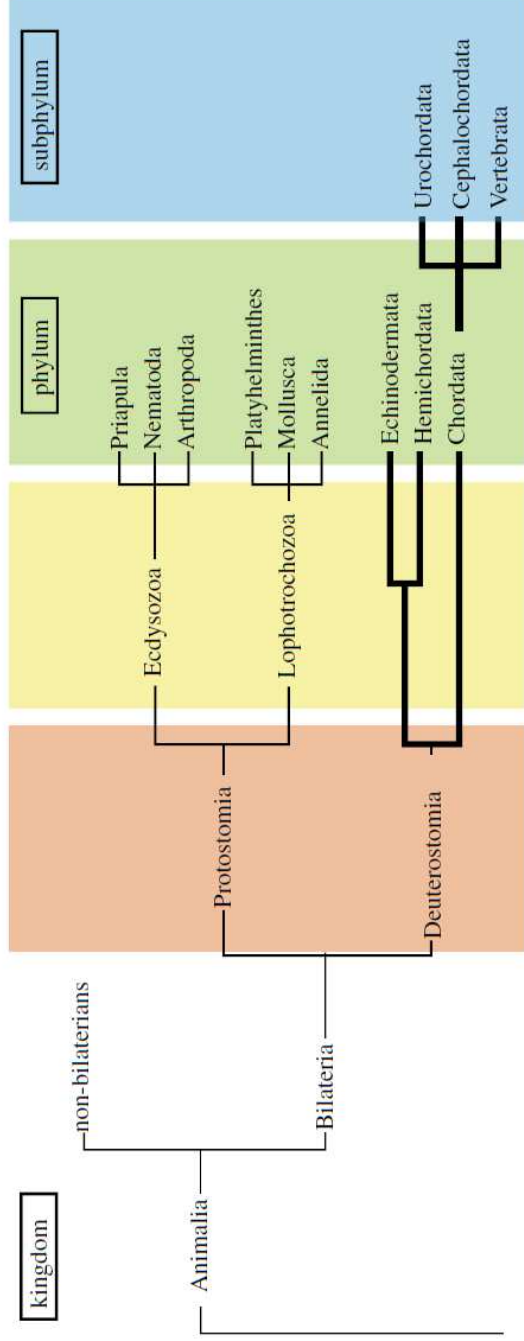


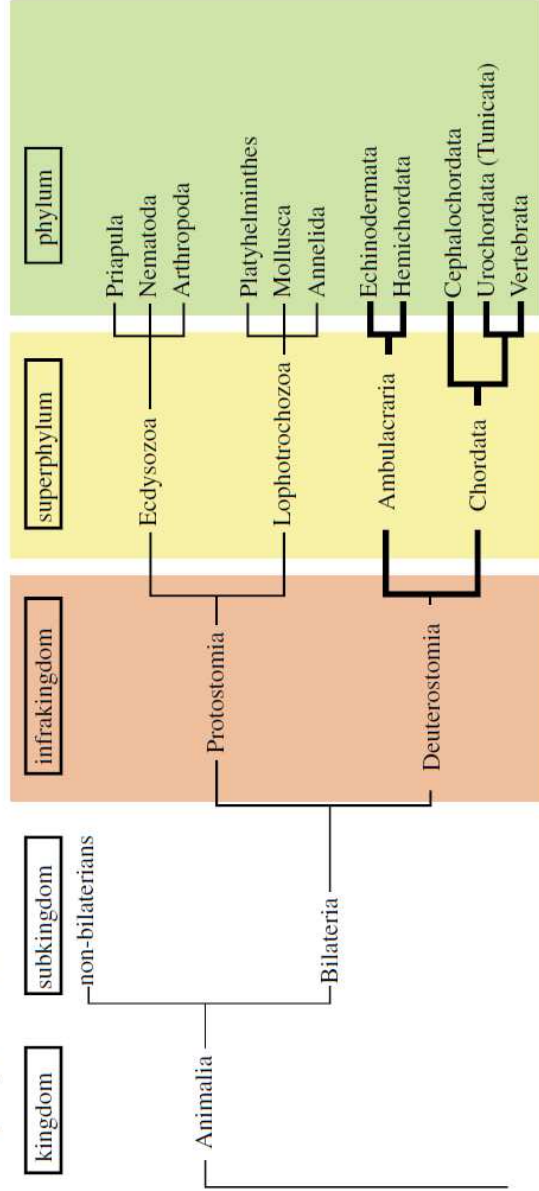
# Chordata

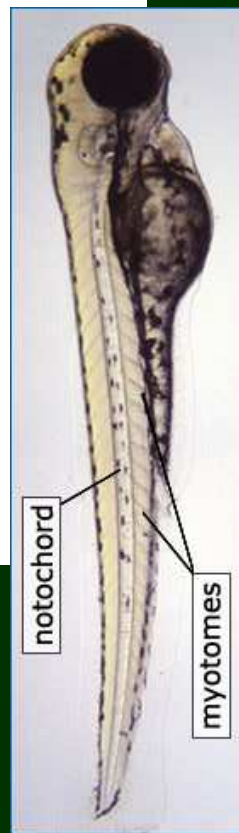
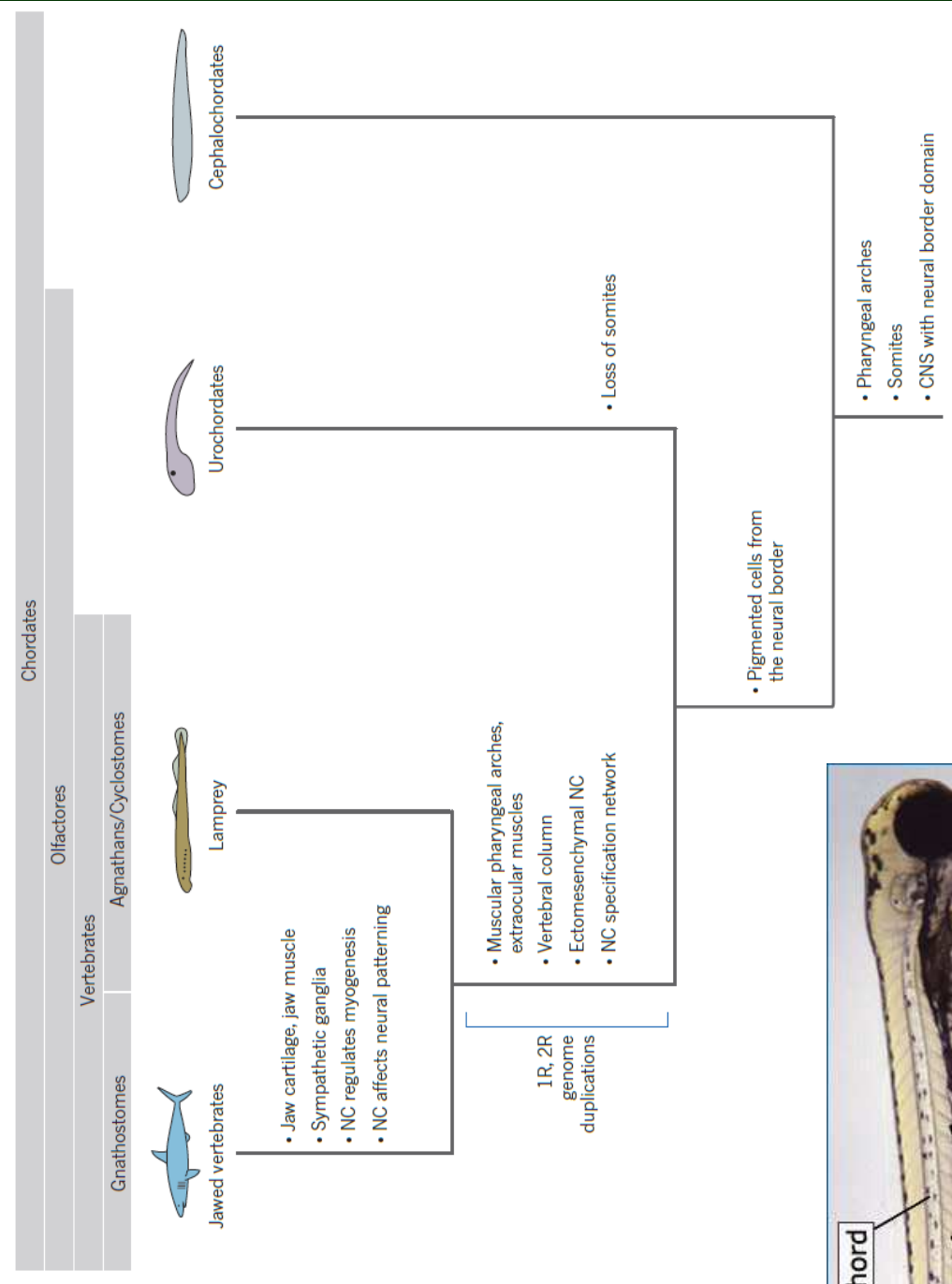


(b) current view

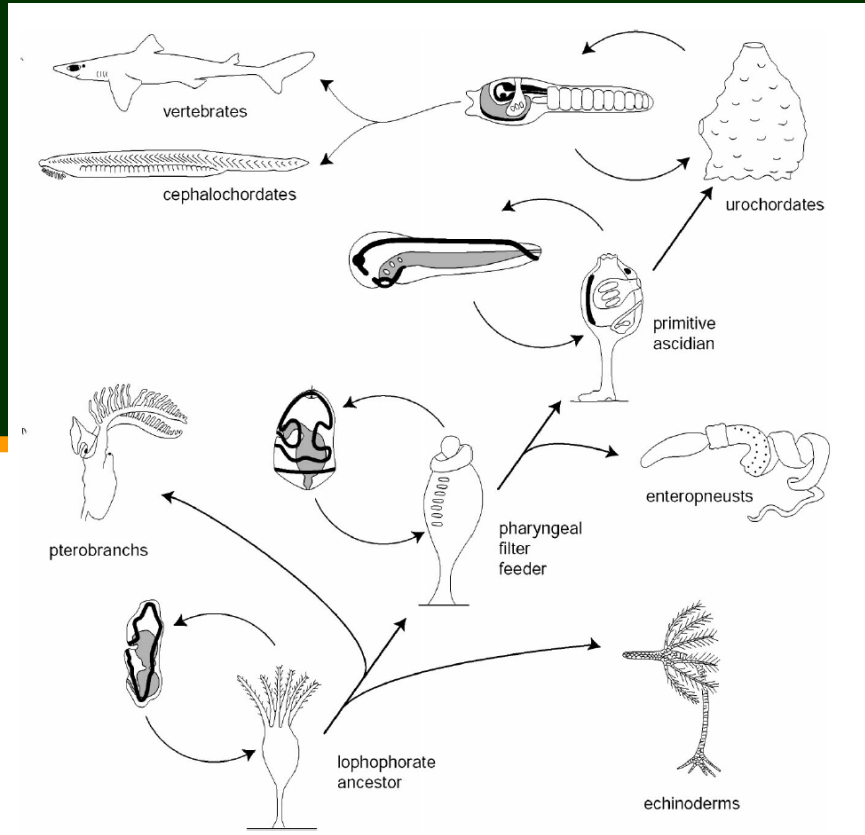
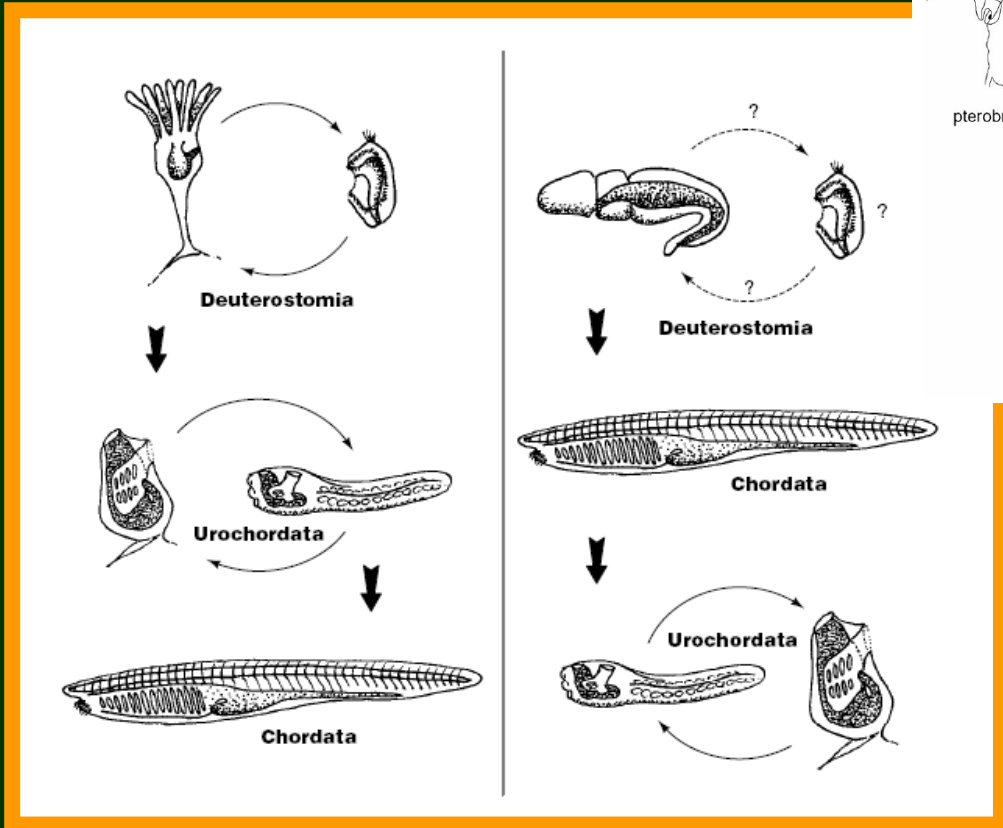


(c) a proposed view

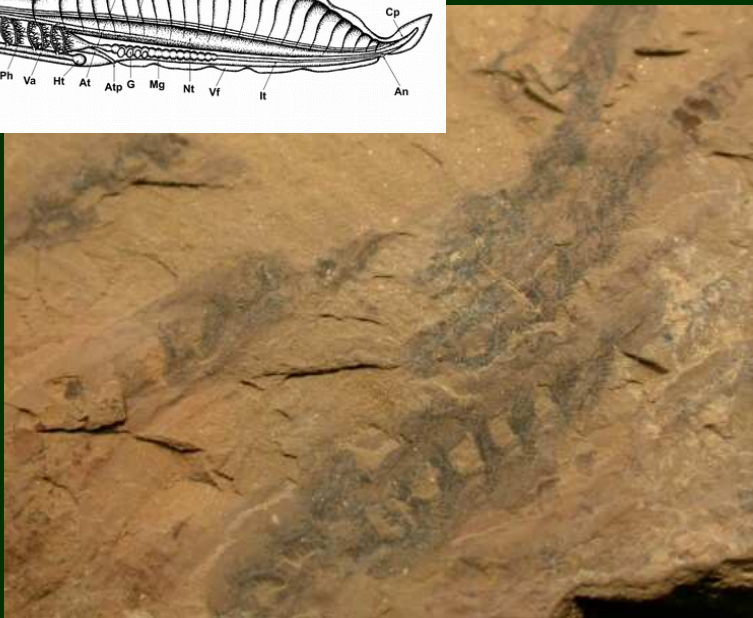
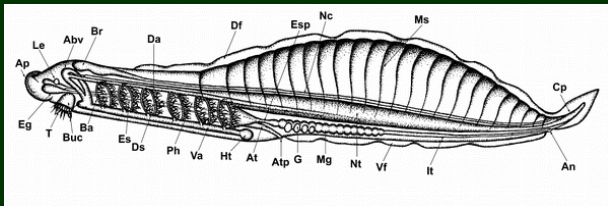




