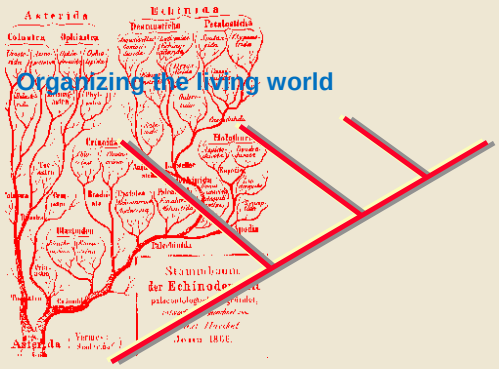

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In this lecture topic

- Classification past and present
- What is cladisticss
- What is a cladogram and how do you build one?

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Some initial definitions

- Classification
- Taxonomy
- Systematics
- Hierarchical

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classification- sorting a group of objects. putting them into categories.

Taxonomy- set of rules that make up a classification

systematics- evolutionary relatedness, hierarchal structure.

The purpose of classification is to arrange biological diversity in such a way as to facilitate communication and accurate information retrieval. This system must operate within a phylogenetic context and must easily accommodate modification while retaining name stability

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needs to be predictability with arrangement.

All organisms, from simple single celled protozoans to complex organisms such as insects and humans, classify their surrounding environment; often using simple dichotomous (Yes or No) outcomes to order the living world around them.

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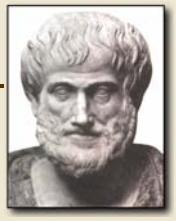
Types of taxonomies

- Folk
- Artificial
- Mechanical
- Natural (Evolutionary)
- Cladistic (Phylogenetic)



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very first taxonomy was Folk- Animate or inanimate. used verbally. 1 gen to next gen.

Artificial- written down taxonomy. Aristotle first person to do this.

Me

Types of taxonomies

- Folk
- Artificial
- Mechanical
- Natural (Evolutionary)
- Cladistic (Phylogenetic)

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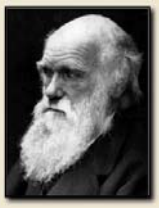
Mechanical- linneaus reorganizes everything into kingdoms etc..

predates evolution but gets some right using predictability but gets some wrong as well.

Types of taxonomies

- Folk
- Artificial
- Mechanical
- Natural (Evolutionary)
- Cladistic (Phylogenetic)



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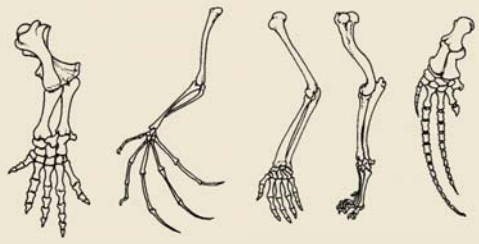
Natural- Darwin used branching pattern. Everything is related to each other. has common ancestry. relies on morphology.

Homologies and homoplasies



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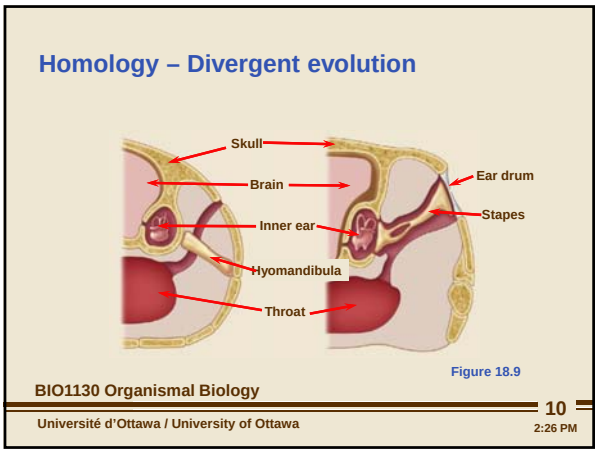
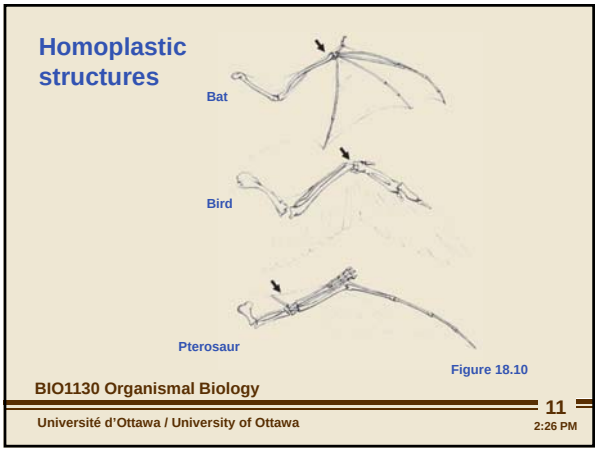
same bone structure, all related.



