



Evolution of Amphibians

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Paleozoic		Mesozoic		Cenozoic	
Devonian	Carboniferous	Permian	Triassic	Jurassic	Cretaceous
416	360	300	250	200	146
↑					


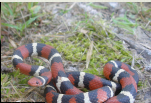

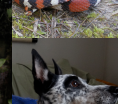
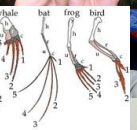

Objectives


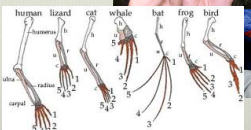
- ❖ Define Tetrapod/Amphibian
- ❖ Origin of Tetrapods
- ❖ Tetrapod Advantages
- ❖ Split of Amphibians
- ❖ First Modern Amphibians
- ❖ Extant Families
- ❖ Simplification

Tetrapod Characteristics

- ❖ Four Limbs
 - ❖ Tetra= Four; Pod=Foot
 - ❖ Some lost or vestigial
- ❖ "One bone → two bones → little blobs → fingers/toes". Neil Shubin
 - ❖ Some lost or vestigial
- ❖ Includes all non-fish vertebrates










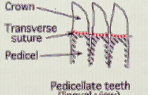




Amphibian Characteristics

"Tetrapod vertebrates that pass through a larval state and undergo metamorphosis into terrestrial adults."

- Anamniotes
 - Eggs need moist environment
- Larval; metamorphosis
- Permeable Skin
 - Cutaneous respiration
- Two Gland Types
 - Mucous
 - Poison
- Pedicellate Teeth
- Amphibian papillae/Opercular bone
 - Can Hear Vibrations
- Fat Bodies
- Green Rods- fxn unknown
- Singular Sacrum
 - Lost in caecilians


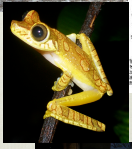
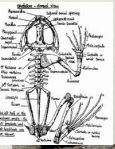





Pedicellate teeth (lingual view)

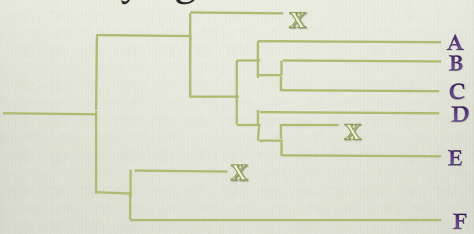
Amphibian Characteristics

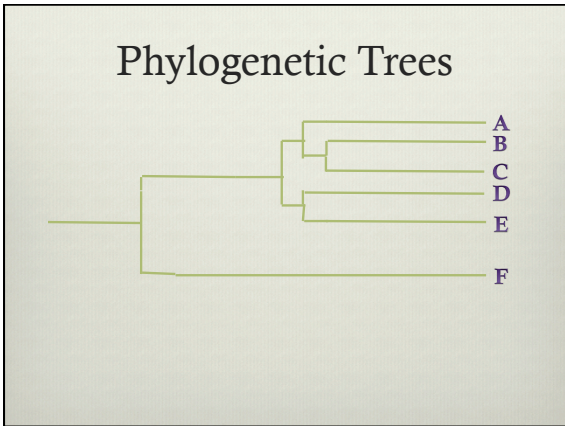
As a Fossil...

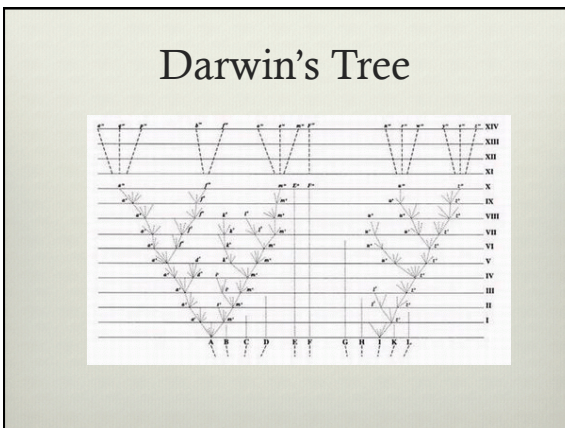
- ❖ Articular surface of axis convex
- ❖ Exoccipital Bone articulates with dermal roofing
- ❖ Hand (Manus) 4 digits
- ❖ Foot (Pes) 5 digits
- ❖ Some Secondarily Lost