# Původ strunatců



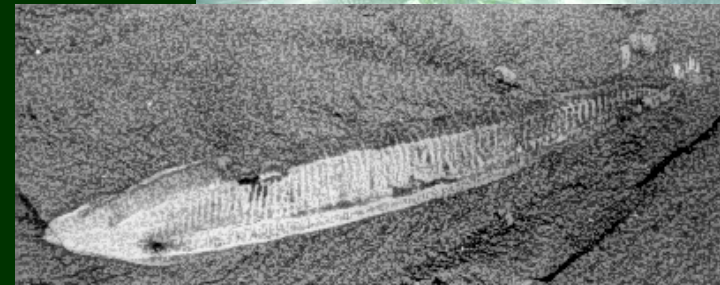
# Kambrijští strunatci



*Haikouella*



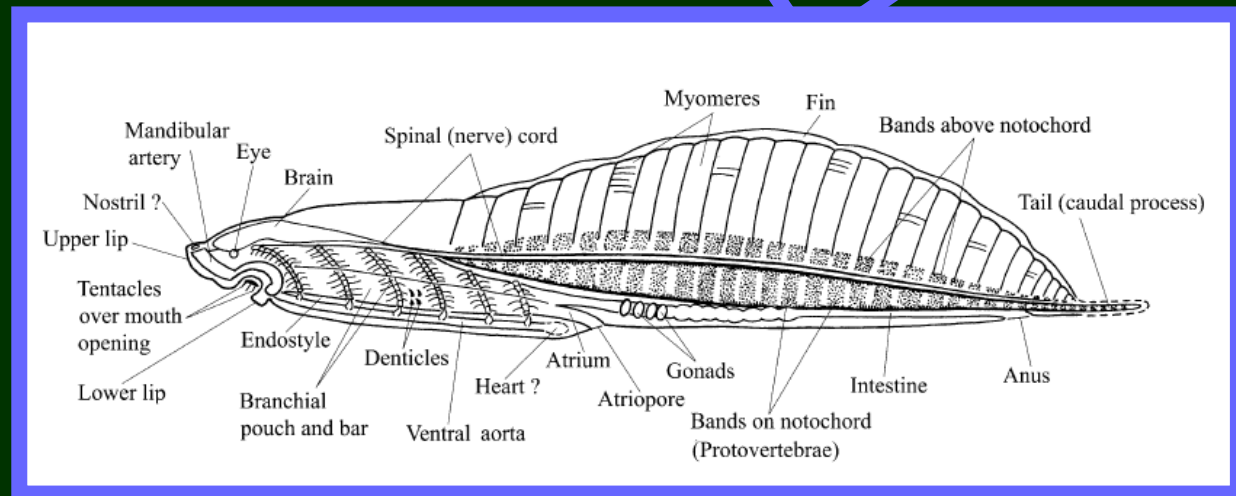
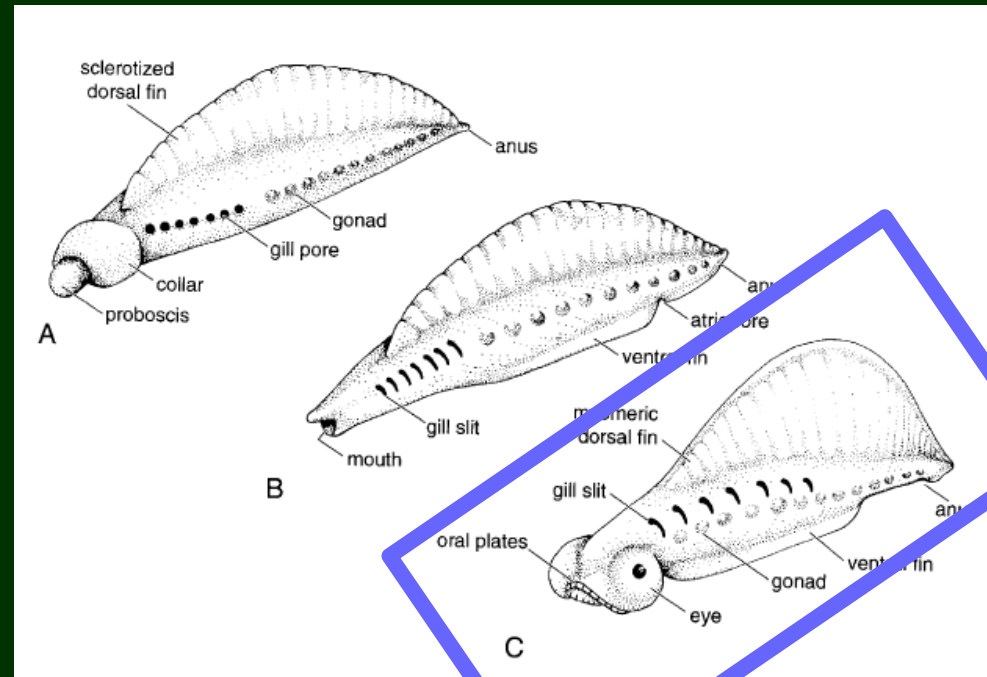
*Pikaia*



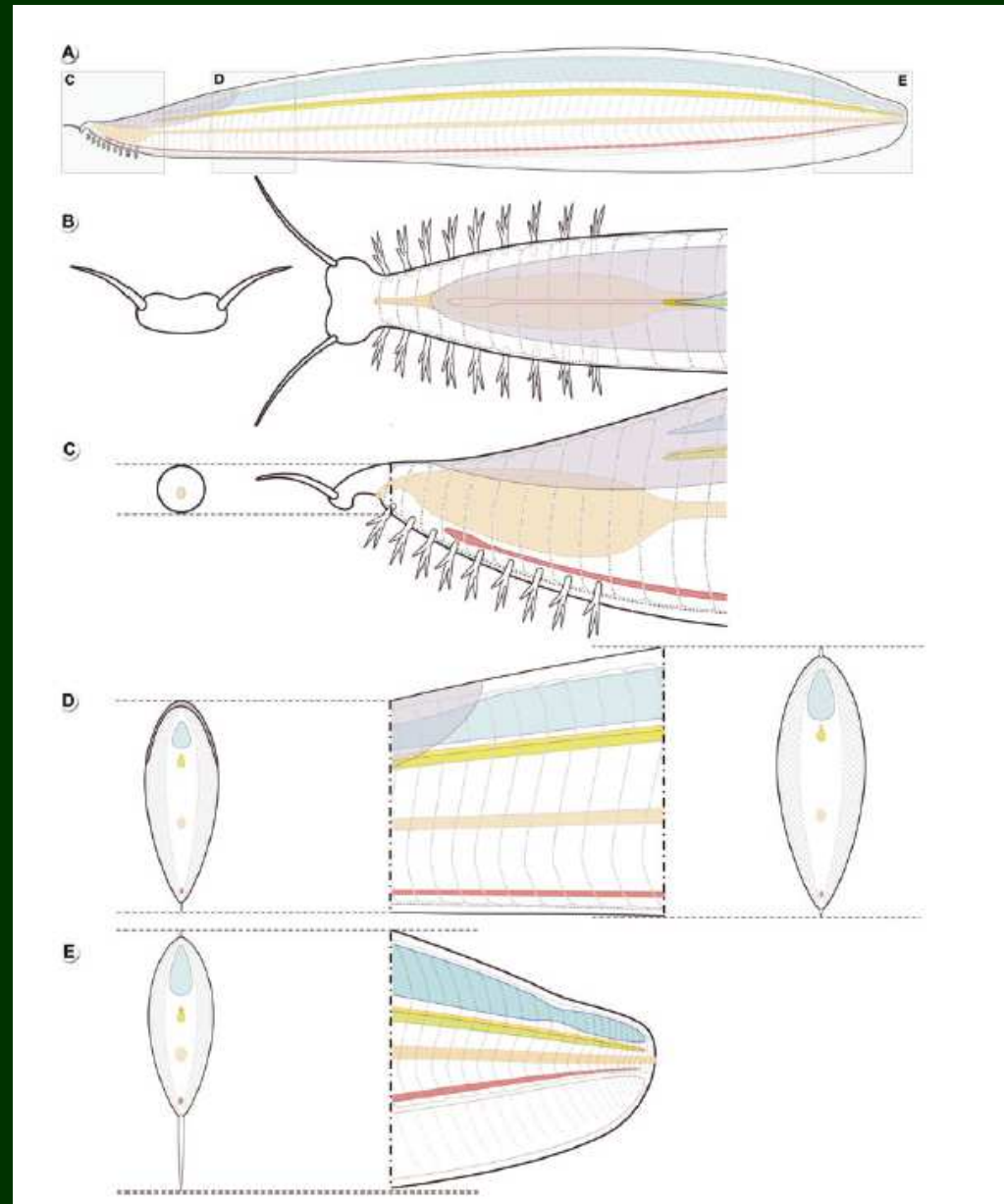
*Yunnanozoon*

# Yunnanozoa

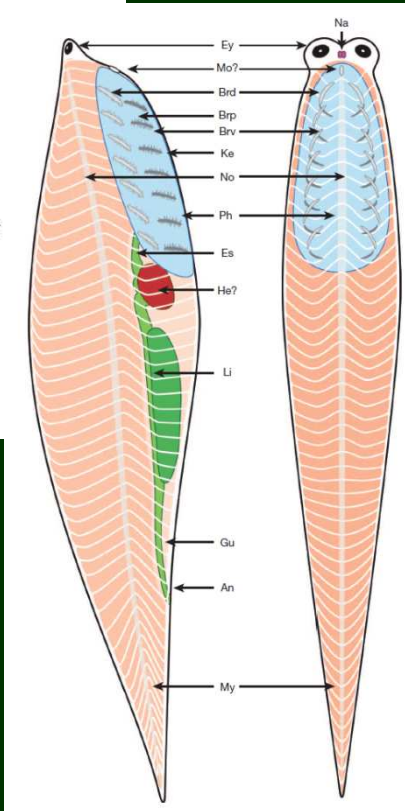
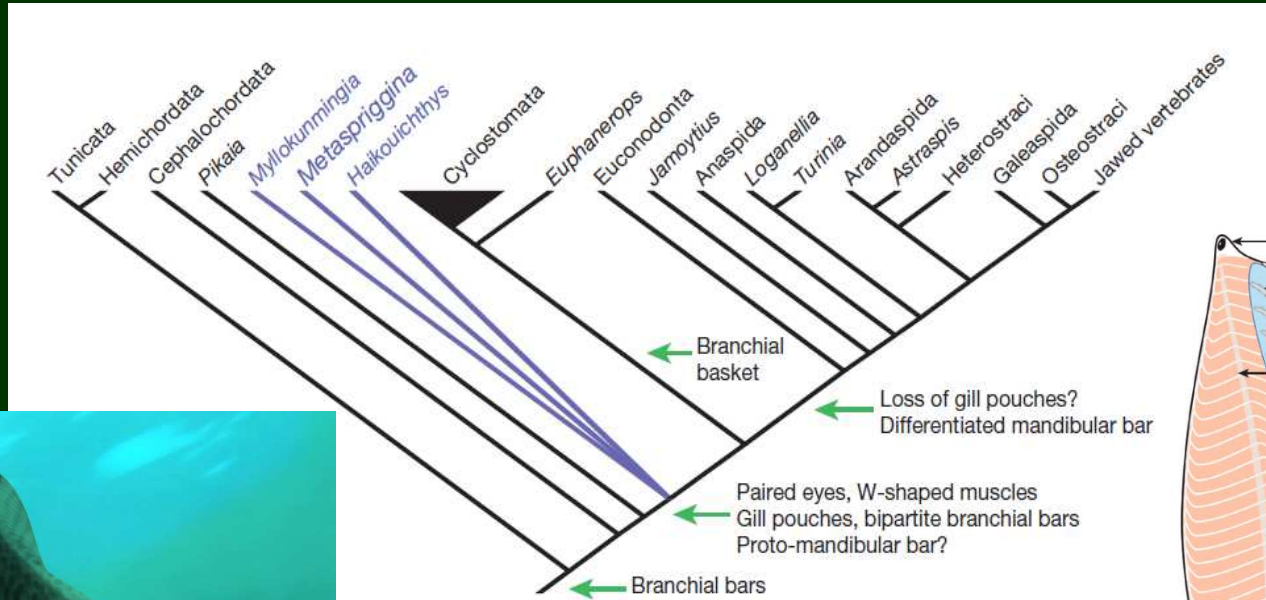
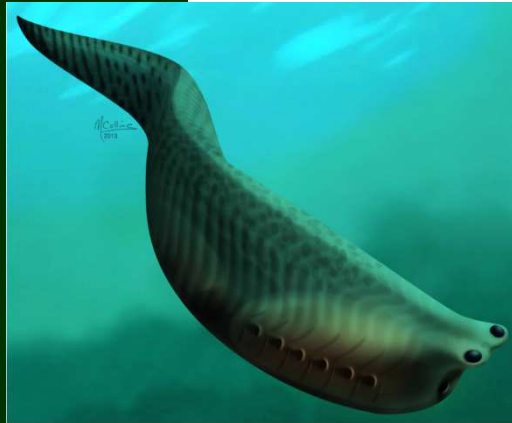
- rekonstrukce – polostrunatec, kopinatec, obratlovec
- *Haikouella*



# *Pikaia*

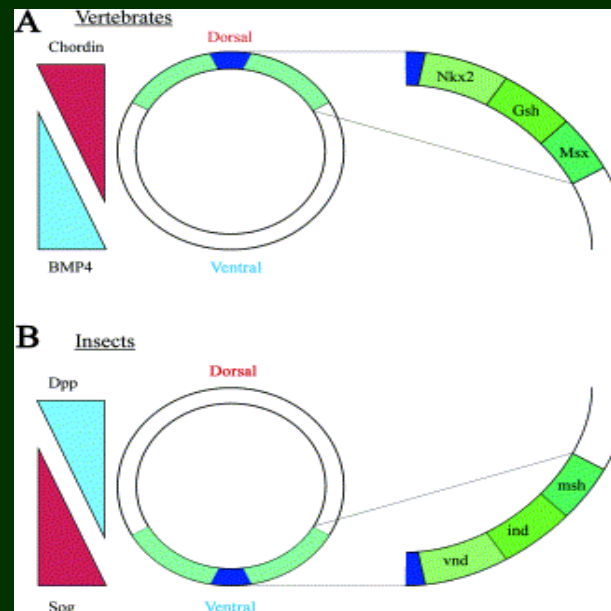
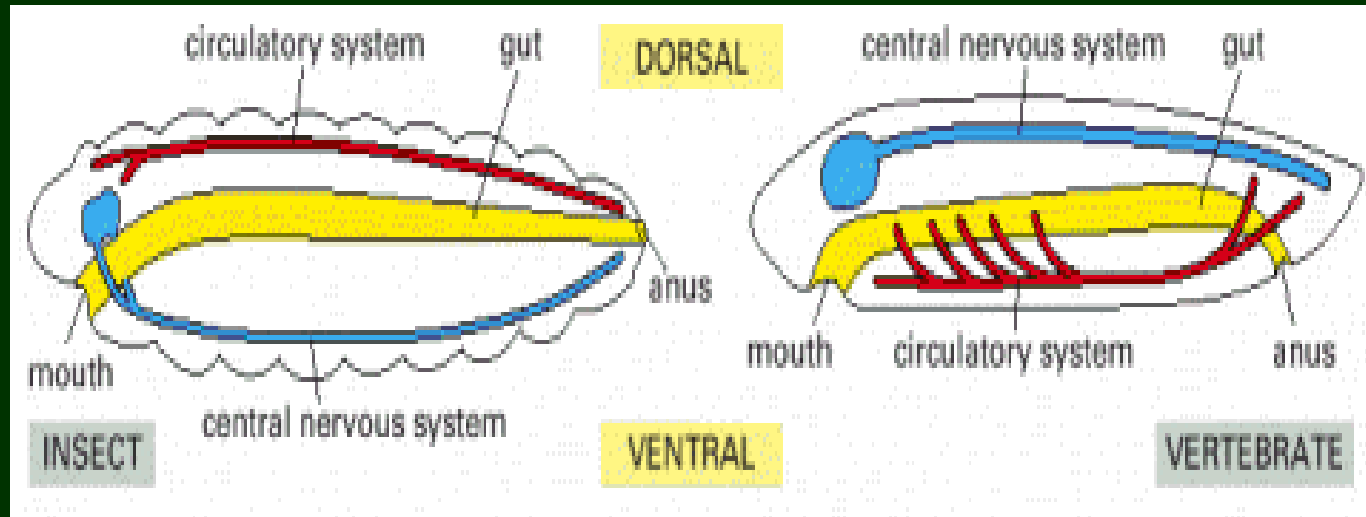