Hyomandibula involved in articulation of jaw. In amphibians, transmits vibrations (sound) to the balance organs in the inner ear.



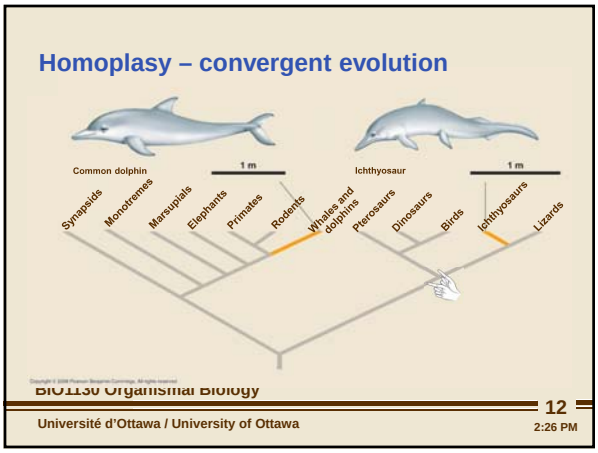
wings are homologous but developed in very different ways.

Bats; flight surface woven between digits and back to body.

Bird; digits have fused, set of feathers attached for flight, not skin.

so bats and birds dont share common ancestor. (Homoplastic)

Pterosaur; small finger extended and membrane attached to it, use other digits for walking.



identical appearance, convergent evolution, developed in the same way but no common ancestry.

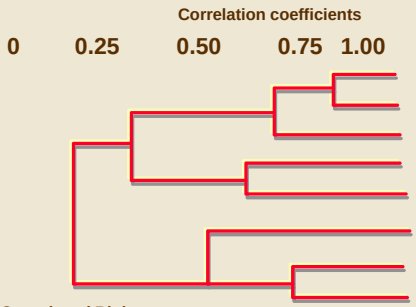
Three main questions

- What is the natural underlying order?
- What types of characters are available to assess that order?
- How do we handle the data from character analysis?

Types of characters

- Morphology
- Ultra-structure
- Embryology
- Fossils
- Molecules

Phenetic Taxonomy



measuring characteristics or organisms, should be possible for cluster analysis. Put into algorithm and figure out what's related, not arbitrary.

Types of taxonomies

- Folk
- Artificial
- Mechanical
- Natural (Evolutionary)
- Cladistic (Phylogenetic)

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entomologist.

new way to look at relationship between organisms called cladistics

what taxons have the most derived traits

the more derived traits, the further from the original ancestor.

Representing groups of animals

- Dendrograms
- Phylogenetic (Evolutionary) trees
- Cladograms

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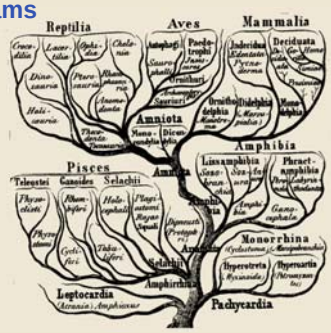
Dendograms



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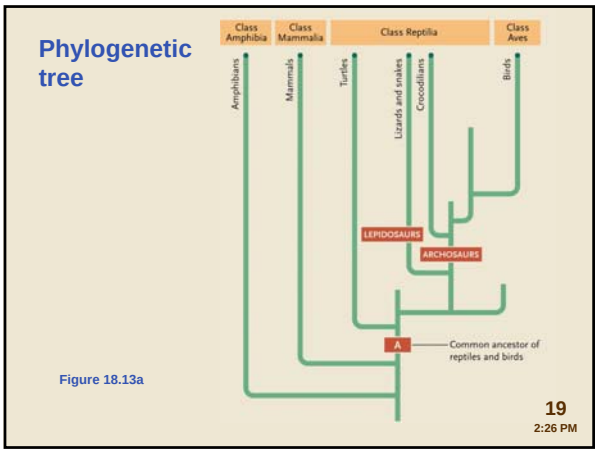
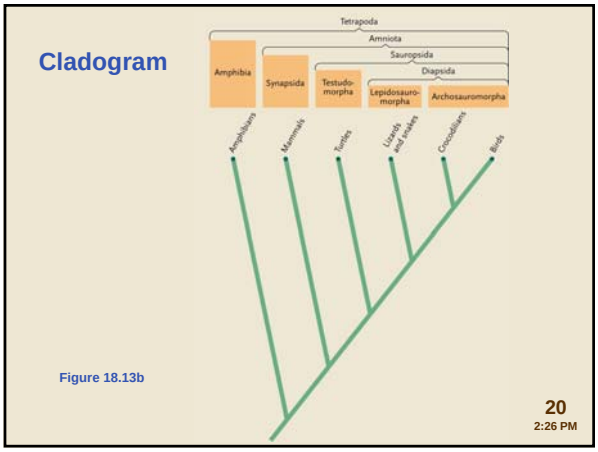
Top groups are better than the bottom groups