Phylogenetic Trees







Geologic Time Scale

ERA	PERIOD	EPOCH	Ma	
Cenozoic	Quaternary	Holocene	Late 0,011	
		Pleistocene	Late 2.4	
	Pliocene	Early	5.2	
		Late	3.6	
	Miocene	Early	16.4	
		Middle	11.2	
	Oligocene	Early	28.3	
		Late	23.0	
	Eocene	Early	54.0	
		Middle	49.8	
	Paleocene	Early	65.0	
		Late	65.5	
	Mesozoic	Cretaceous	Early	99.0
			Late	145
Jurassic		Middle	162	
		Early	176	
Triassic		Middle	200	
	Early	228		
Permian	Early	251		
	Late	260		
Pennsylvanian	Early	292		
	Middle	299		
Mississippian	Early	311		
	Late	318		
Carboniferous	Early	336		
	Late	355		
Devonian	Early	369		
	Late	372		
Silurian	Early	392		
	Late	416		
Ordovician	Early	423		
	Middle	438		
Cambrian	Early	444		
	Middle	488		
Precambrian	Proterozoic	Early	542	
		Late	542	
Precambrian	Proterozoic	Early	1000	
		Late	1000	
Precambrian	Proterozoic	Early	1600	
		Late	1600	
Precambrian	Proterozoic	Early	2500	
		Late	2500	
Precambrian	Proterozoic	Early	3200	
		Late	3200	
Precambrian	Proterozoic	Early	4000	
		Late	4000	

Paleozoic			Mesozoic		Cenozoic
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Devonian: Age of Fishes

- ❖ Lobed-Finned Fishes
- ❖ Lungfishes; Coelacanths
- ❖ Tetrapodomorpha
- ❖ Panderichthyids
 - ❖ *Ichthyostega*, *Acanthostega*
 - ❖ **Tetrapods**

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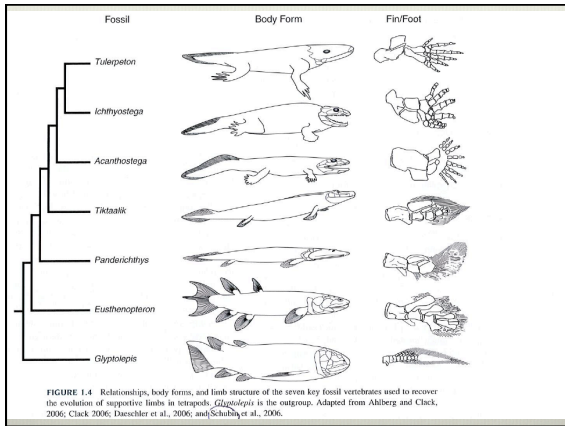
Tetrapod Adaptations Or Exaptations?

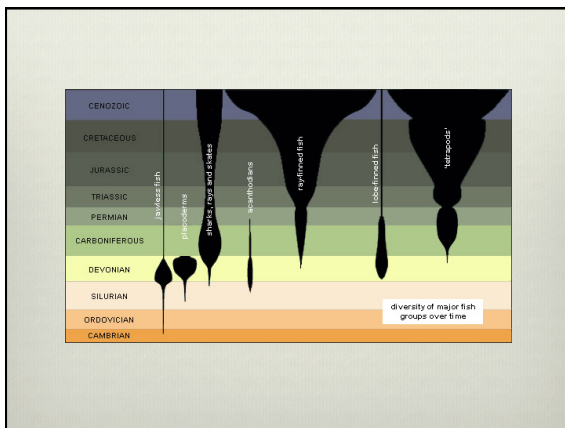
- Lungs
 - ❖ Earliest Adaptation
- Limbs*
 - ❖ Movement and support
 - ❖ Pectorals first
- Free movement of head*
 - ❖ Functional neck
 - ❖ Feeding and catching prey

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Tetrapod Advantages



- ❖ (1) Unexploited resources
- ❖ (2) Low Oxygen in warm shallow swamps
- ❖ (3) Periodic drought- move between pools