# Metaspriggina

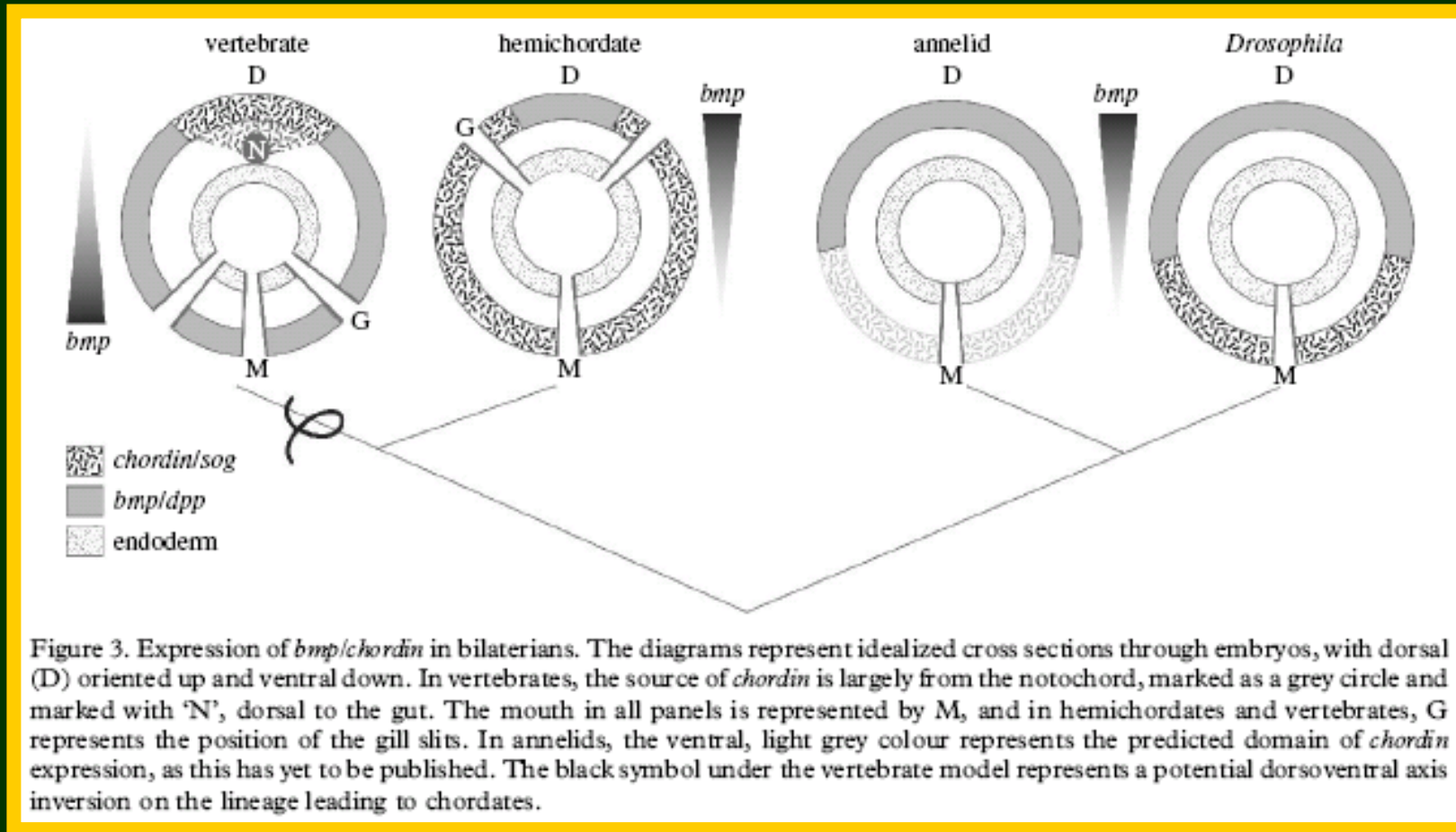


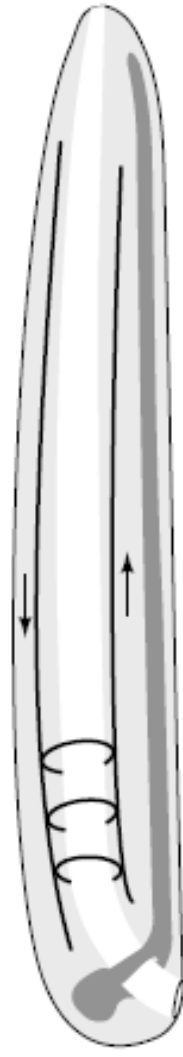


# Dorsoventrální inverze?

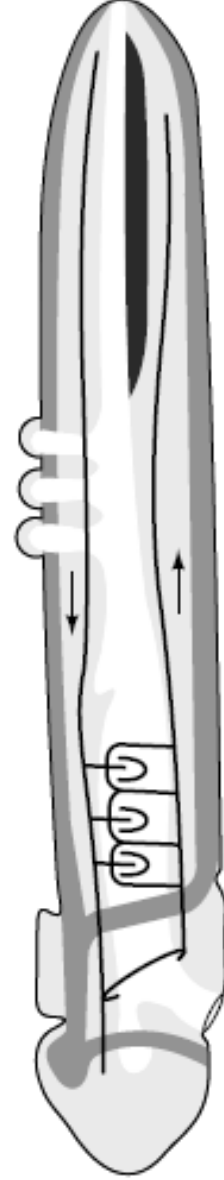


# Dorsoventrální inverze?









**Protostomia**



**Hemichordata**

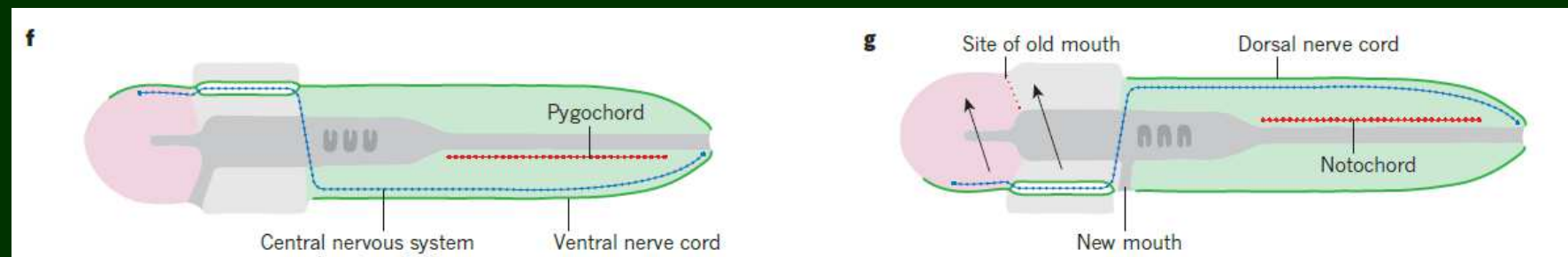
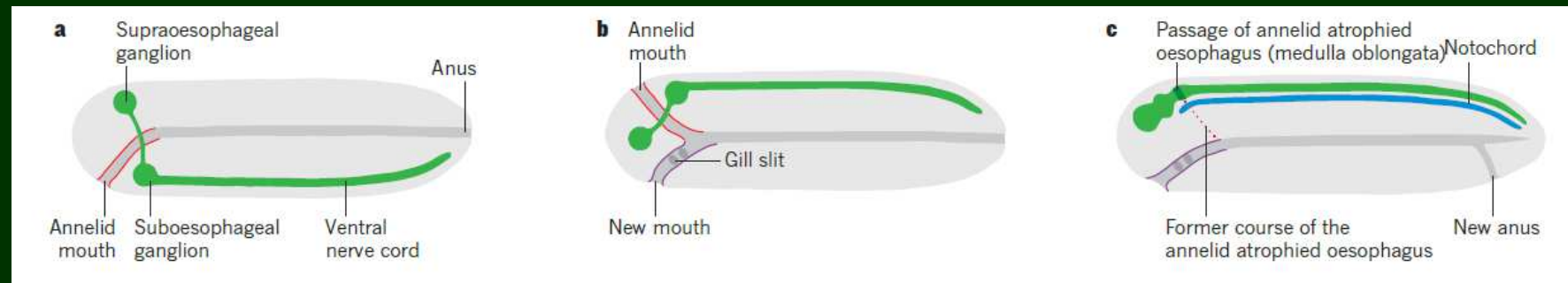
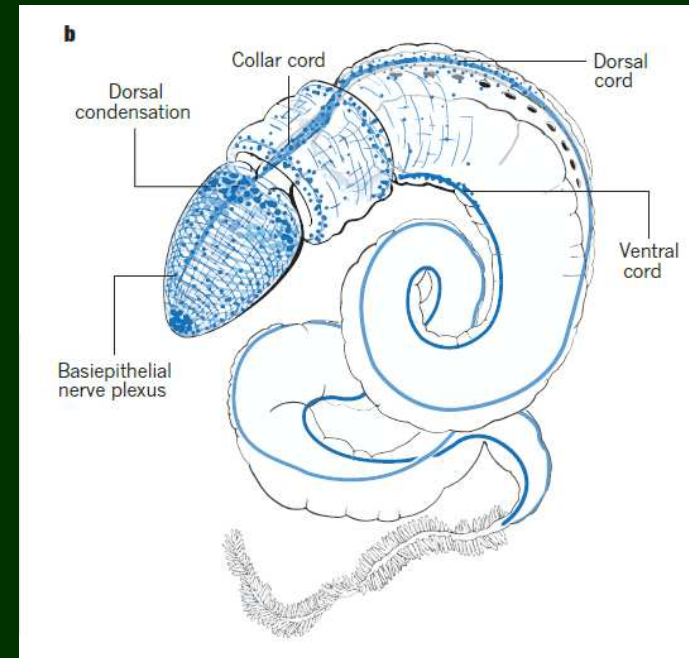


**Chordata**

-  trávící soustava
-  nervová soustava
-  notochord / pygochord
-  cévní soustava

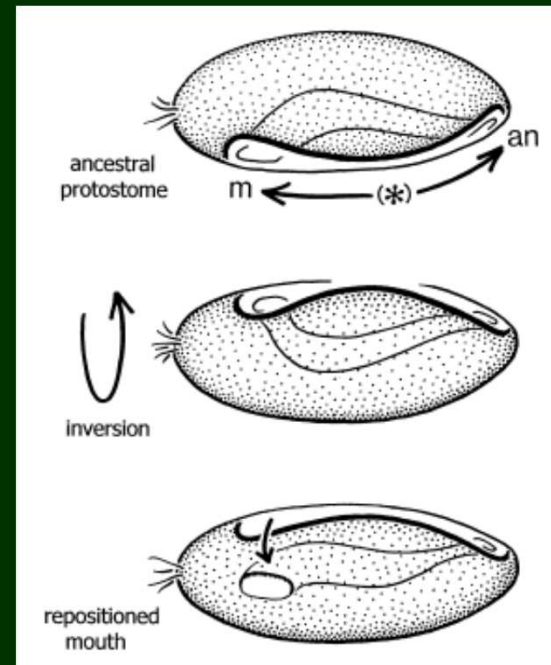
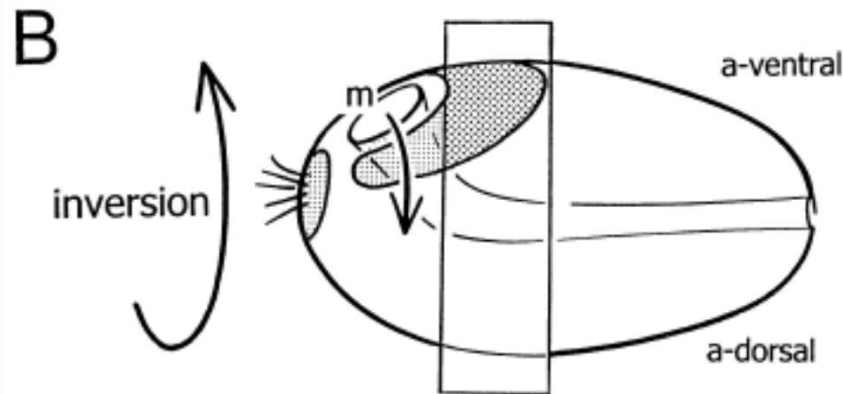
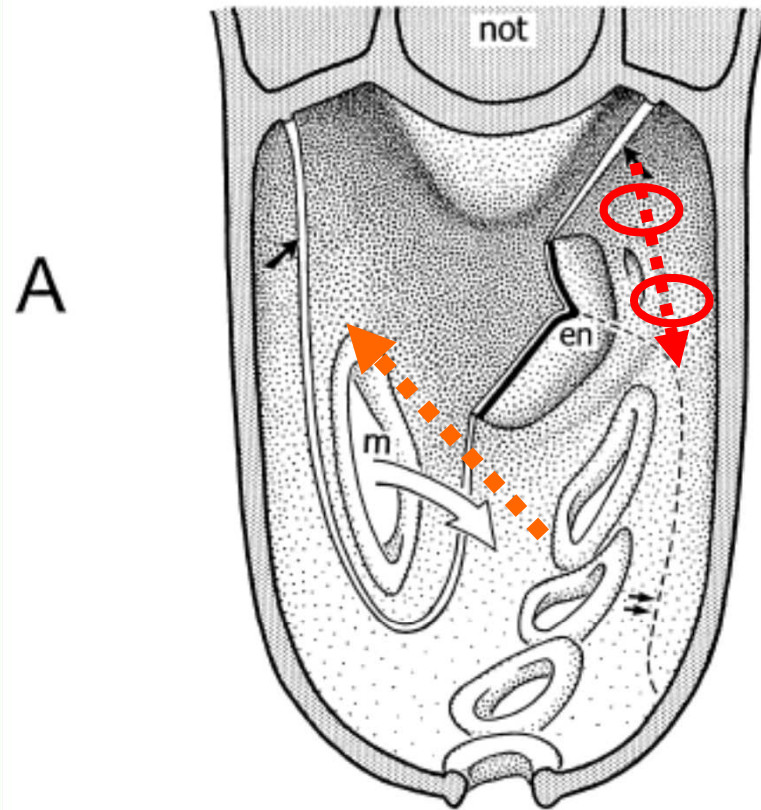
# Vznik strunatců

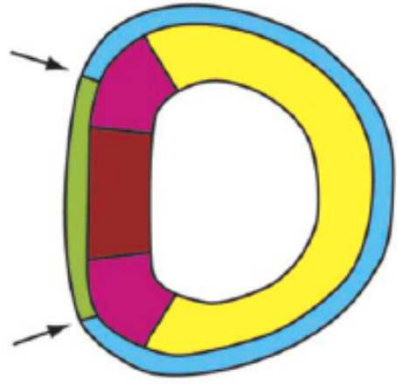
- „annelidní teorie“
- „hemichordátní teorie“



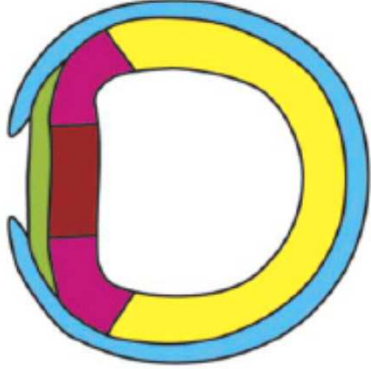
# Vznik ústního otvoru strunatců

- posun „dorsálního“ ústního otvoru do nové „ventrální“ pozice?
- „ústní otvor“ *de novo* ze žaberní štěrbiny?

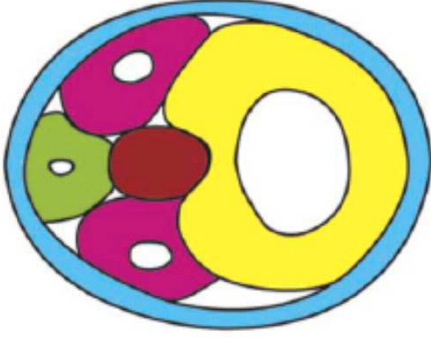




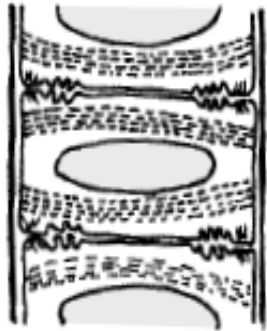
Late gastrula



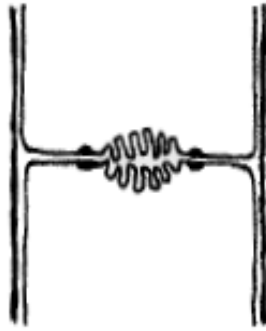
Early neurula



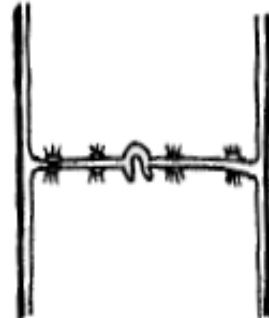
Late neurula



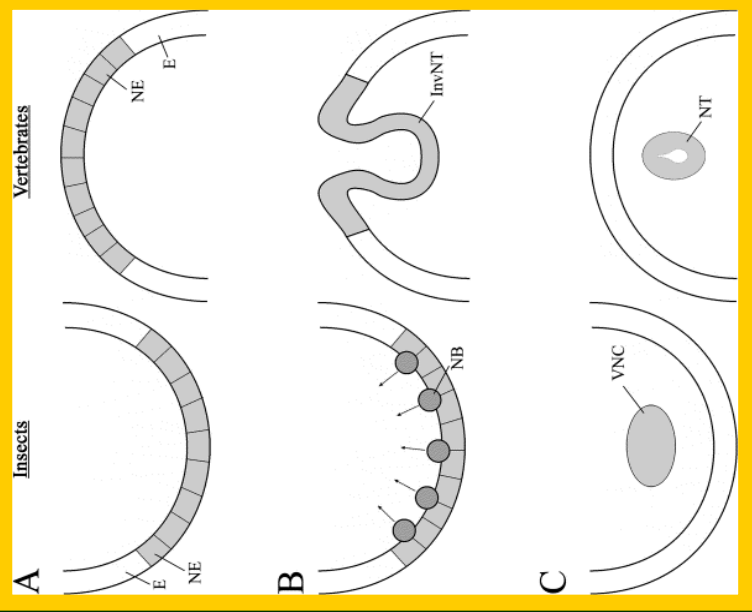
**Cephalochordata**



**Urochordata**



**Craniata**



**A**

**Insects**

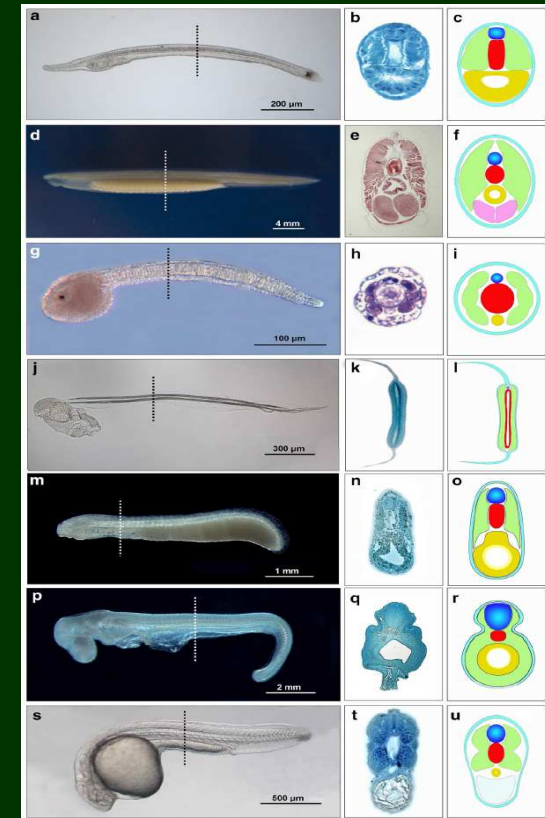
**Vertebrates**

**B**

**C**

# Původ notochordu

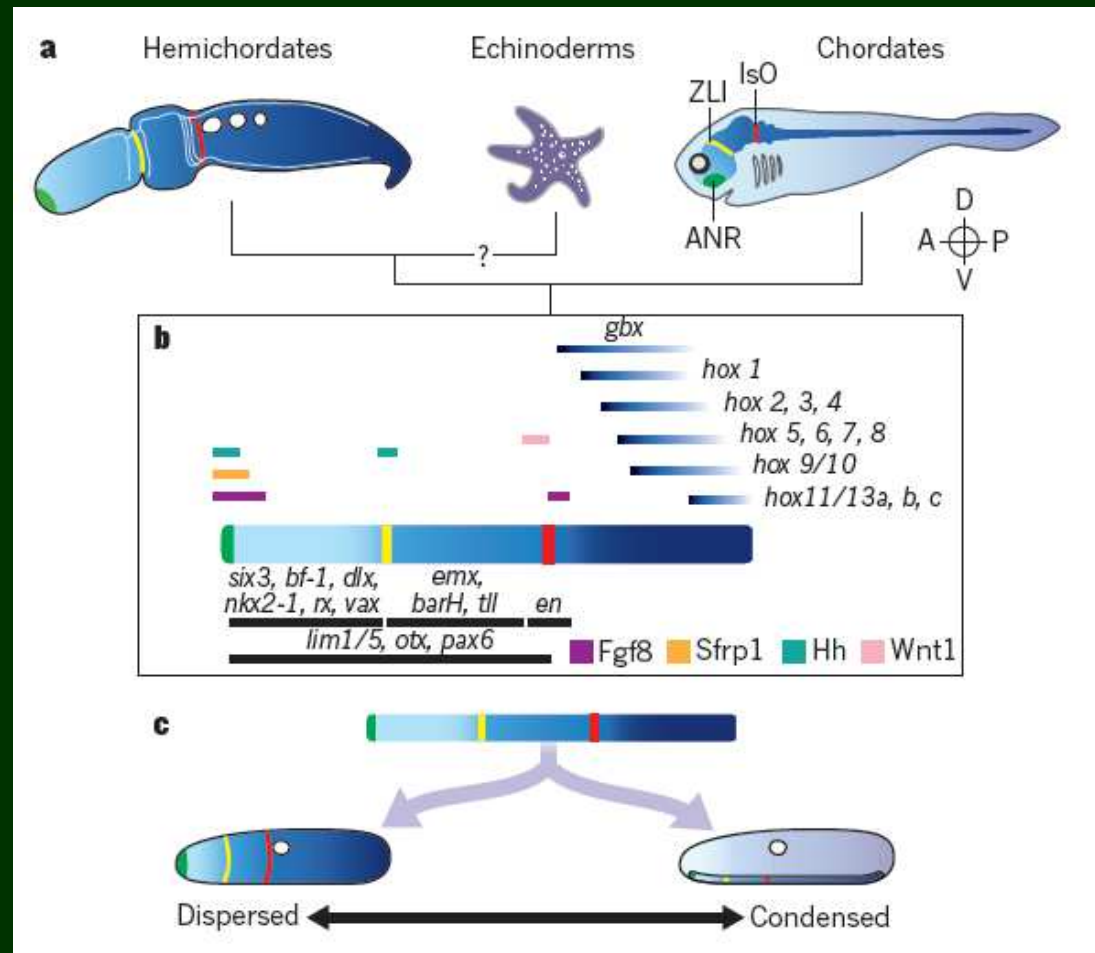
- 1. **axochord** (břišní podélné svaly těsně spojené s nervovou páskou ~ Annelida)
- 2. Enteropneusta – **stomochord**
- 3. Enteropneusta – **pygochord**
- homologie nejasná



