Taxonomy and Pylogenetics

Taxonomy - Biological Classification

- First invented in 1700's by Carolus Linneaus for organizing plant and animal species.
- Based on overall anatomical similarity.
- Similarity due to the "blueprint" of Creation.

Through classification we discover the great plan of Creation.

Taxonomy

- Arranging organisms into a hierarchy of categories.

Kingdom Animalia
Phylum Chordata
Class Mammalia
Order Primates
Family Hominidae

Genus Homo
species sapiens

Note: species name has two parts (binomen). Only genus is capitalized, but both are italicized.

Taxonomy

- Arranging organisms into a hierarchy of categories.

Kingdom Animalia
Phylum Chordata
Class Mammalia
Order Primates
Family Hominidae
Genus Homo
species erectus

Note: species name has two parts (binomen). Only genus is capitalized, but both are italicized.

Evolution - The idea that species are related by descent.

- New species have arisen from existing species.
- Species appear with new adaptations through time.
- Similarities between species reflect their history of descent.
- Species look alike because they share a common ancestor.

Erasmus Darwin (1731-1802)

Organisms modify themselves to suit their immediate needs.

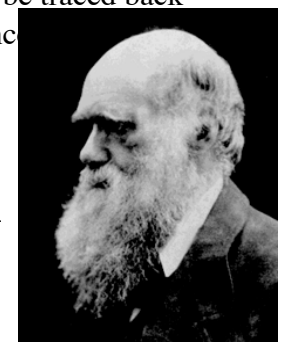
These modifications are passed on to the offspring.

Jean Baptiste de Lamarck (1744-1829)

The modern theory of evolution was first developed by Charles Robert Darwin (1809-1882).

- Darwin saw the similarities shared between species as evidence for having evolved from the same ancestor species.
- Darwin realized that all species could be traced back through time to an original, shared, anc

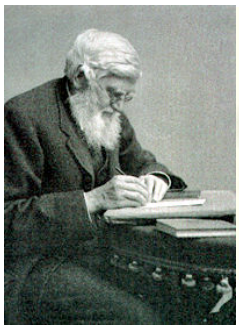
"...from so simple a beginning endless forms most beautiful and most wonderful have been, and are being evolved."



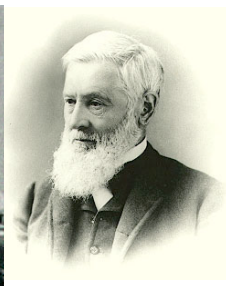
Darwin himself pointed out that if all species are related to one another by evolutionary descent, then the only basis for classification that was meaningful was one based on evolutionary ancestry or **Phylogeny**.

In spite of their new evolutionary view of life, Darwin's contemporaries continued to classify species the way Linneaus did - by grouping species into a hierarchy of categories based on their anatomical similarities.

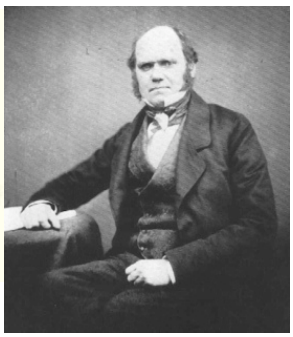
- Linnean or Phenetic Classification



Alfred Russell Wallace



Asa Gray



Charles Darwin

Phenetic (Linnean) Classification

- Compatible with evolution because closely related organisms tend to have similar traits.
- However, overall similarity can often hide evolutionary relatedness and criteria chosen are often arbitrary.

	Alligator	Sparrow	Tyran. rex	Lizard
K	Animalia	Animalia	Animalia	Animalia
P	Chordata	Chordata	Chordata	Chordata
C	Reptilia	Aves	Reptilia	Reptilia
O	Crocodylia	Passeriformes	Saurischia	Squamata
F	Crocodylidae	Fringillidae	Tyrannosauridae	Iguanidae
G	Alligator	Melospiza	Tyrannosaurus	Iguana
S	A. mississipp.	M. melodia	T. rex	I. iguana

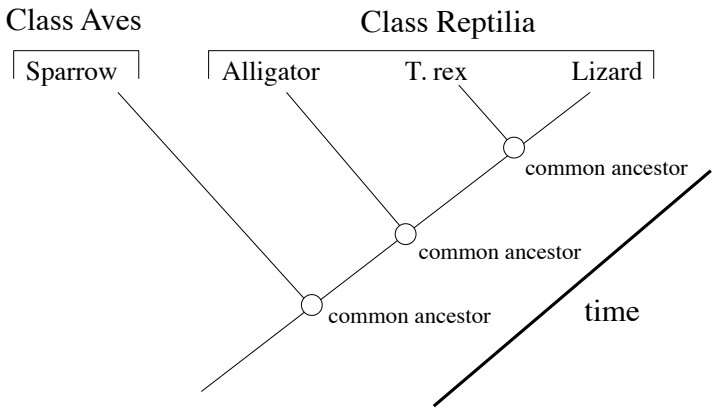
In the 1950's a German entomologist named Willi Hennig began outlining a new approach to classifying organisms that was based strictly on evolutionary relatedness.