Devonian: Fish to Tetrapod

- ❖ Panderichthyids 380 mya
 - ❖ Predators in shallow water
 - ❖ Eyes on top of head
 - ❖ Lung and Gills
 - ❖ Dorsoventrally Flattened*
 - ❖ Pectoral Fins more developed for support/crawling

Lepospondyli ~300 mya

Microsaurs
Nectrideans

Fig. 1.8. Representative Carboniferous and Permian lepospondyls. A-C are microsaurs. (A) *Tadlanus*. (B) *Pantylus*. (C) *Goniatrychus*. (D) *Ophiderpeton*, a snake-like allostegid. (E) *Sauripterus*, an aquatic nectridean. (F) *Diplacawalus*, a bizarre horned nectridean from early Permian deposits in Oklahoma and Texas. A-C after Alter Pough, Heise, and McFarland (1996). D-F from Benton (1996).

Temnospondyli 330-120 mya



Fig. 1.6. Representative temnospondyls. (A) *Fryxys*, a terrestrial disorophid from the Permian. (B) *Cacops*, another terrestrial disorophid from the Permian. (C) *Cyclotosaurus*, an aquatic crocodile-like captorhinid from the late Triassic. Scale lines indicate 10 cm. (D) *Branchiosaurus*, a paedomorph or larval temnospondyl from the early Permian, with external gills similar to those of modern larval or paedomorph salamanders. Scale line for (D) indicates 5 cm. After Pough, Heise, and McFarland (1996).

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Triassic- Aquatic Shift 245mya

- ❖ Temnospondyli: **Stereospondyli***
 - ❖ Only remaining Temnospondyls
 - ❖ All mostly aquatic
 - ❖ Terrestrial Reptiles dominated
 - ❖ Miniaturization through progenesis
 - ❖ Scales and Dermal Armor
 - ❖ Still much Diversity
 - ❖ One group marine

Lissamphibia: Modern Amphibians*

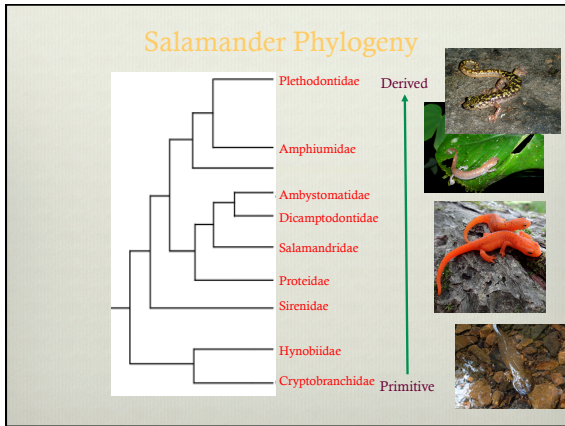
- ❖ Class: Amphibia
 - ❖ Monophyletic (most likely)
 - ❖ Caecilians
 - ❖ Frogs
 - ❖ Salamanders
- ❖ First Appearance
 - ❖ *Triadobatrachus* (Frog) 245mya
 - ❖ Triassic

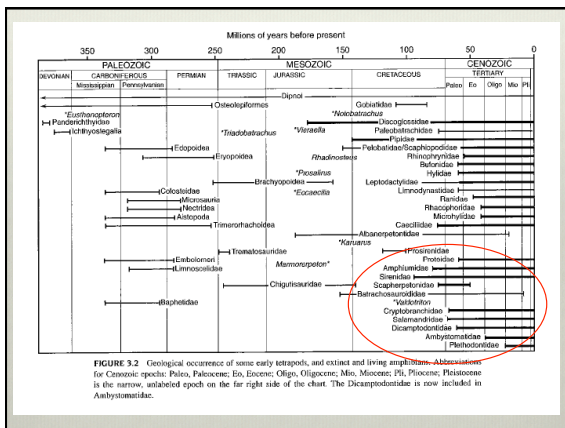
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Amphibia Evolution: Recap





Evolved Simplifications

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- ❖ Pronounced in Salamanders
- ❖ Pedomorphosis
- ❖ Reduction Body Size
- ❖ Large Genomes and Cells
- ❖ Low Metabolic Rates
 - ❖ Affect life history strategies
- ❖ Simplified Organ Systems