**Table 2 Salient features of notochords compared among amphioxus, tunicates, and vertebrates**

	Amphioxus larvae and adults	Tunicate larvae	Vertebrate embryos <sup>a</sup>
Cell types	I. Discoidal cells (stacked like coins <sup>b</sup> ; each cell containing transverse myofilaments) II. Müller cells: sparsely distributed; no known function	Early larva: discoidal cells (stacked like coins <sup>b</sup> ; no myofilaments) Late larva: above cells change to squamous epithelium around fluid-filled lumen <sup>c</sup>	I. Inner core cells <sup>d</sup> : each with a large vacuole; no myofilaments II. Surrounding epithelial cell layer
Extracellular sheath	Inside to out: external lamina <sup>e</sup> , circular collagen layer, and longitudinal collagen layer <sup>f</sup>	External lamina <sup>e</sup>	Inside to out: external lamina <sup>e</sup> , circular collagen layer, and longitudinal collagen layer <sup>f</sup>
Organizer genes involved in notochord formation <sup>g</sup>	Comparable to those of vertebrates	Highly divergent <sup>h</sup>	Comparable to those of amphioxus
Hedgehog from notochord involved in patterning central nervous system	Yes <sup>i</sup>	No <sup>j</sup>	Yes

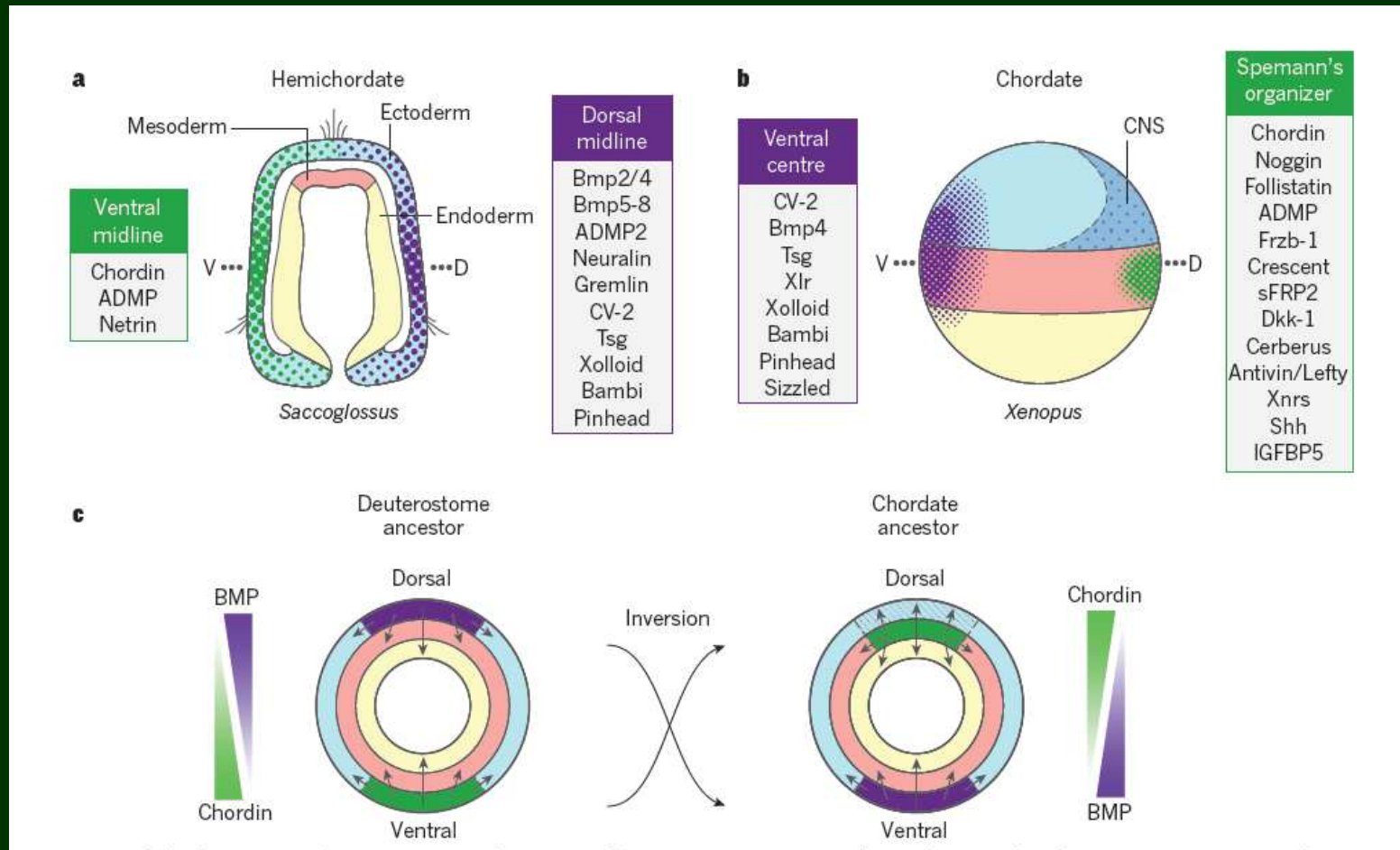
# AP uspořádání hemichordátů a chordátů



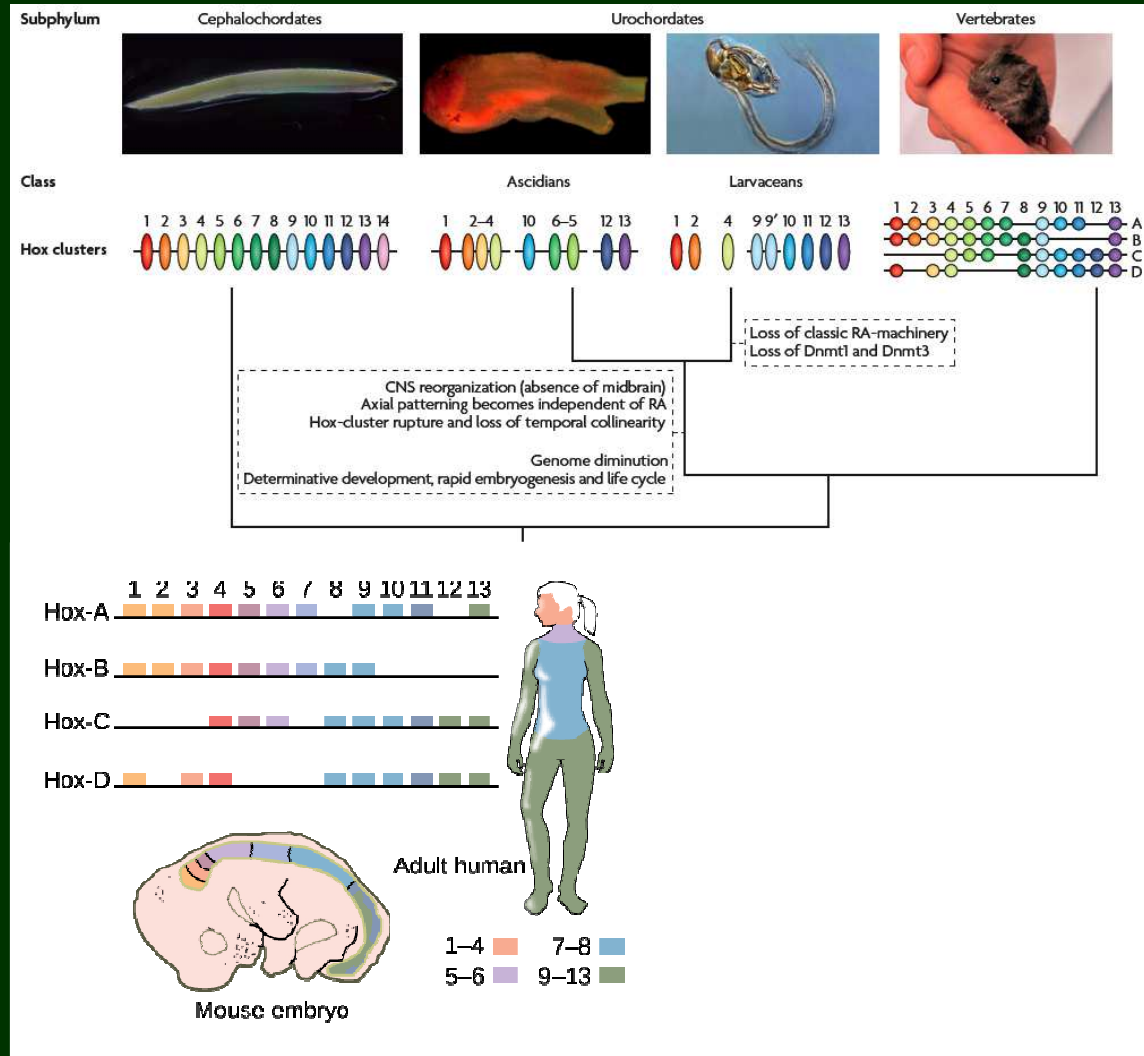
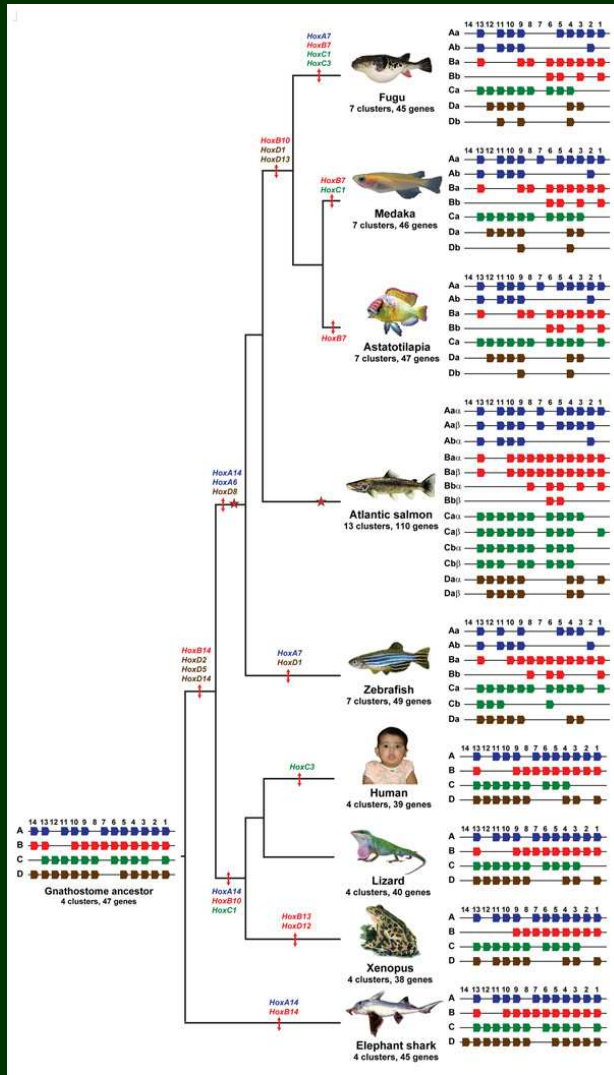
- lze zrekonstruovat genetický systém koordinát předka
- ale je obtížné zrekonstruovat anatomii předka (týká se AP systém celého těla, nebo jen midventrální oblasti?)



# DV uspořádání hemichordátů a chordátů



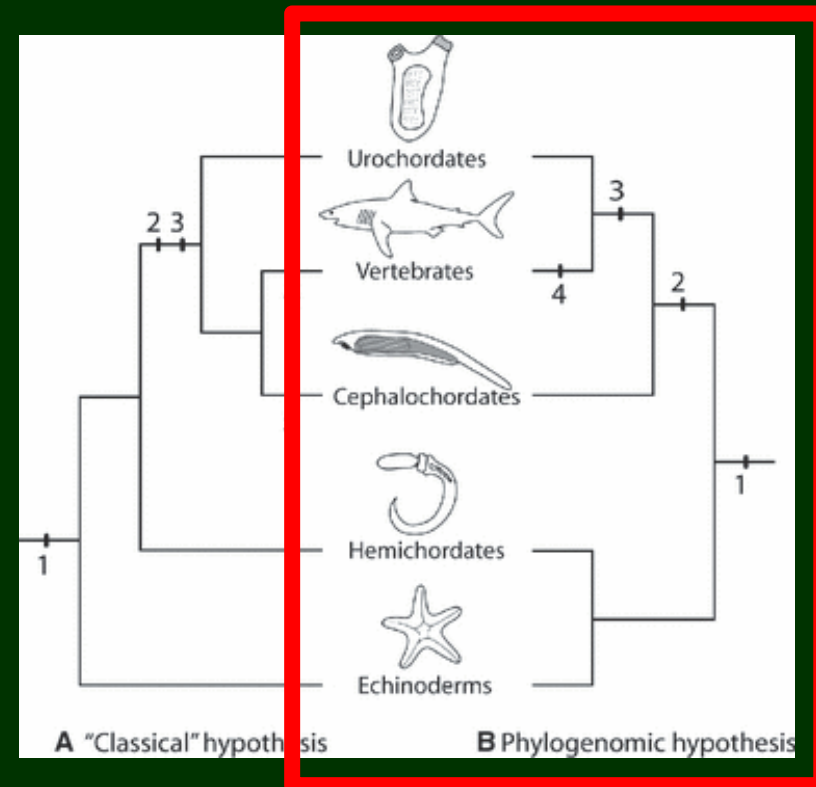
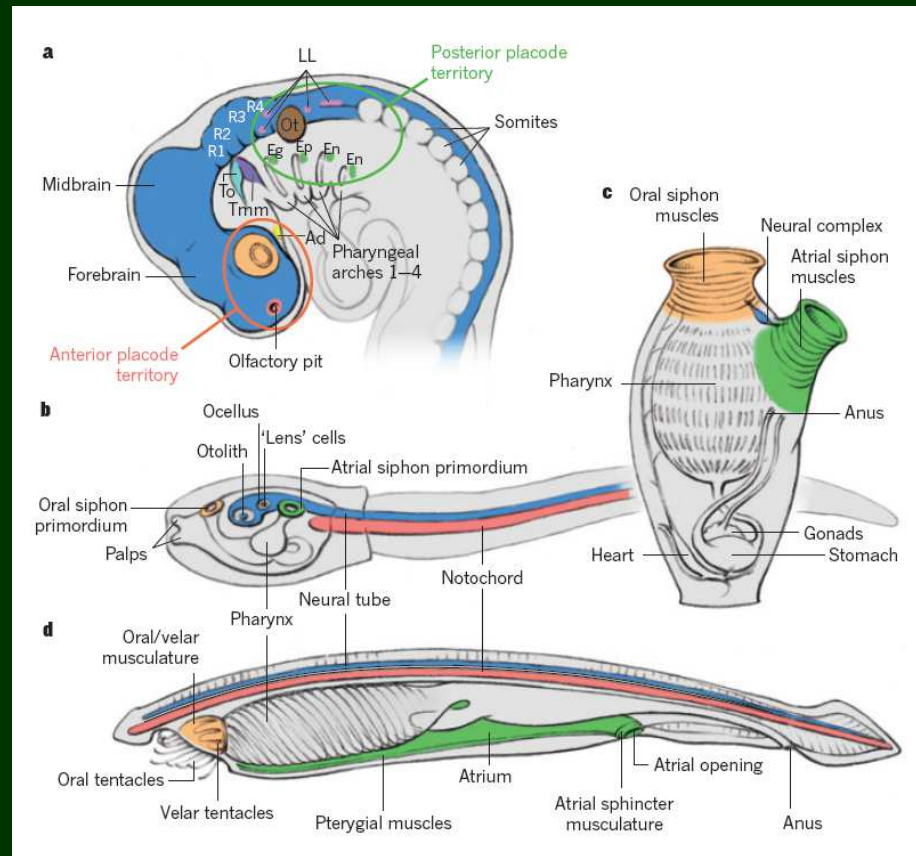
# Hox komplexy strunatců



