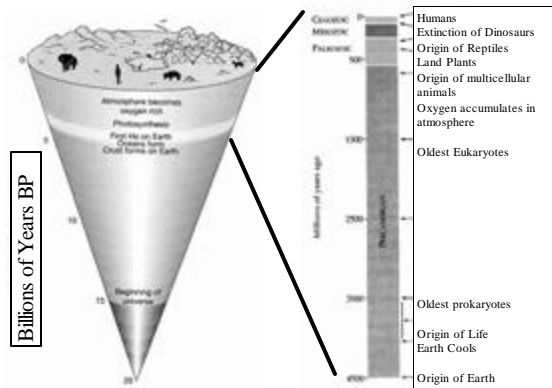


Timeline of Major Events in History of Universe

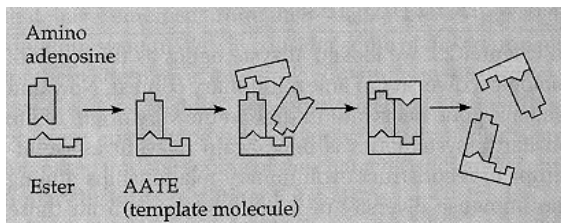


Brief history of life on earth

- 4.5 bya - Earth formed
- 3.8 bya - Earth cools, water condenses, oceans form
- 3.5 bya - 1st life appears, first O₂ produced, but absorbed by seabed
- 2 bya - O₂ released into atmosphere
- 1.8 bya - 1st eukaryotes
- 0.6 bya - 1st multicellular organisms
- 0.54 bya - rapid diversification; all modern phyla formed,
- 0.4 bya - oxygen-rich atmosphere, ozone layer formed, life moves onto land, tetrapods form
- 0.28 bya - 1st dinosaurs
- 0.065 bya - last dinosaurs, mammals diversify
- 0.005 bya - 1st hominids
- 0.0000002 bya - human population explodes
- 0.0000004 bya - modern environmental problem arise.
- Ecology is a science best poised to address modern environmental problems.

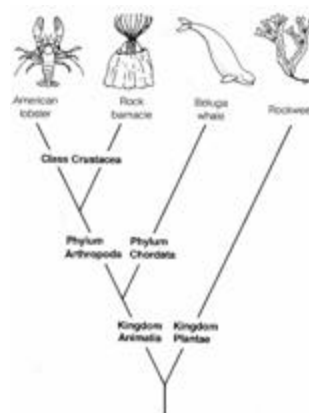
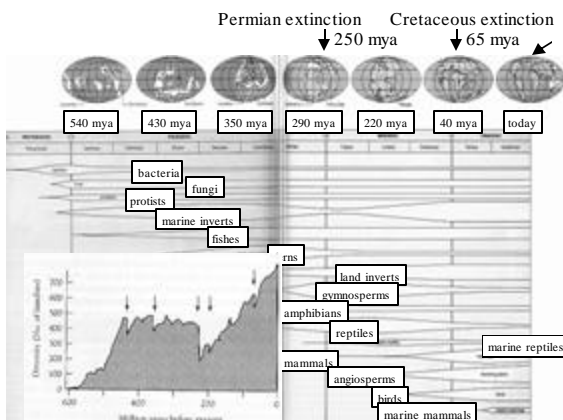
Reproduction - an important condition of life

- simple molecules can reproduce themselves
- this process is similar to the duplication that occurs with DNA and RNA, the molecular genetic codes of life



Evolution and Natural Selection: The Heart of Ecology

- Evolution: all the changes that life has gone through since its beginning that has resulted in the great diversity of living forms that occur today
- Evolution can be viewed from many scales - within a species (gene frequency), creation of a species (speciation), above species level (macroevolution)



Linnaean system of naming organisms

Kingdom	Animal
Phylum	Chordata
Class	Mammalia
Order	Primate
Family	Hominidae
Genus	Homo
Species	sapiens

<http://phylogeny.arizona.edu/tree/phylogeny.html>



Evolution within a species

Change in the frequency of a trait within a population of moth due to natural selection by predators

Evolution cannot predict the future or create adaptations to match an environmental change. It acts on existing variation.

Speciation - the making of a new species

Species: a group of potentially or actually interbreeding populations that are reproductively isolated from all other populations

Allopatric speciation: where populations of a species are isolated by geographical barriers. Over time, the populations diverge in characteristics until they are distinct species.

marsupials of Australia

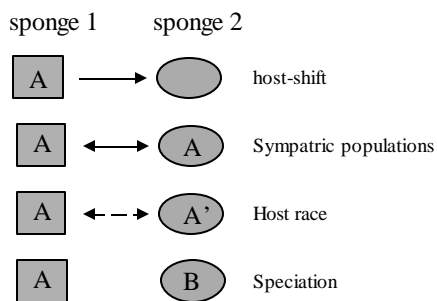
Galapagos finches

Plate tectonics can create geographic barriers (continents split, oceans form, islands form, mountains rise)

Sympatric speciation: where populations with overlapping range become reproductively isolated, allowing them to diverge and become distinct species.

Sympatric Speciation

Some individuals of shrimp species A develops a liking for sponge 2, which can eventually lead to a new species of shrimp (B)



Speciation: "the rendering of one closed genetic system into two"

Feder and Bush 1989

Allopatric: "Allopatric populations are separated by uninhabited space (even if it is a very short distance), across which migration (movement) occurs at a very low frequency."

Bush and Howard, 1986

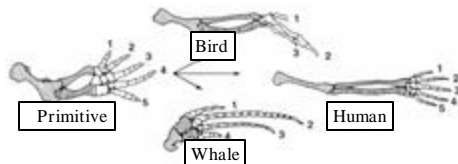
Sympatric: "two populations are sympatric if individuals of each are physically capable of encountering one another...with moderately high frequency." *Bush and Howard, 1986*

Host race: partially reproductively isolated populations that utilize different host plants.

Species: "a group of populations whose evolutionary pathway is distinct and independent from that of other groups...groups having achieved full species status if they are or could be (given the opportunity) truly sympatric without losing their separate identities through interbreeding." *Bush and Howard, 1986*

Evidence that supports evolution

Fossil record - often shows intermediate forms of life
 Shared traits - all animals have similar cellular structure
 Homologous structures - structure in different species that have common origin, but can serve different roles

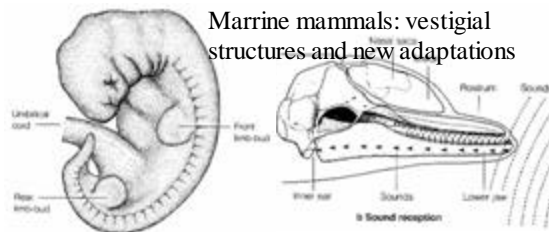


Analogous structures: structures in different species that serve the same role, but come from different origins.

Embryonic development - whale embryos have leg buds, but adults don't have legs. 4-wk old human embryos have gill pouches and tail

Vestigial structures - whale hip bones, human appendix

Marrine mammals: vestigial structures and new adaptations



modifications include extra vertebrae, loss of hind limbs, strong tail, dorsal fin

head is designed for echo location of objects

