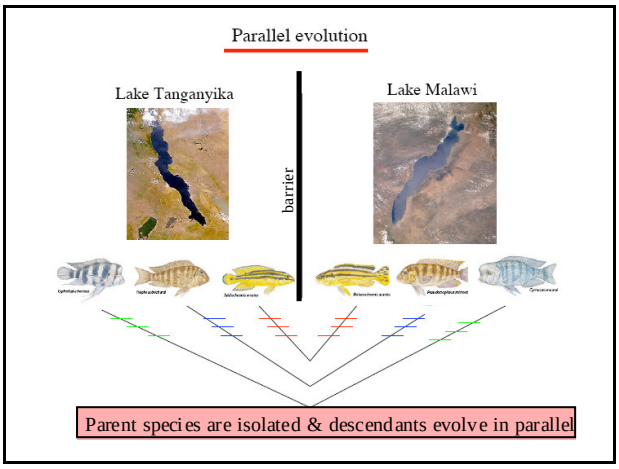
Lake Tanganyika

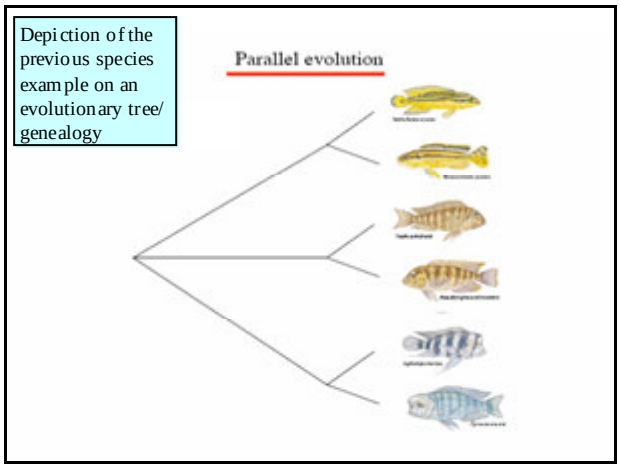
Lake Tanganyika: about 140 species, very deep; age: 1.5-2.0 MY

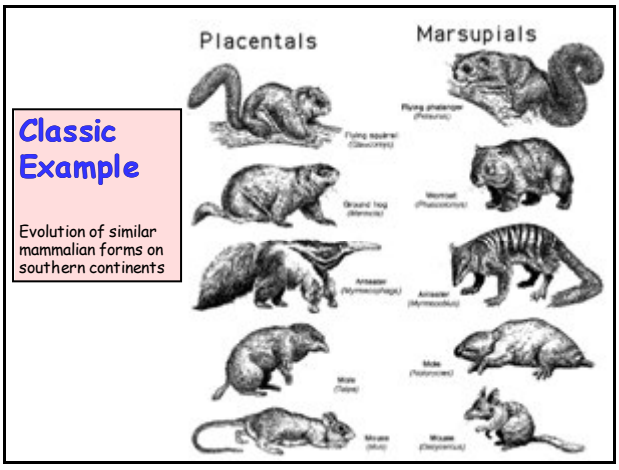
Lake Malawi

Lake Malawi at least 200- 500, very deep; age: 1.5-2.0 MY









Co-evolution

- the change of a biological object triggered by the change of a related object
- Each party in a coevolutionary relationship exerts selective pressures on the other

e.g.
- host species and its parasites
- Mimicry