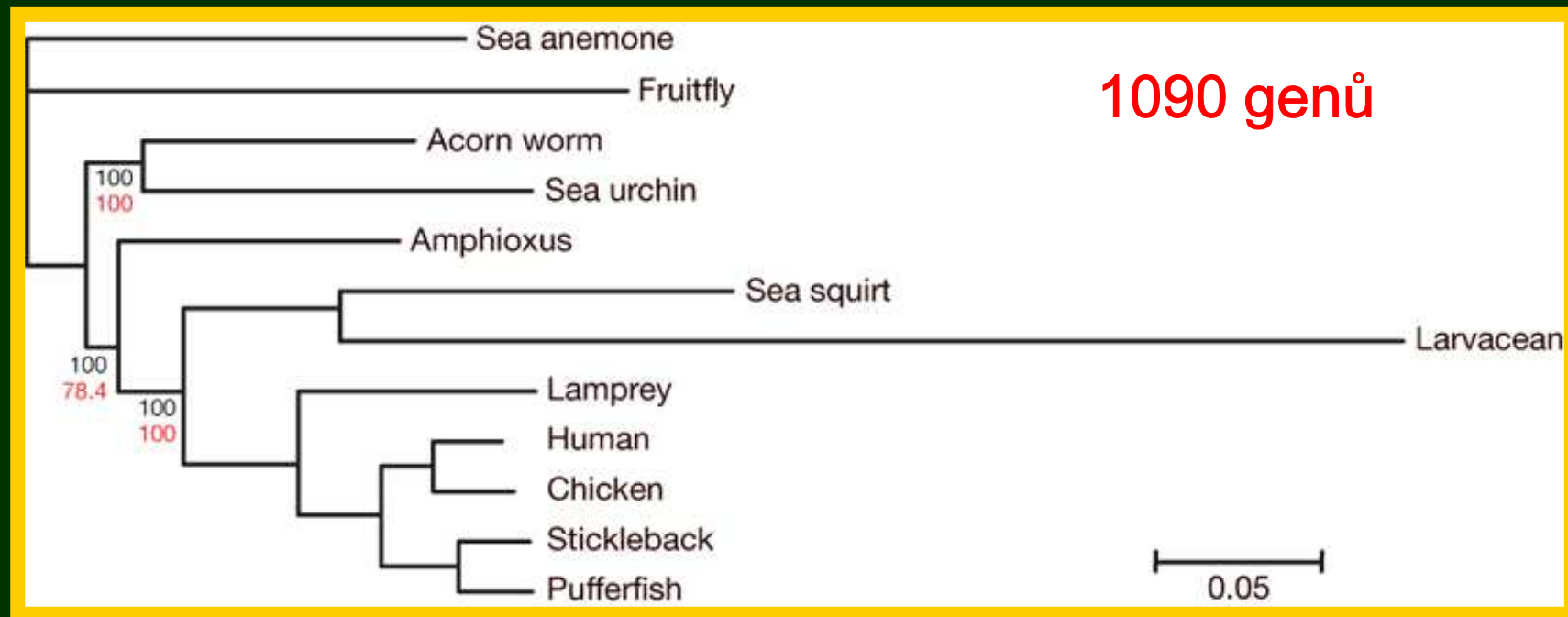
# Fylogeneze strunatců

- Cephalochordata
- Urochordata = Tunicata
- Craniata (lépe „Craniota“) = Vertebrata s.lat.
- =====
- Ce+Ur = Protochordata
- Ce+Cr = Notochordata
- **Ur+Cr = Cristozoa = Olfactores**

# Fylogeneze strunatců



# Fylogeneze strunatců



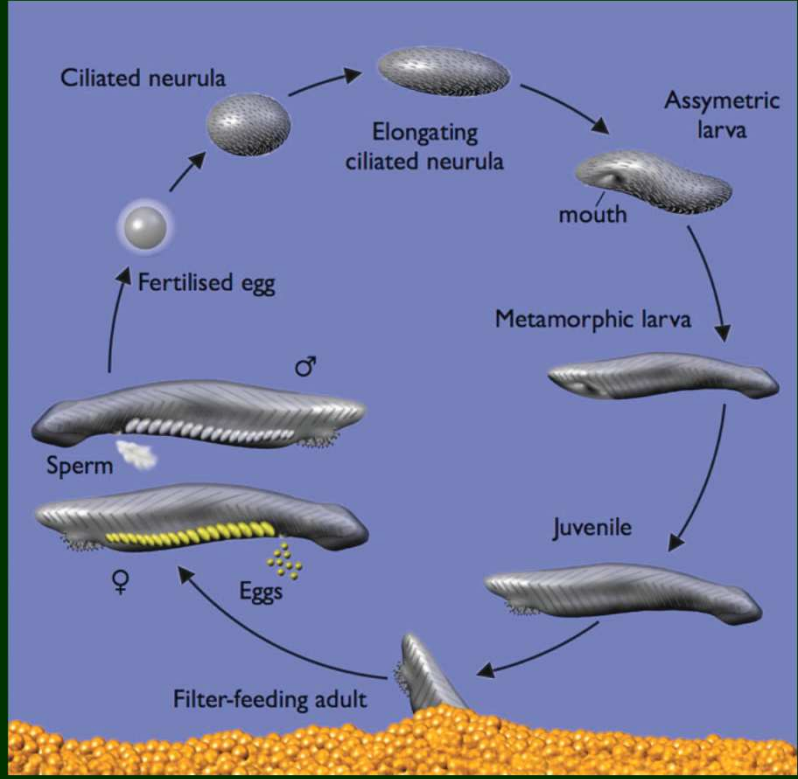
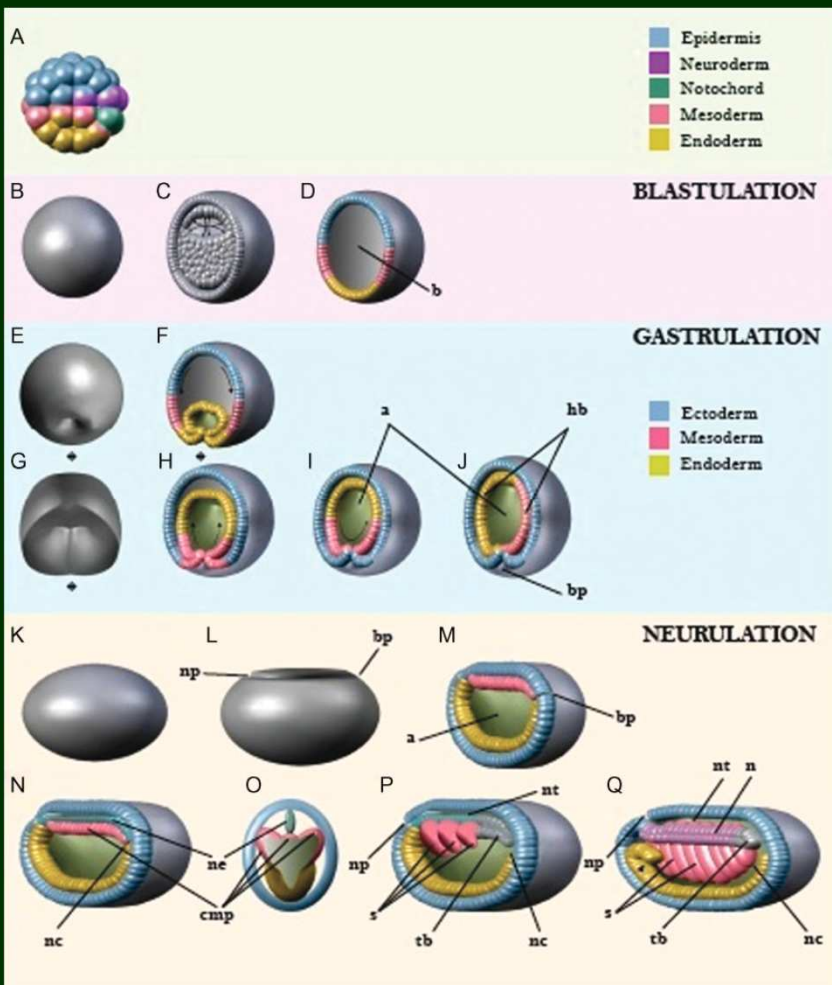
# Fylogeneze strunatců

- **Notochordata**: notochord po celé délce těla, segmentace célomu a mezodermu, stavba nervové trubice, nepárový ploutevní lem, metapleury, přímý vývoj, mtDNA?
- **Cristozoa (Olfactores)**: *tight junctions*, odvozená stavba notochordu, odvozená ontogeneze hltanu a svaloviny (*Pax*), neuromasty, multiciliární epitely, **neurální lišta, fylogenomika**

# Cephalochordata



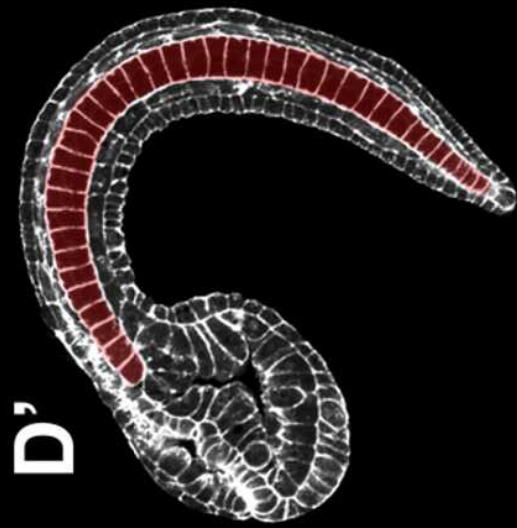
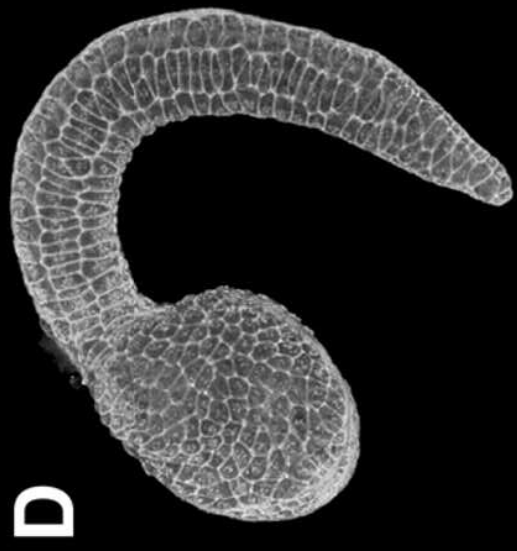
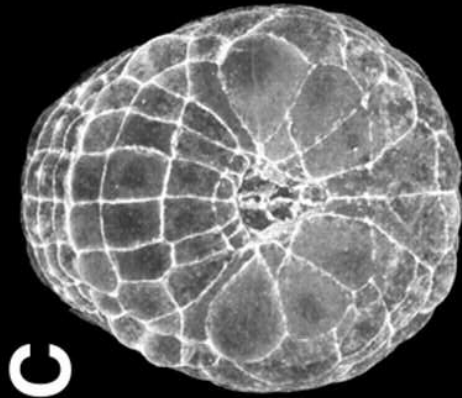
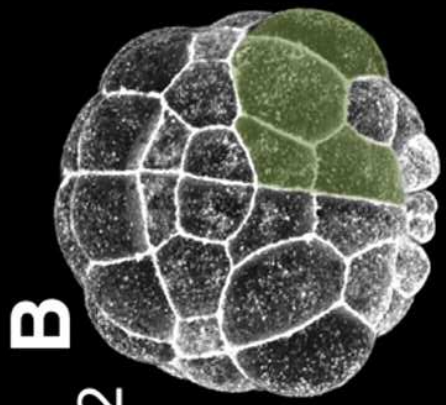
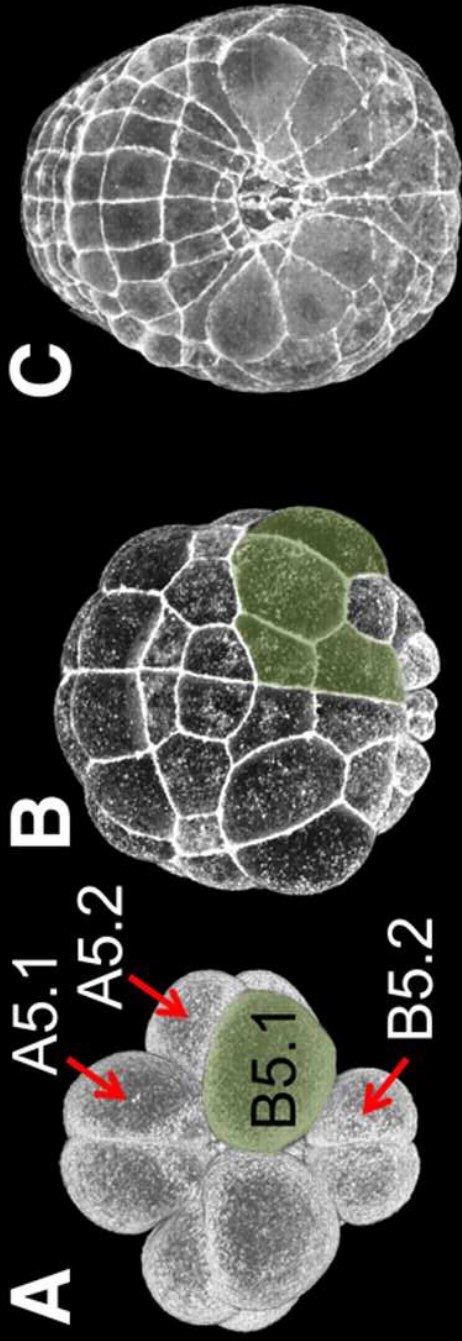
# Cephalochordata



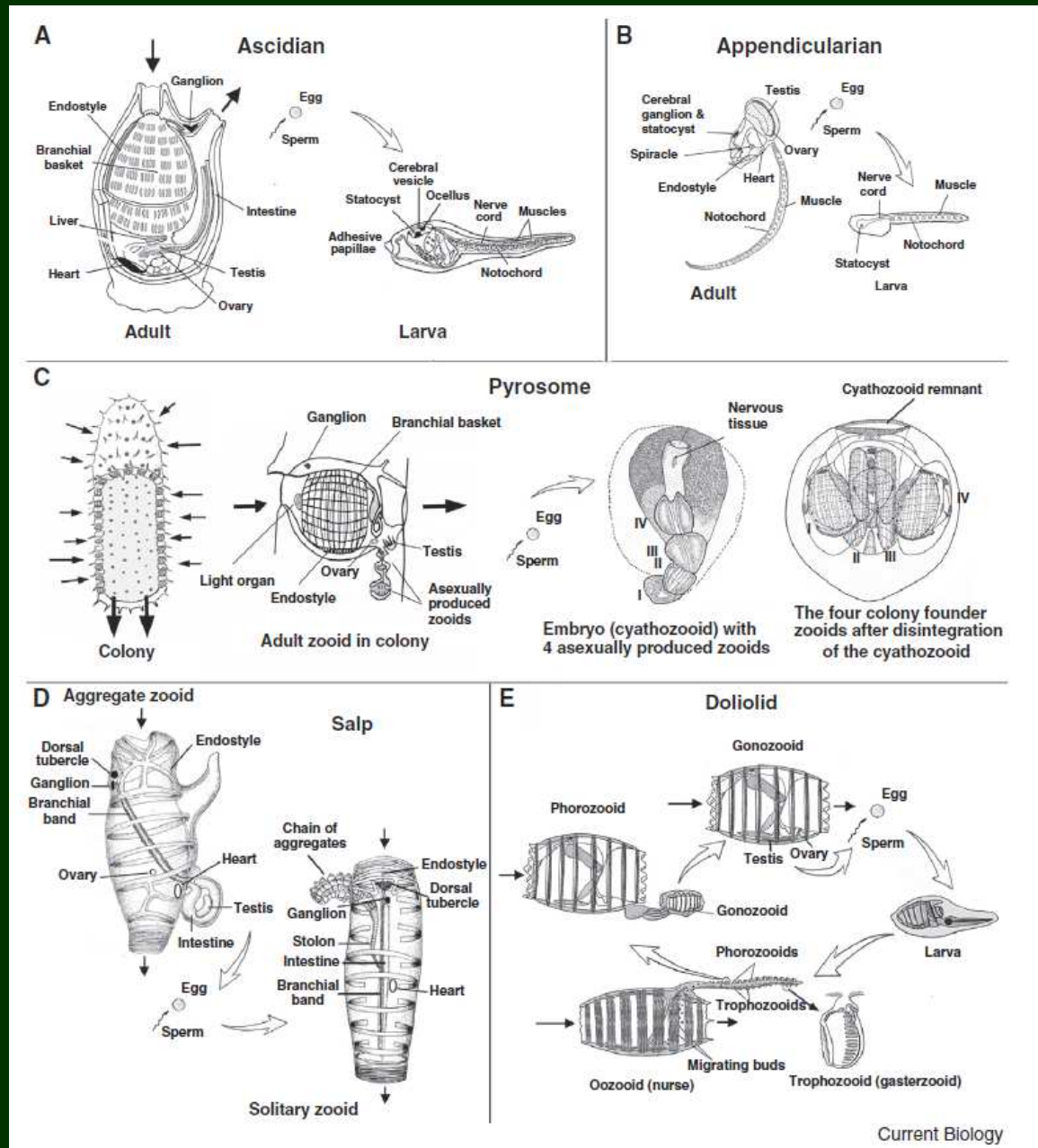
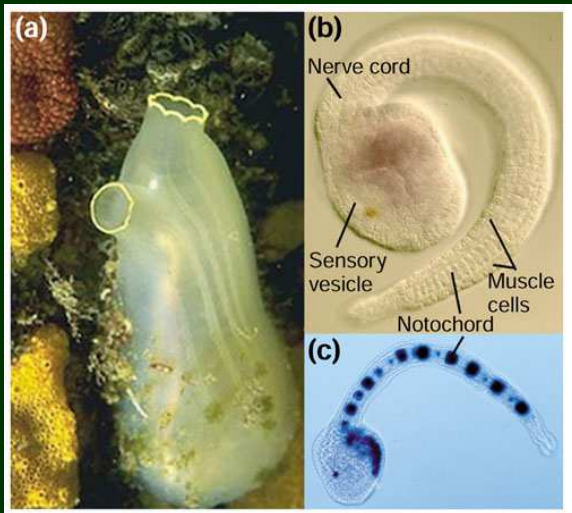