•Phylogenetic Classification (Cladistics)

•Cladistics compares selected traits among a group of species to determine their pattern of evolutionary descent.
•Was controversial at first.
•Method is testable and falsifiable!
•Now universally accepted and used.

Willi Hennig

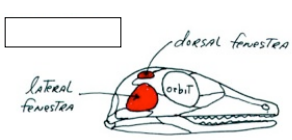
Cladogram
- a classification
- a hypothesis of descent

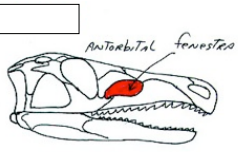


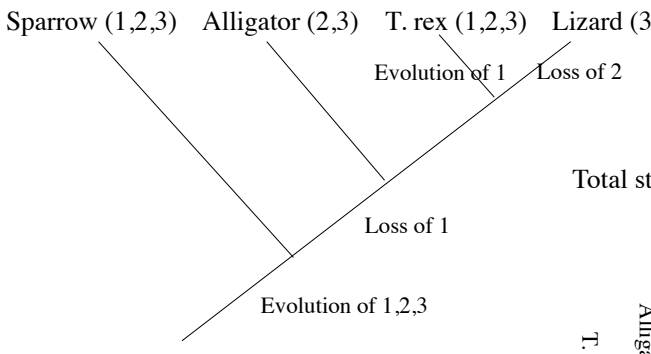
Cladistic Analysis

Character matrix for 3 reptiles and a bird

	T. rex	Alligator	Lizard	Sparrow
Three toed foot (1)	+			+
Antorbital fenestra (2)	+	+		+
Two holes in skull (3)	+	+	+	+

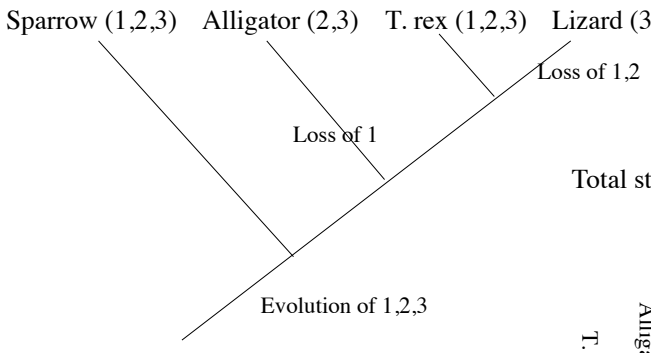






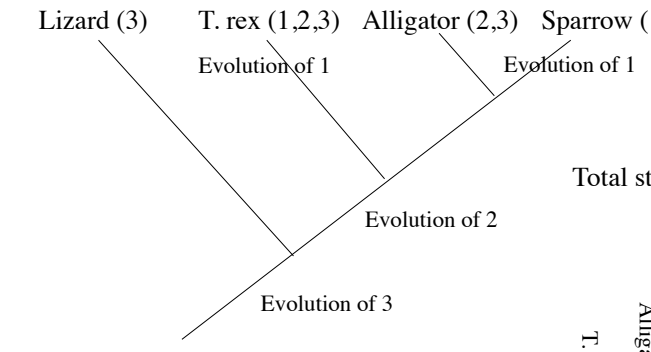
Total steps = 6

	T. rex	Alligator	Lizard	Sparrow
Three toed foot (1)	+			+
Antorbital fenestra (2)	+	+		+
Two holes in skull (3)	+	+	+	+



Total steps = 6

	T. rex	Alligator	Lizard	Sparrow
Three toed foot (1)	+			+
Antorbital fenestra (2)	+	+		+
Two holes in skull (3)	+	+	+	+

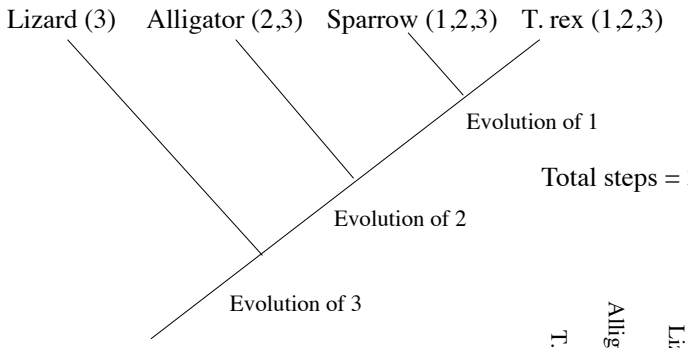


Total steps = 4

	T. rex	Alligator	Lizard	Sparrow
Three toed foot (1)	+			+
Antorbital fenestra (2)	+	+		+
Two holes in skull (3)	+	+	+	+

Homoplasy

Independent evolution of the same character in two groups



Total steps = 3

Most Parsimonious Tree!