best evolutionary tree up to cladistics

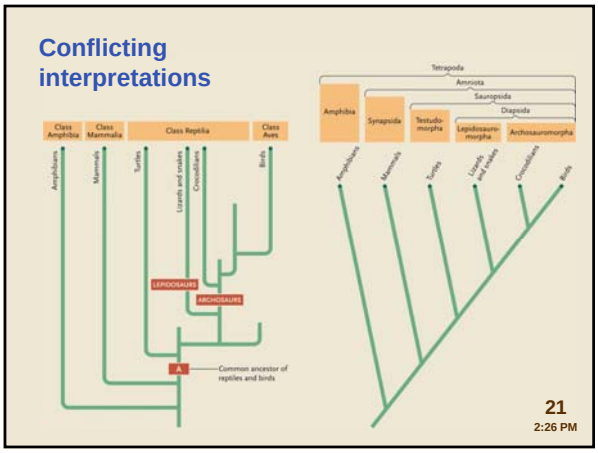


cladistics: dichotomous branching pattern.

trait at bottom inherited by all descendents

shared, derived characteristics that link,

groups together that are hierarchically nested



Cladistics - Useful terms

- **Apomorphies**
  - Derived characters within a group (evolutionary lineage)
- **Plesiomorphies**
  - Primitive characters within a group
- **Synapomorphies**
  - Derived characters shared between groups
- **Symplesiomorphies**
  - Shared primitive characters that are shared between groups

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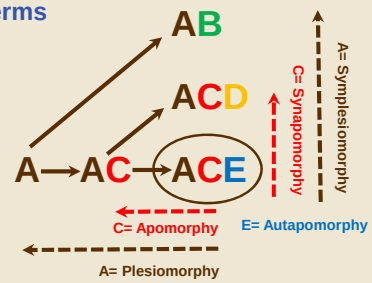
Cladistics – Useful terms



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Anatomy of a Cladogram

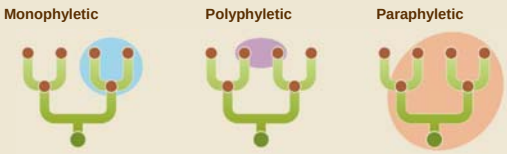

Figure 18.12

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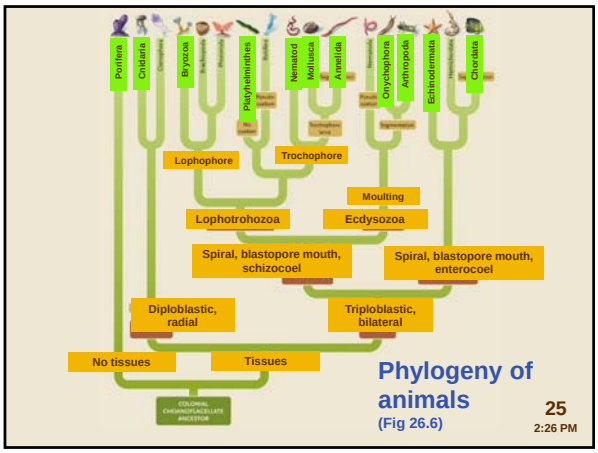
paraphyletic: some groups are excluded but later is found out that they should be included.

Polyphyletic: think they are related to each other but later another trait is used and is found out that they are not related to each other.