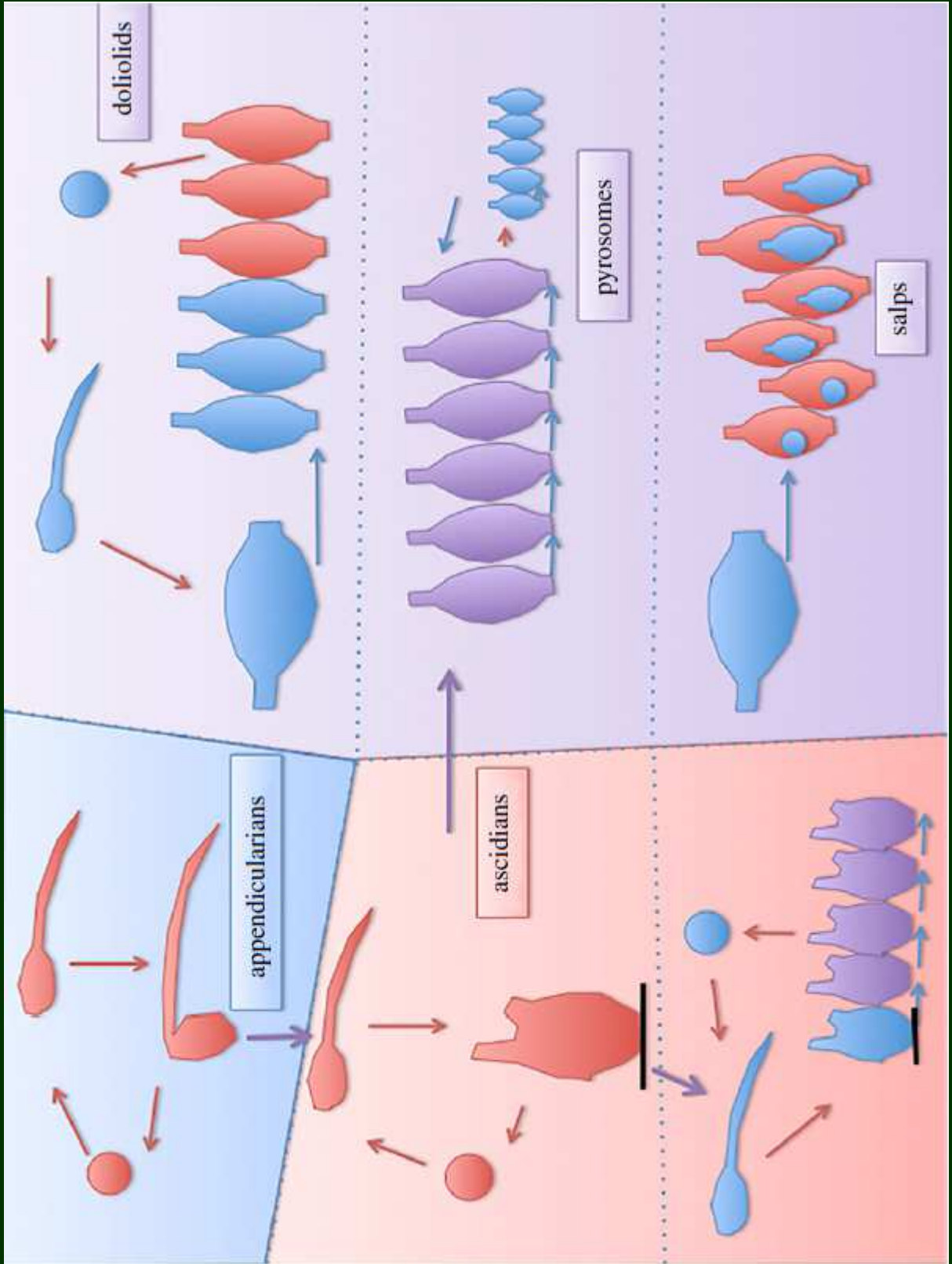
# Urochordata (Tunicata)



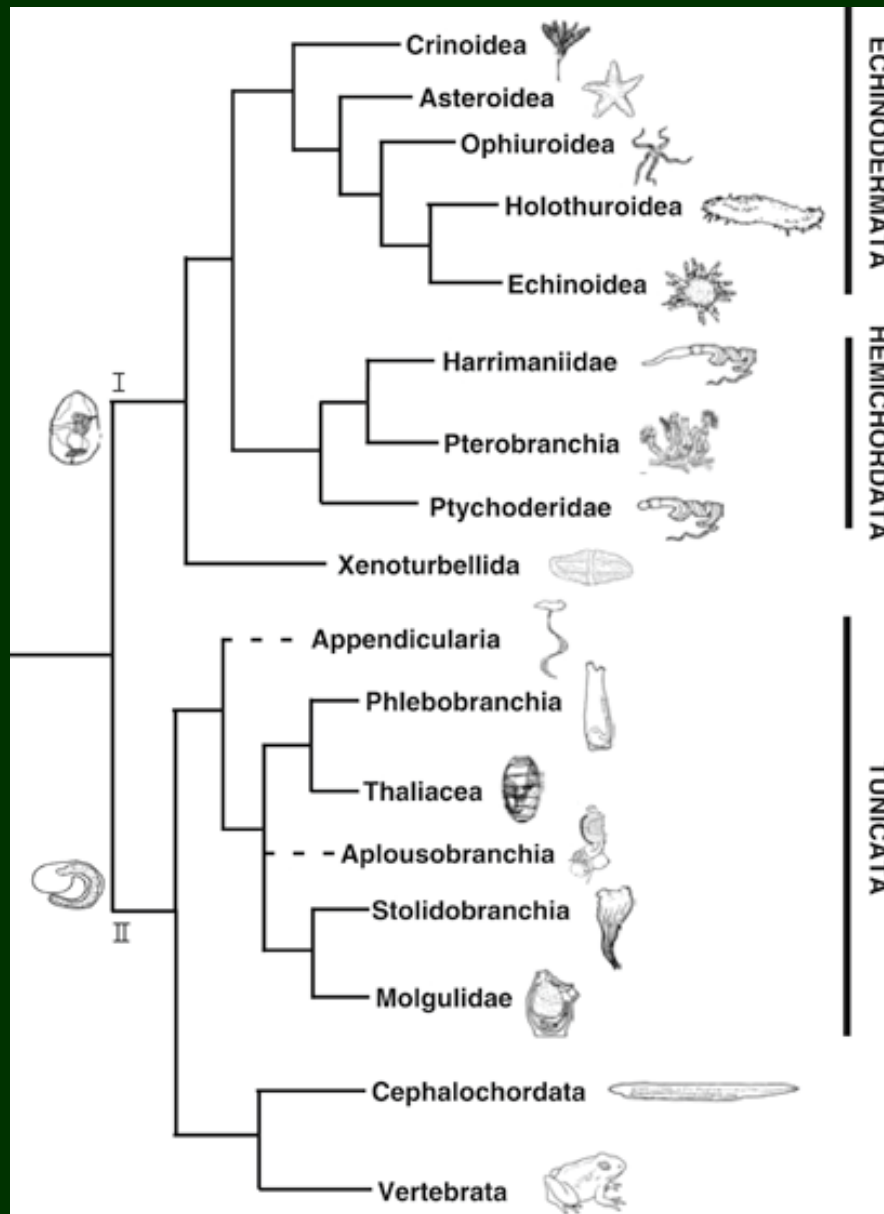


- mláďata plavou nepravidelným helikálním způsobem – nejasná DV orientace

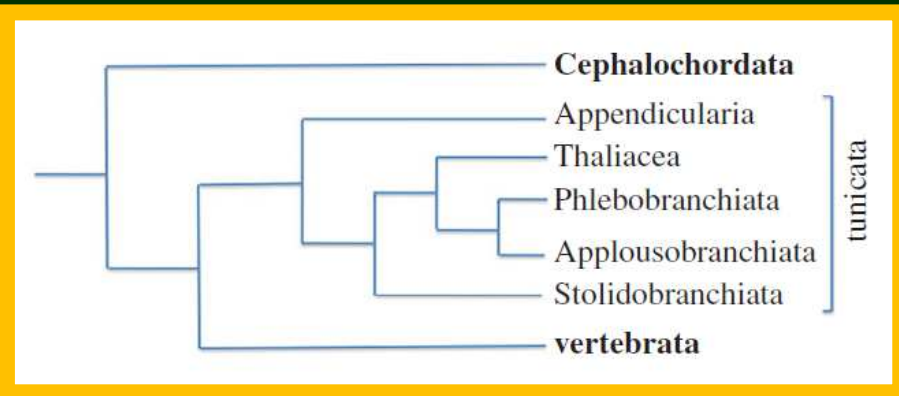




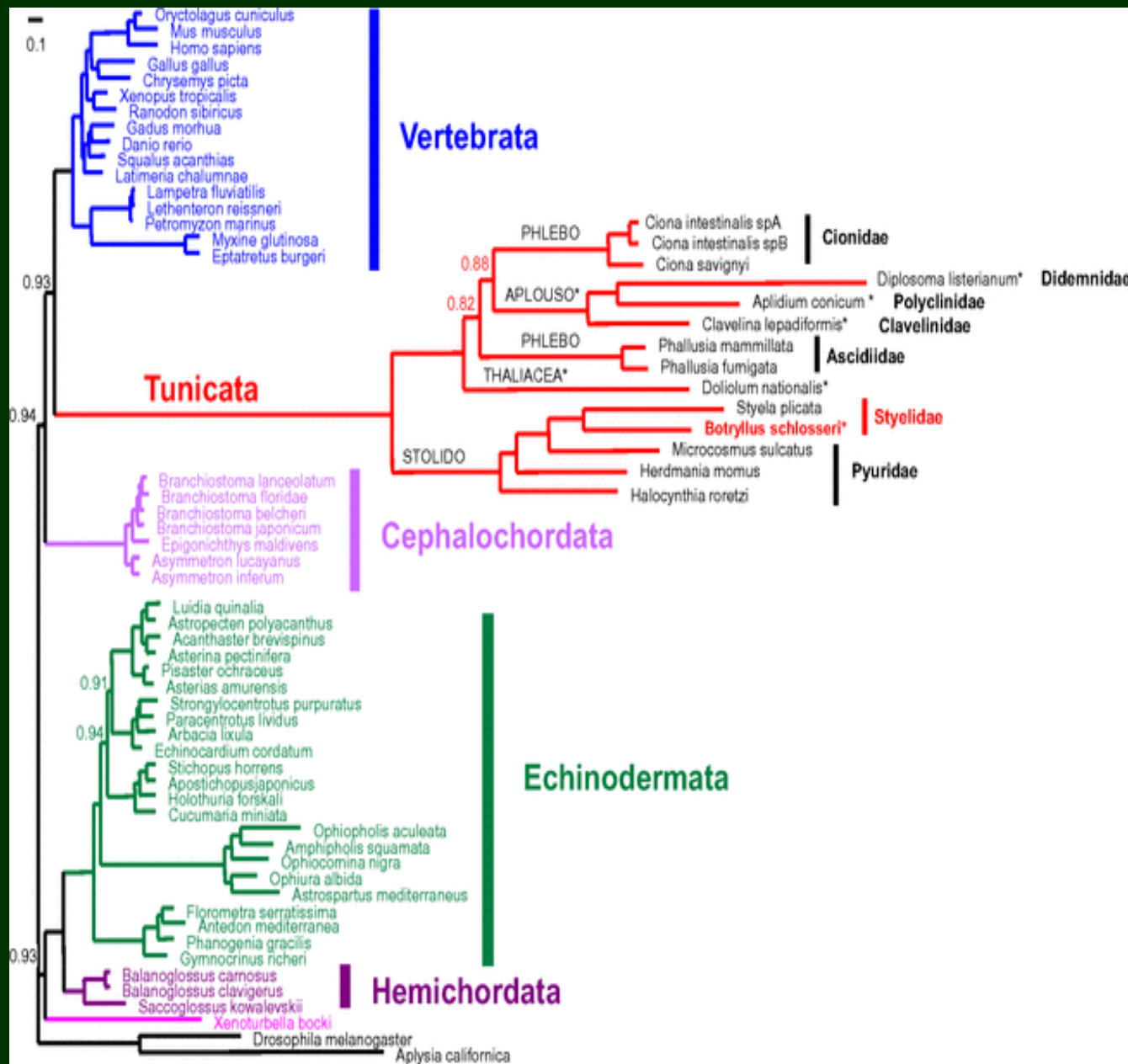
# Urochordata



údajně bayesovská analýza čehosi dosud nepublikovaného (z nefylogenetického review)

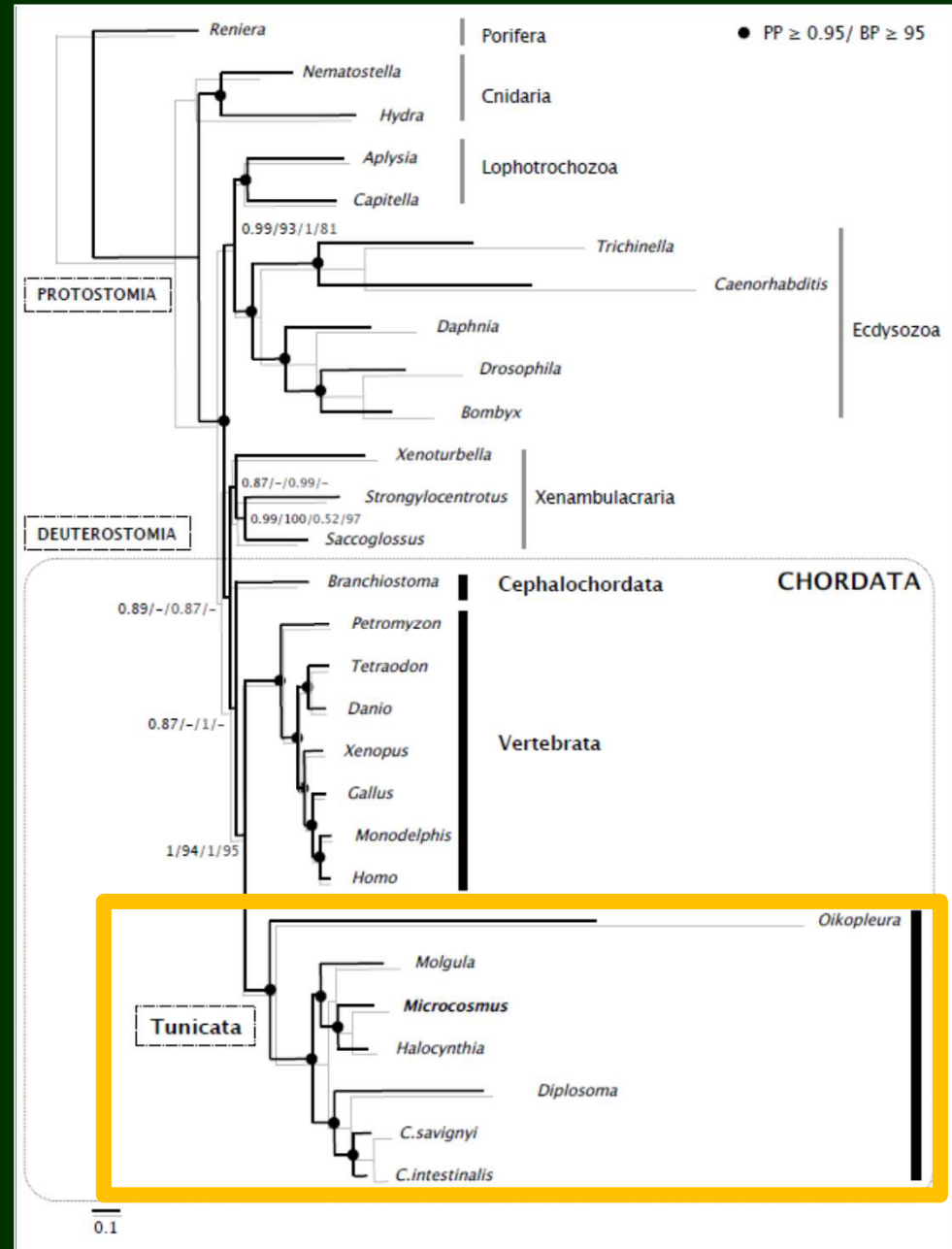


mtDNA



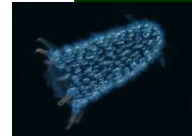
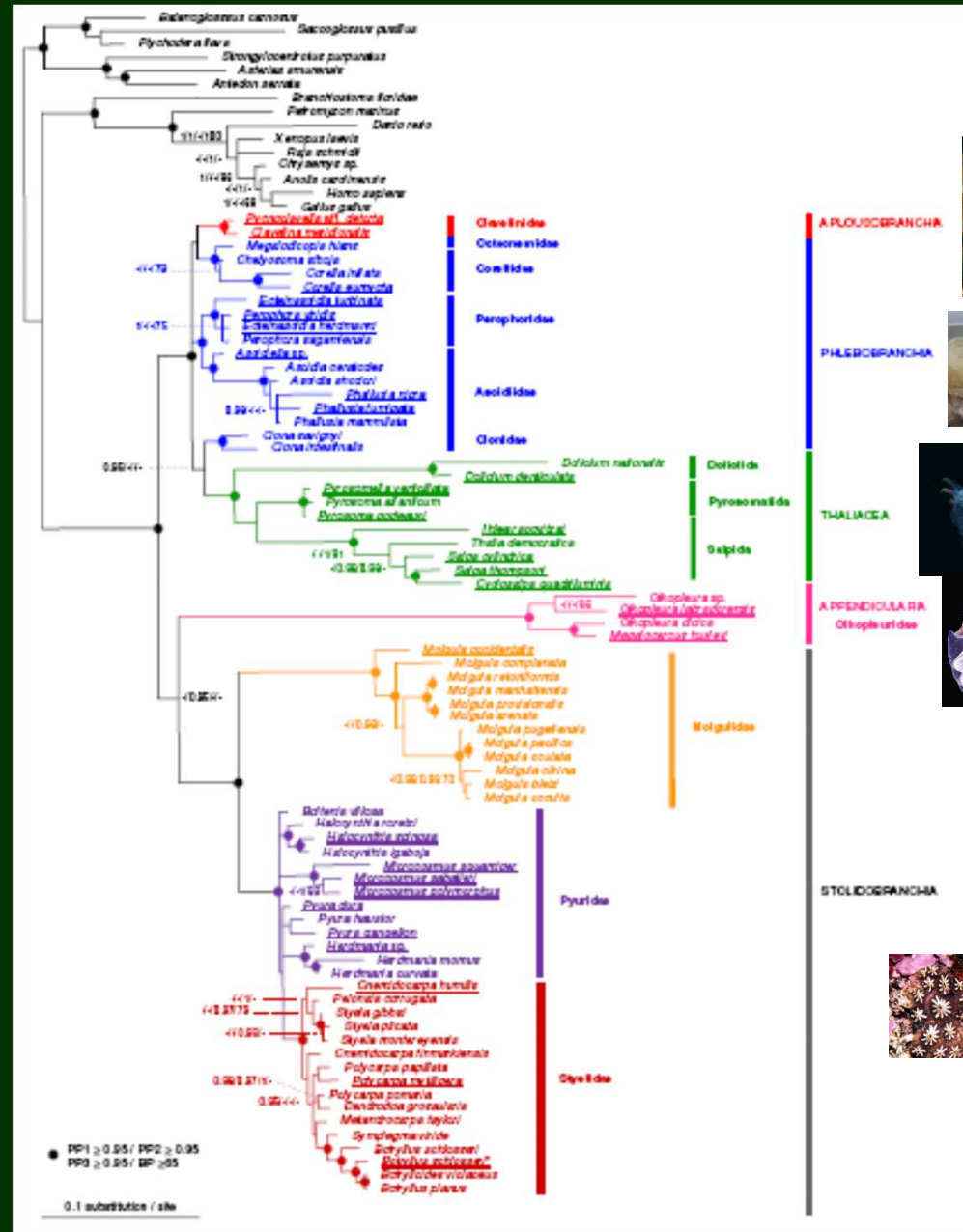
# 35 housekeeping genes