	T. rex	Alligator	Lizard	Sparrow
Three toed foot (1)	+			+
Antorbital fenestra (2)	+	+		+
Two holes in skull (3)	+	+	+	+

Phylogenetic Classification ("cladistics")

- Only basis for grouping species (classification) is degree of evolutionary relatedness.
- Similarities are the clues that point to relatedness.
- Similar traits shared between species represent evolutionary events.
- Gaining or losing a trait counts as a step in evolution.
- Species are arranged on a "tree" showing their relative evolutionary relatedness.
- Many trees are possible, only one is correct.
- The tree that requires the least number of evolutionary steps is most probably the correct one.
- Simplest tree or cladogram is the most parsimonious.

Phenetic (Linnean) Classification

	Alligator	Sparrow	Tyran. rex	Lizard
K	Animalia	Animalia	Animalia	Animalia
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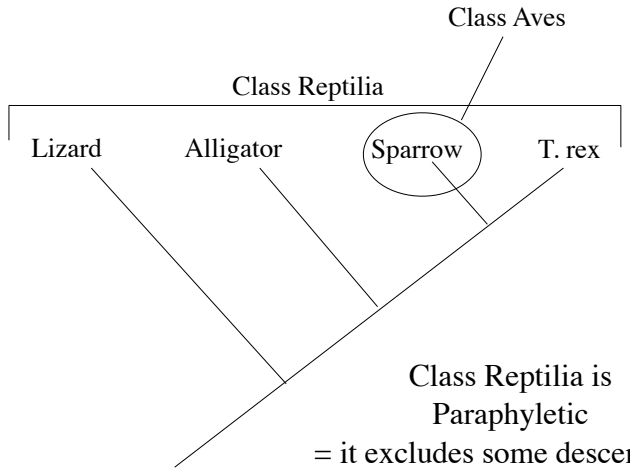
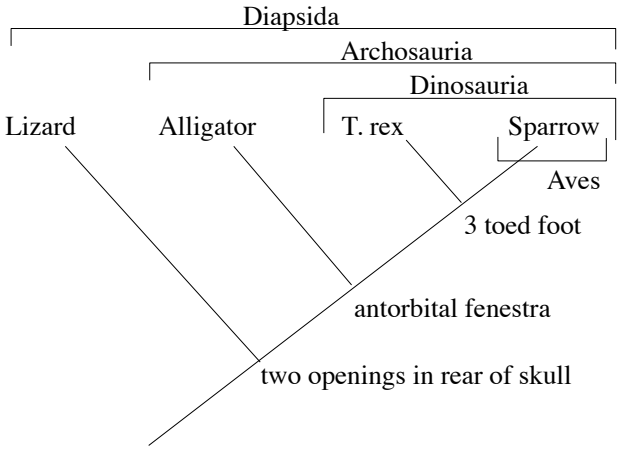
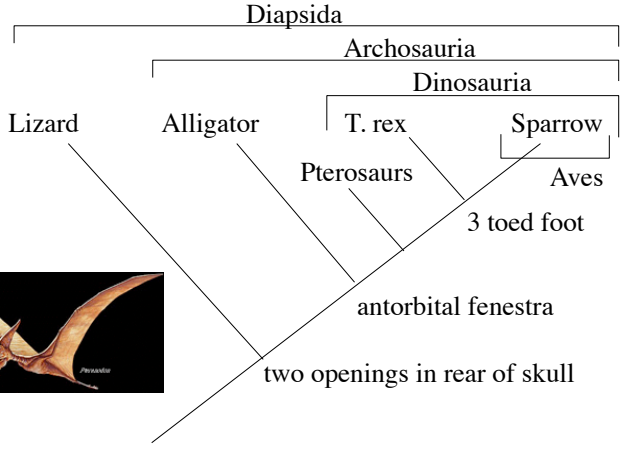


Class Reptilia is
Paraphyletic
= it excludes some descendants

Cladistic Classification



Cladistic Classification



Cladistic Classification

Cladistic Classification

Phenetic (Linnean) Classification	Phylogenetic Classification
Phylum Chordata	Diapsida
Subphylum Vertebrata	Archosauria
Class Aves	Ornithodira
Melospiza melodia	Dinosauria
	Aves
	Melospiza melodia

Path of Evolutionary Descent