Porifera
Cnidaria
Bryozoa
Platyhelminthes
Nematod
Mollusca
Annelida
Onychophora
Arthropoda
Echinodermata
Chordata
Lophophore
Trochophore
Moulting
Lophotrohozoa
Ecdysozoa
Spiral, blastopore mouth, schizocoel
Spiral, blastopore mouth, enterocoel
Diploblastic, radial
Triploblastic, bilateral
No tissues
Tissues
Phylogeny of animals
(Fig 26.6)
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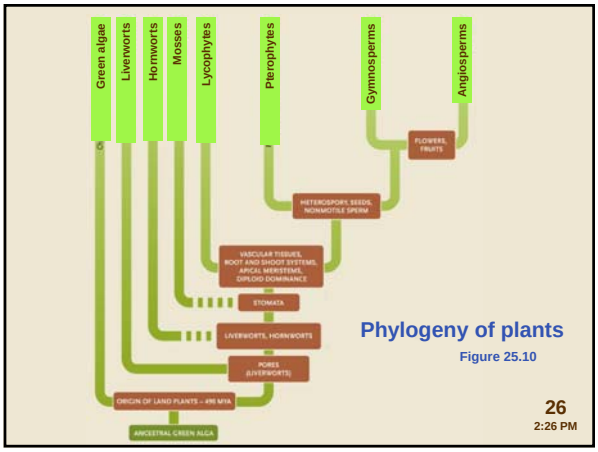
Green algae
Liverworts
Hornworts
Mosses
Lycophytes
Pterophytes
Gymnosperms
Angiosperms
FLOWERS, FRUITS
HETEROSPORY, SEEDS, NONMOTILE SPERM
VASCULAR TISSUES, ROOT AND SHOOT SYSTEMS, APICAL MERISTEMS, DIPLOID DOMINANCE
STOMATA
LIVERWORTS, HORNWORTS
PORES (LIVERWORTS)
ORIGIN OF LAND PLANTS – 490 MYA
ANCESTRAL GREEN ALGA
Phylogeny of plants
Figure 25.10
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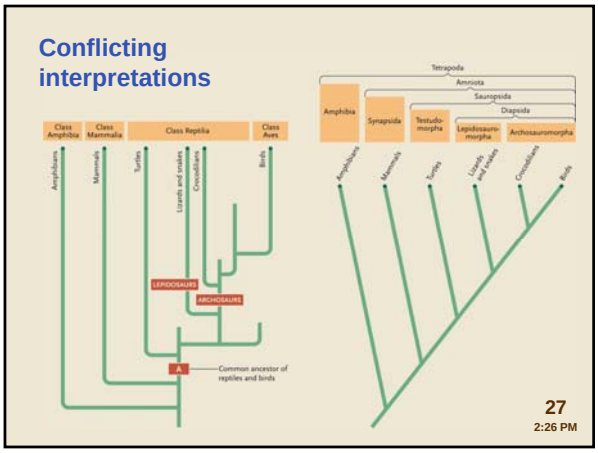
Conflicting interpretations
Class Amphibia
Class Mammalia
Class Reptilia
Class Aves
Amphibians
Mammals
Turtles
Lizards and snakes
Crocodilians
Birds
LEPIDOSAURS
ARCHOSAURS
A
Common ancestor of reptiles and birds
Tetrapoda
Amniota
Sauropsida
Diapsida
Amphibia
Synapsida
Testudo-morpha
Lepidosauro-morpha
Archosauromorpha
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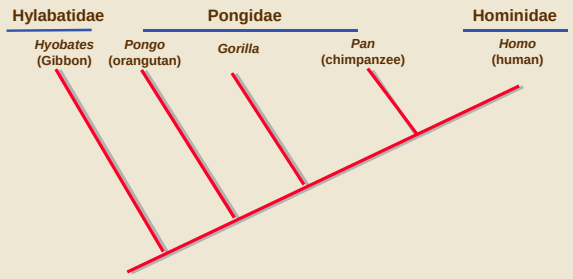
Conflicting interpretations



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Cladogram construction

	Springtail	Silver fish	Dragon fly	Cockroach	Beetle	Fly	
0							Double jointed mandible
0							Two pairs of wings
0							Folding wing mechanism
0							Metamorphosis
0							Reduction of wings to haltere

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Springtail will become the outgroup, scores 0 on all traits.

everything will be compared to this

Cladogram construction

	Springtail	Silver fish	Dragon fly	Cockroach	Beetle	Fly	
0	1						Double jointed mandible
0	0						Two pairs of wings
0	0						Folding wing mechanism
0	0						Metamorphosis
0	0						Reduction of wings to haltere

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Cladogram construction


Springtail Silver fish Cockroach

0	1	1				Double jointed mandible
0	0	1				Two pairs of wings
0	0	1				Folding wing mechanism
0	0	0				Metamorphosis
0	0	0				Reduction of wings to haltere