- 1. Appendicularia
- 2.1. Pleurogona  
(*Molgula* +  
*Microcosmus* +  
*Halocynthia*)
- 2.2. Enterogona  
(*Diplosoma* + *Ciona*)
- chybí Thaliacea



# Fylogeneze pláštěnců

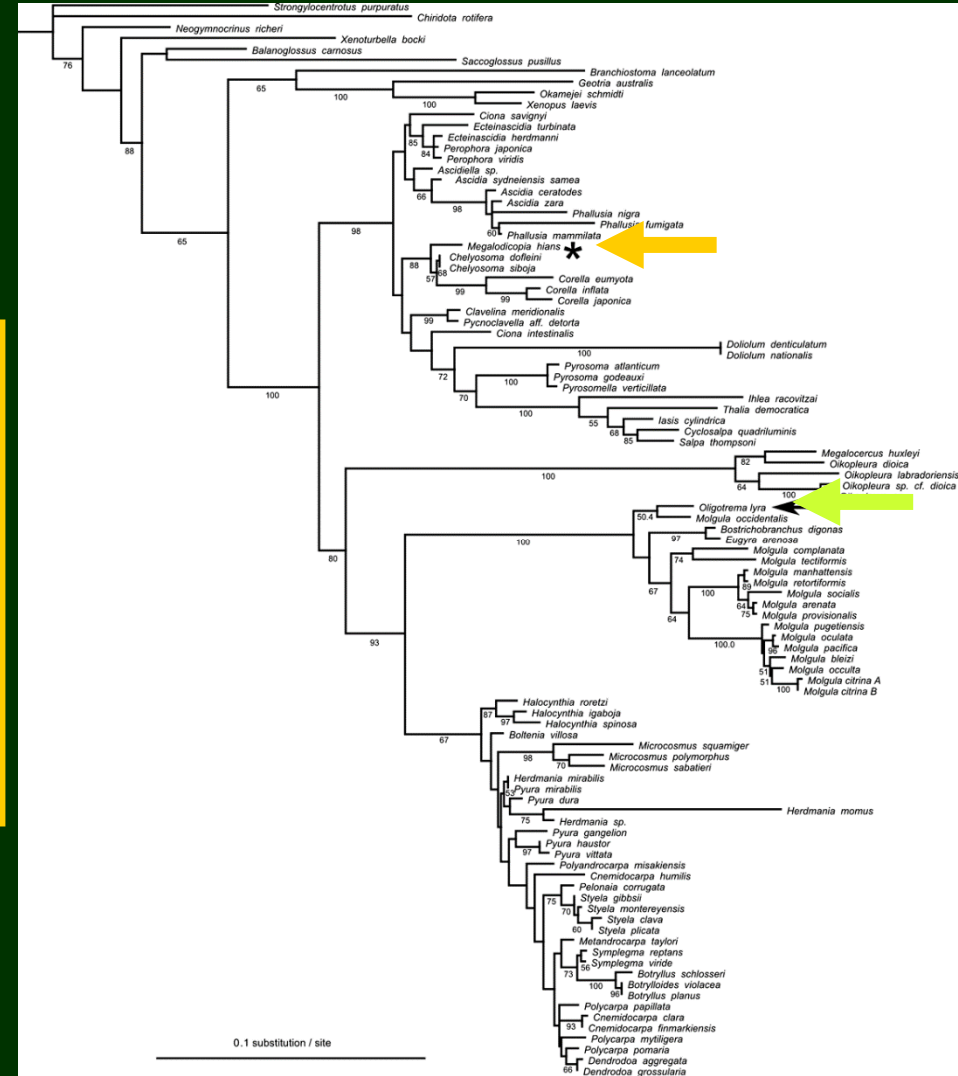
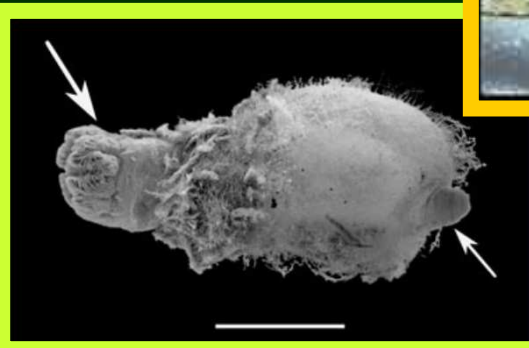
- 2009 (dobrý sampling, ale pořád jenom SSU...)
- **1. Enterogona** (nepárové gonády)
  - - Aplousobranchiata
  - - "Phlebobranchiata" (incl. Octacnemidae)
  - - Thaliacea
- **2. Pleurogona** (párové gonády) = Stolidobranchiata (incl. Sorberacea)
- + **Appendicularia**???



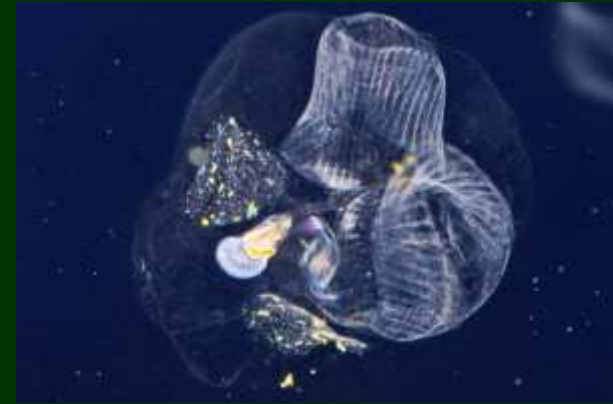
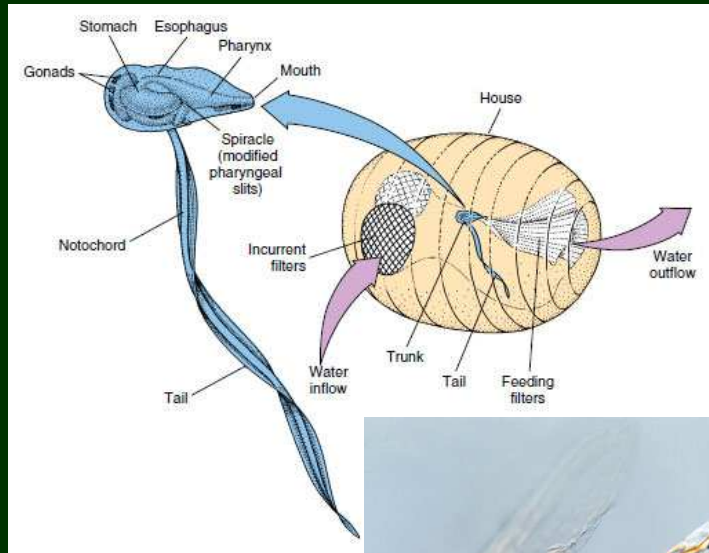


# Draví hlubokomořští pláštěnci

- Hexacrobylidae (Sorberacea)
- Octacnemidae

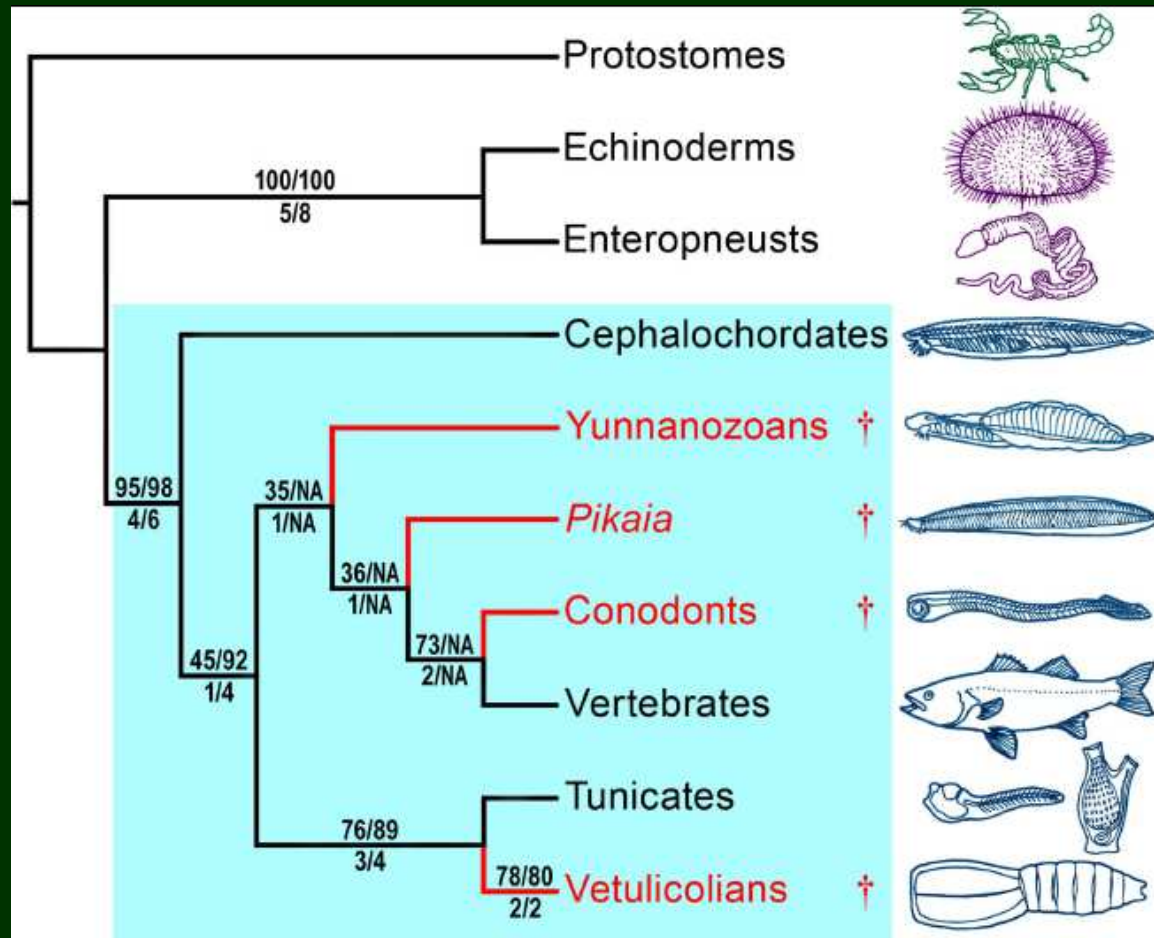
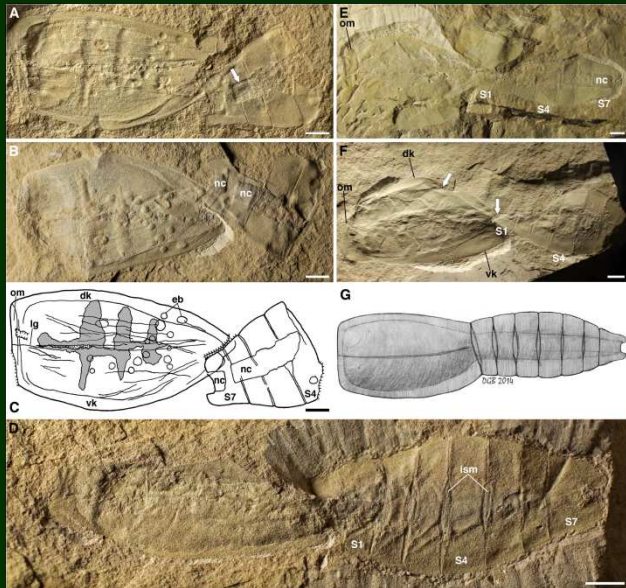


# Appendicularia (Larvacea)



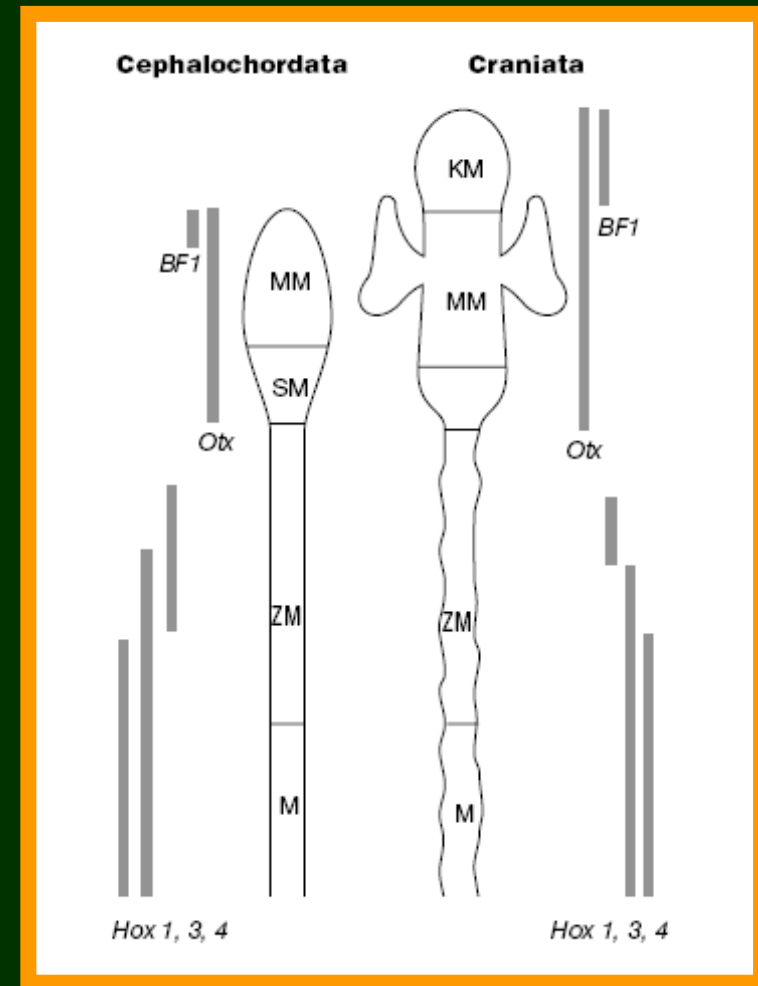
# Vetulicolia

- Vetulicolia + Tunicata → jednoduchý cyklus je primitivní (~ vršenky)



# Obratlovci

- vícevrstevná multiciliátní pokožka + mezodermální dermis
- postanální ocas
- postupný vznik skeletálních tkání, sklerotom (původně dermální kosti a chrupavčitý endoskelet)
- diferencovaná nervová trubice (*Otx*, *Pax*, *Hox*)
- cévy s mezodermálním epitelem (célom + améboocyty)

