

Ch 25

Phylogeny and Systematics



AP Biology
Mrs. King

Fossil of a fish: perch



- **Phylogeny**
 - -evolutionary history of a species
- **Systematics**
 - -study of biological diversity in an evolutionary context

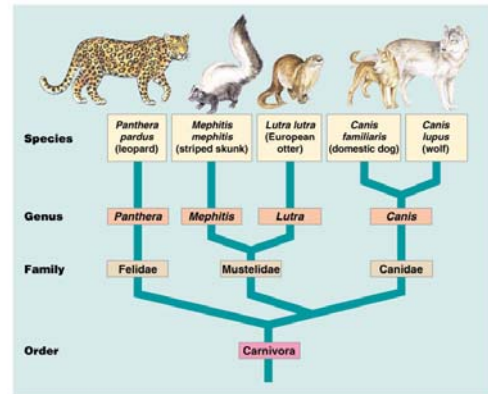


Figure 25.1 A gallery of fossils



The Fossil Record and Geologic Time

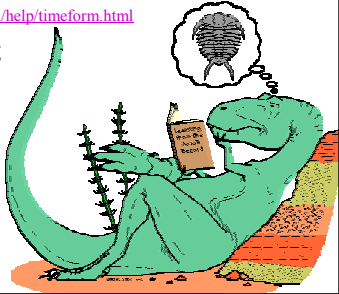
- Role of sedimentary rocks
- Fossil dating, use of strata location vs. absolute dating
- Fossil record incomplete, favors species that existed for a long time, **why?**
- Role of continental drift
- Mass extinctions and adaptive radiations

Age of the Earth

- Geologic Time Scale

<http://www.ucmp.berkeley.edu/help/timeform.html>

- Radioactive Dating



Geologic Time Scale

Earth's history is organized into four eras:

- Precambrian
- Paleozoic
- Mesozoic
- Cenozoic

- [pdf](#)

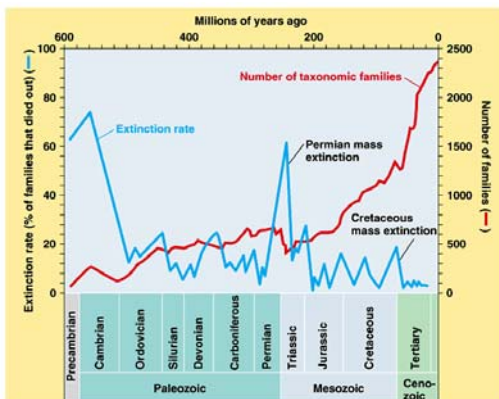
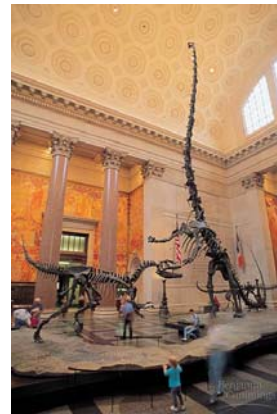


Campbell, et.al, 2004

Examples of Mass Extinctions

- Approximately 12 mass extinctions
- Permian extinctions-250 million years ago, 90% species (marine) eliminated
- Cretaceous extinctions-65 million years ago, 50% marine species, dinosaurs, many plants
- Asteroid impact (Alvarez or Impact Hypothesis), crater from Cretaceous extinction- 180 km dia. Yucatan coast

Figure 25.1x2 Barosaurus



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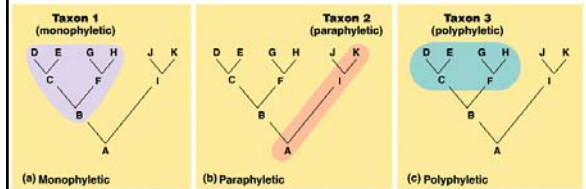


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Phylogeny and Systematics

- Goal of systematics-biological classification should reflect phylogeny
- Taxonomy-*binomial nomenclature*
- *Monophyletic taxon*-single ancestor gave rise to all species in a taxon
- *Polyphyletic taxon*-members are derived from two or more ancestral groups (plants from vascular and mosses)
- *Papraphyletic taxon*-excludes species that share a common ancestor that gave rise to the species included in the taxon (birds and reptiles)

Phylogeny and Systematics



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Homology and Analogy

- *Homology*-likeness attributed to shared ancestry
- *Analogy*-similarities due to **convergent evolution**
- *Convergent evolution*-acquisition of similar characteristic in species due to sharing similar ecological roles

Molecular Biology and Systematics

- Molecular comparisons of proteins and DNA
- Comparisons are objective and quantitative

DNA, RNA and Protein Comparisons

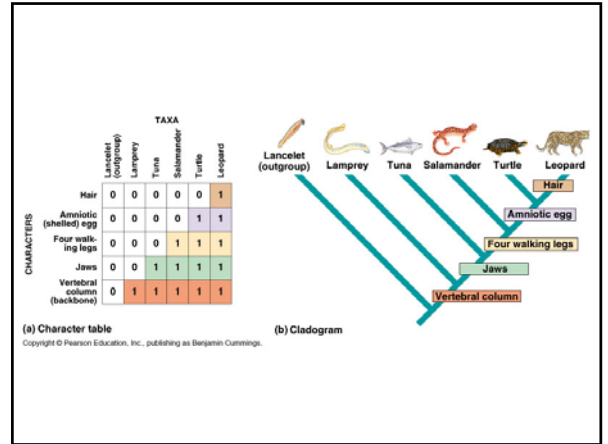
- DNA hybridizations-compare degree of similarity between two species
- Restriction maps
- DNA sequence analysis
- Homologous DNA sequences-mutations accumulate as species diverge
- Molecular clocks-number of amino acid substitutions is proportional to the elapsed time since divergence

Jurassic Park?

- Fossilized DNA has been isolated from
 - 17 million year old magnolia leaves,
 - 40,000 year old mammoth,
 - and 65 million year old *t. rex*.
- Problem-contaminated with fungus

Two Approaches to Phylogentic Systematics

- *Phenetics*
 - decides taxonomic affinities on measurable similarities and differences.
- *Cladistics*
 - classifies organisms according to the order in time that taxonomic groups diverge.



Phylogenetics-Problems?

- Accepts only monophyletic origins-consequences?
- Birds and reptiles.....