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Cladogram construction



Springtail Silver fish Cockroach Fly

0	1	1	1			Double jointed mandible
0	0	1	1			Two pairs of wings
0	0	1	1			Folding wing mechanism
0	0	0	1			Metamorphosis
0	0	0	1			Reduction of wings to haltere

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Cladogram construction




Springtail Silver fish Cockroach Fly Dragon fly

0	1	1	1	1		Double jointed mandible
0	0	1	1	1		Two pairs of wings
0	0	1	1	0		Folding wing mechanism
0	0	0	1	0		Metamorphosis
0	0	0	1	0		Reduction of wings to haltere

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Cladogram construction

Springtail	Silver fish	Cockroach	Fly	Dragon fly	Beetle	
0	1	1	1	1	1	Double jointed mandible
0	0	1	1	1	1	Two pairs of wings
0	0	1	1	0	1	Folding wing mechanism
0	0	0	1	0	1	Metamorphosis
0	0	0	1	0	0	Reduction of wings to haltere

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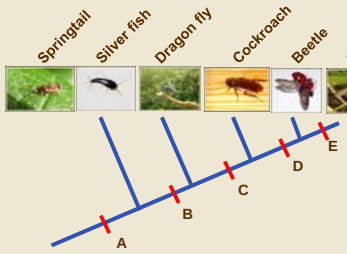
Cladogram construction

	Springtail	Silver fish	Dragon fly	Cockroach	Beetle	Fly
A	0	1	1	1	1	1
B	0	0	1	1	1	1
C	0	0	0	1	1	1
D	0	0	0	0	1	1
E	0	0	0	0	0	1



A - Double jointed mandible
B - Two pairs of wings
C - Folding wing mechanism
D - Metamorphosis
E - Reduction of wings to haltere

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Parsimony – The KISS principle

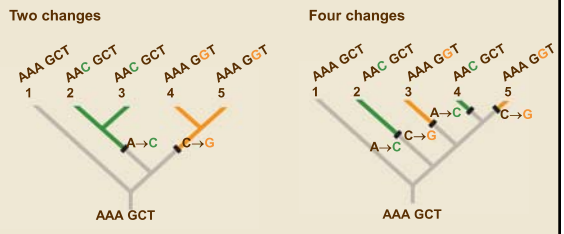

Figure 27-3

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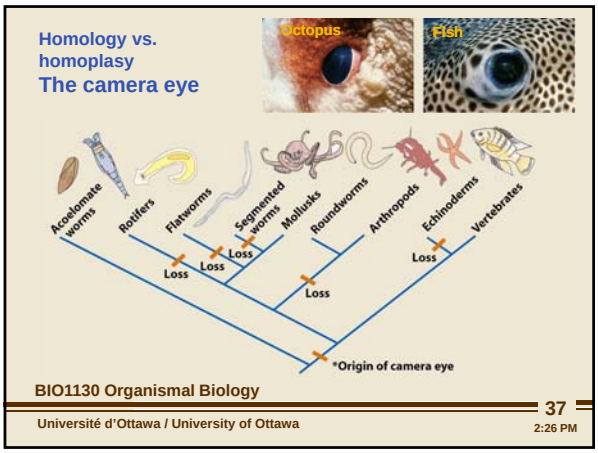
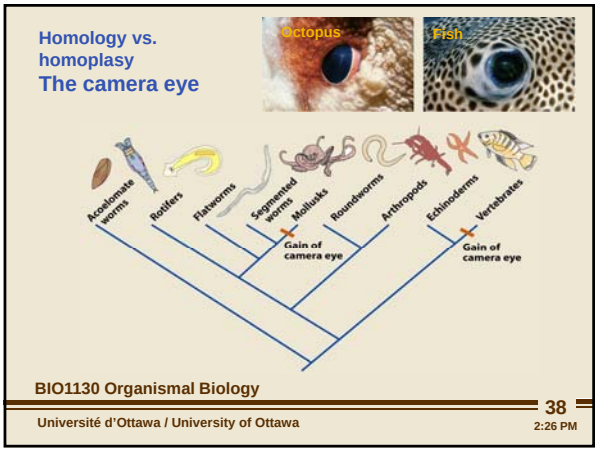
some organisms will have the same score, need to break the tie.

use parsimony to break the tie between the two organisms.

the second diagram is not considered to be parsimonious because it is not the simplest form



camera eye: occurs in octopus and vertebrate.



this is the better evolutionary tree than the one before it because it has the simplest events. only 2 rather than a bunch.