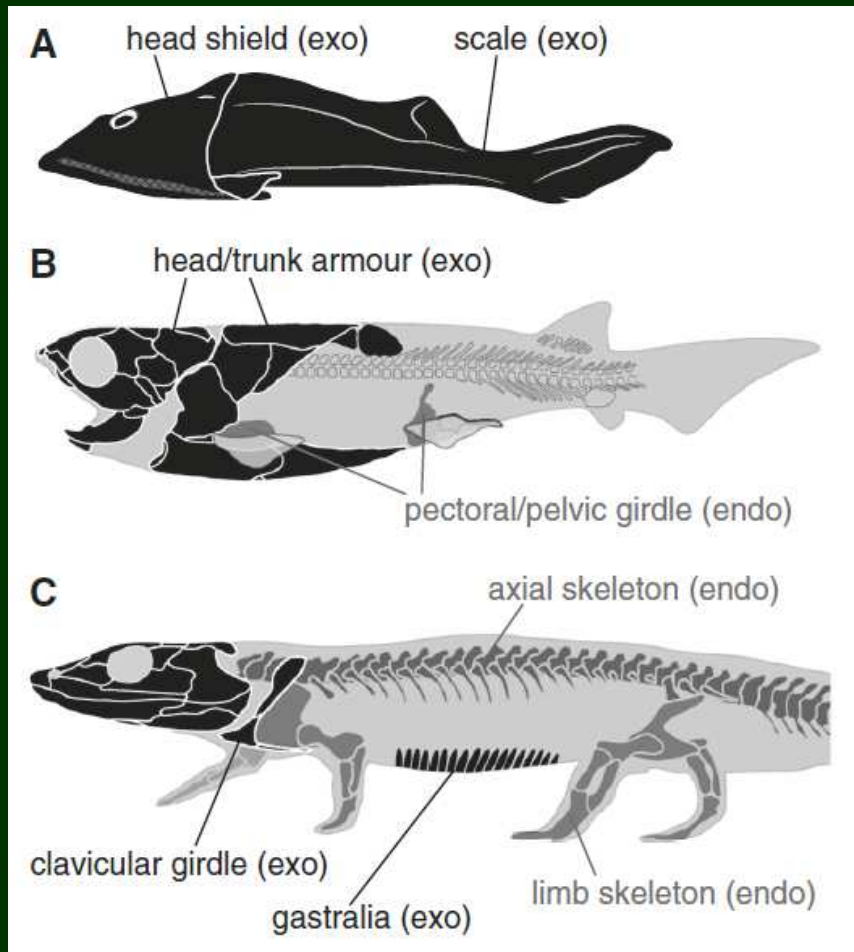
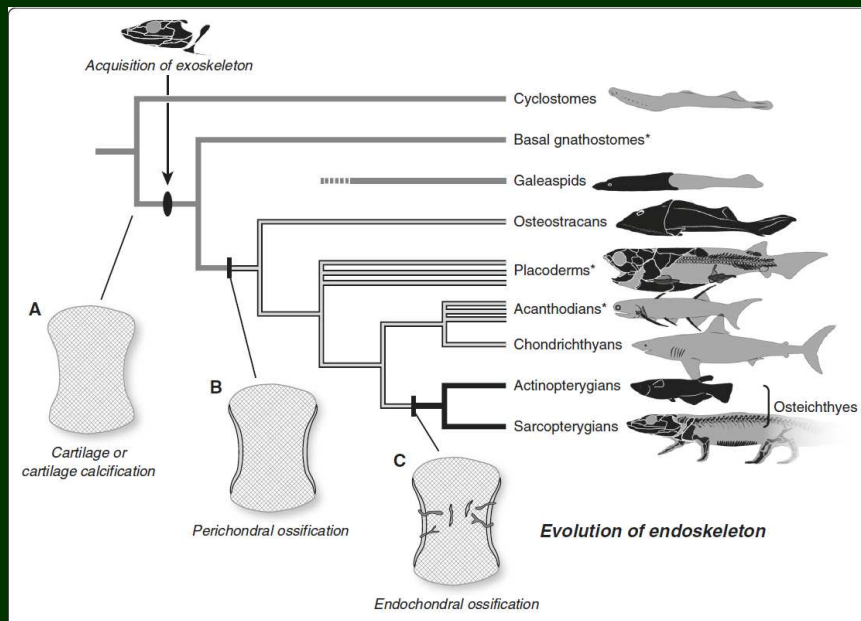




# Obratlovci

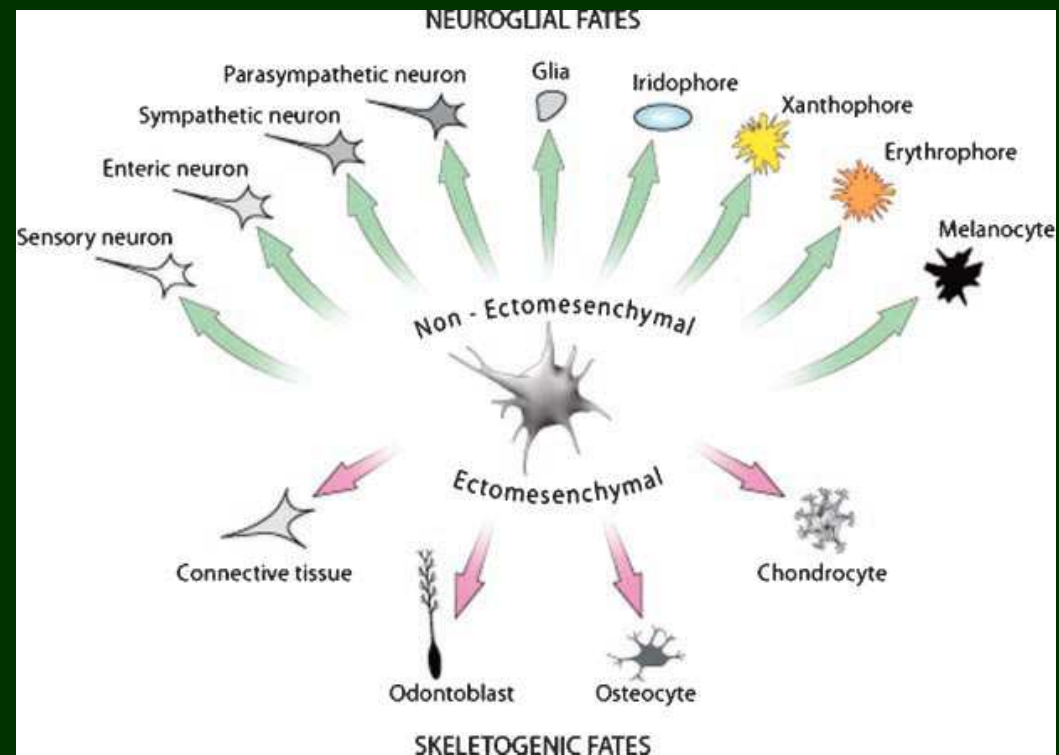
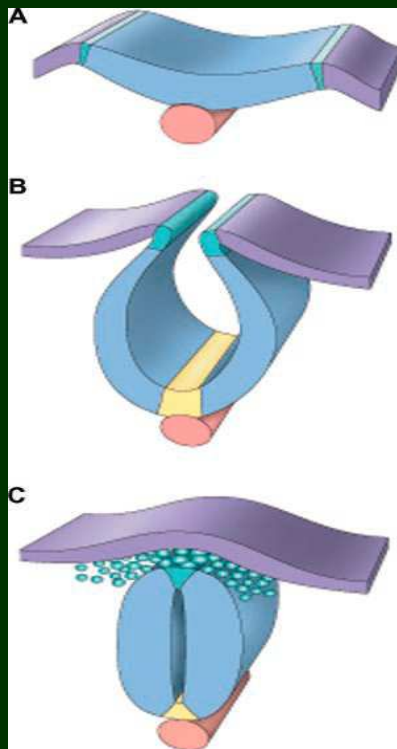
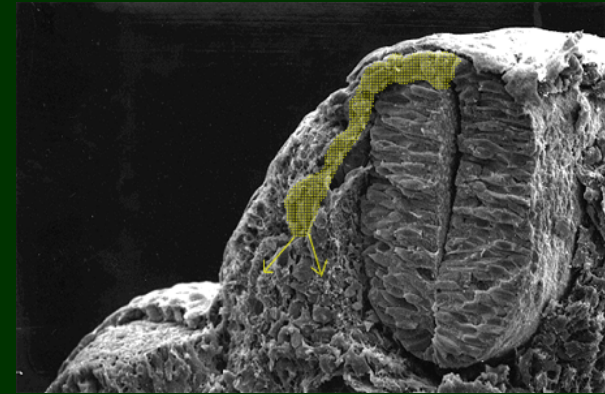
- žaberní koš: redukce slizového filtru (→ dýchání), poháněn hltanovými svaly, redukce počtu štěrbin (13 → 7 párů), endostyl → štítná žláza
- hypofýza
- játra a slinivka
- ledviny
- smyslové a neurogenní plakody
- neurální lišta → skelet, svaly, smyslové orgány, pigmentace
- adaptivní imunitní systém
- duplikace genomu

- endo- a exoskeleton

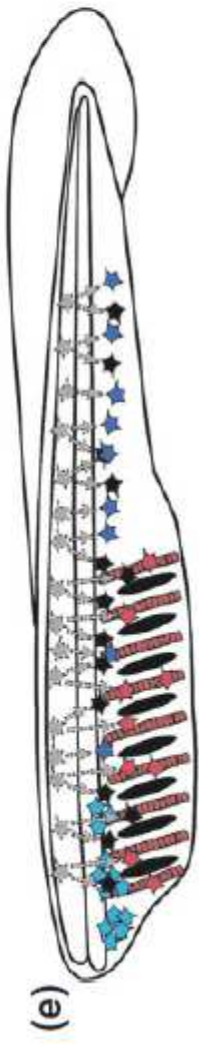
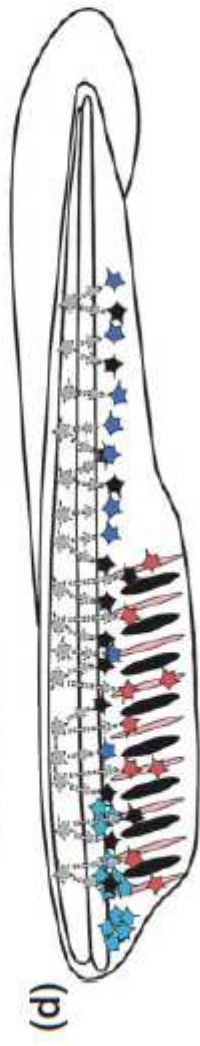
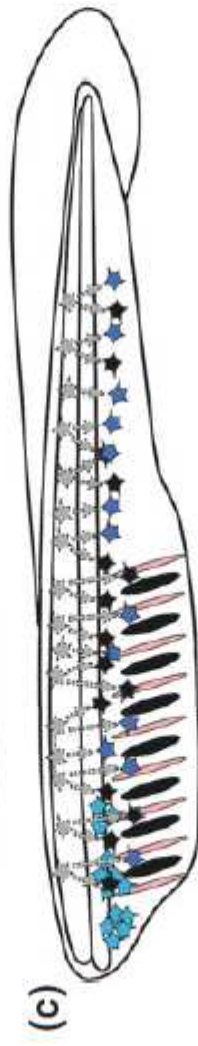
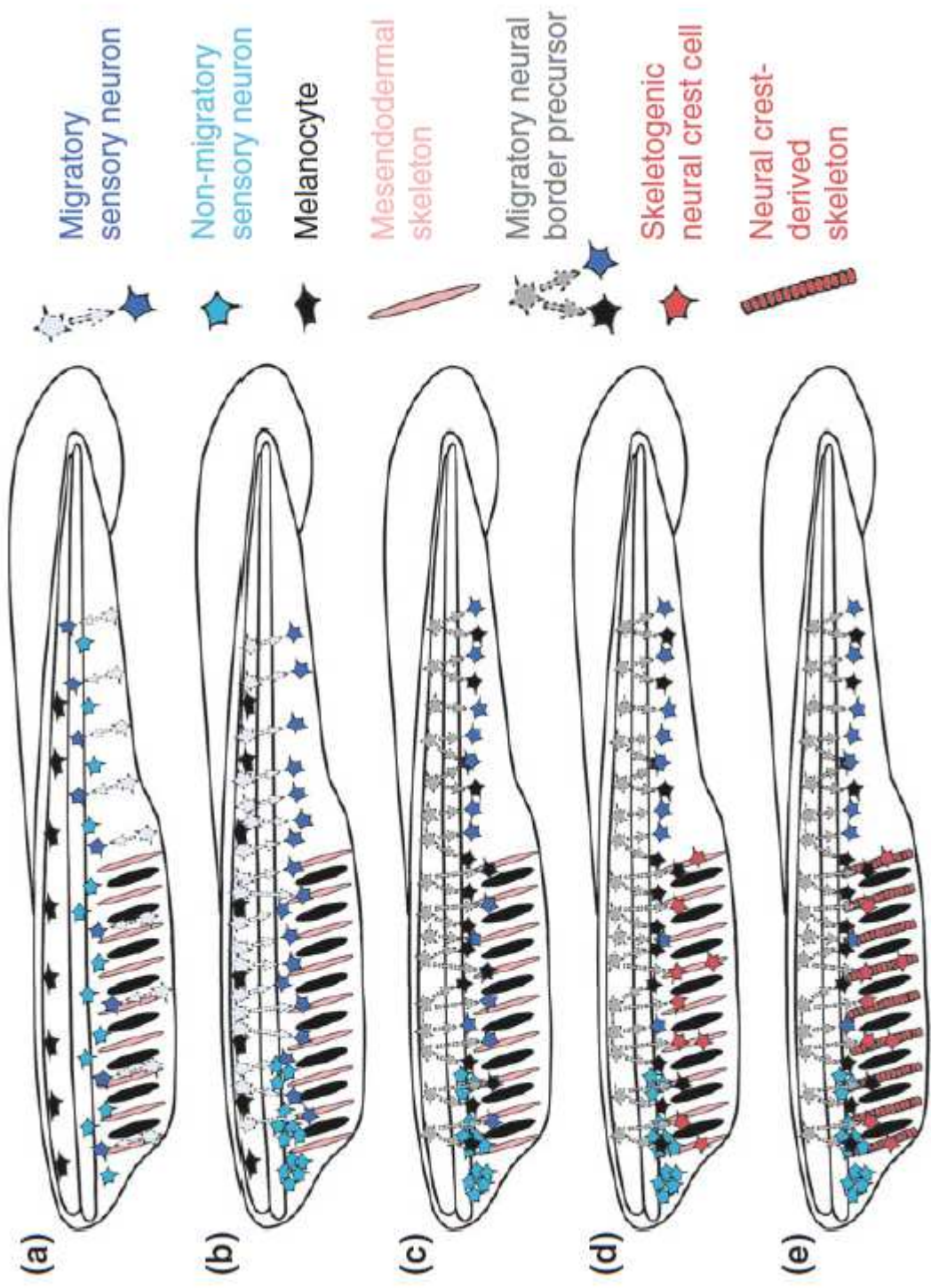


# Neurální lišta

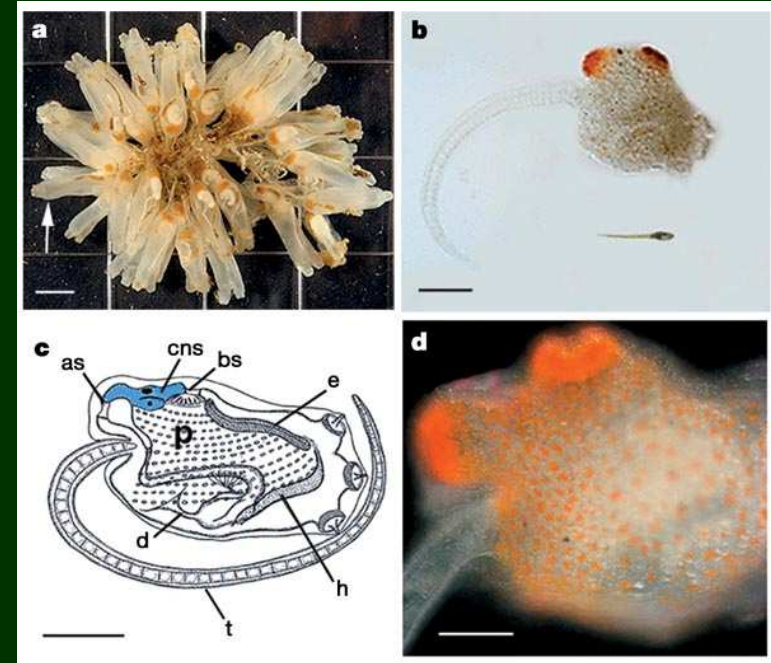
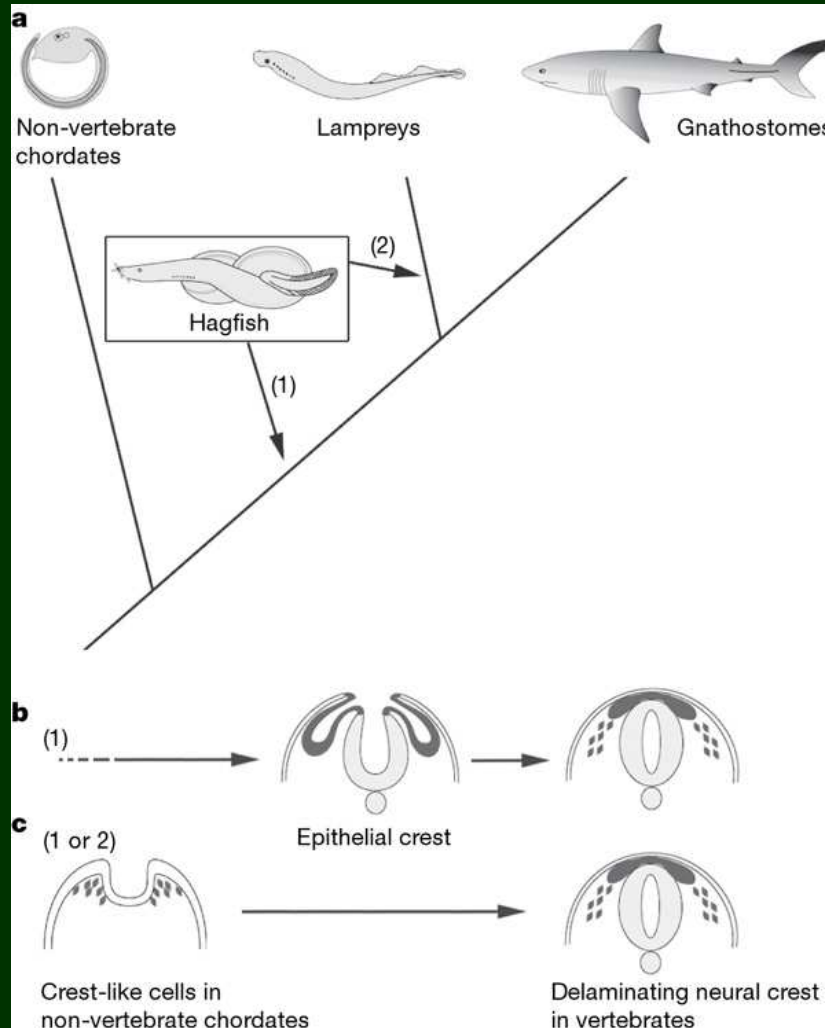
- Brian Hall: „jediná zajímavá věc na obratlovcích je neurální lišta“
- kompletní předělání embryonálního vývoje: neurální lišta je „čtvrtý zárodečný list“







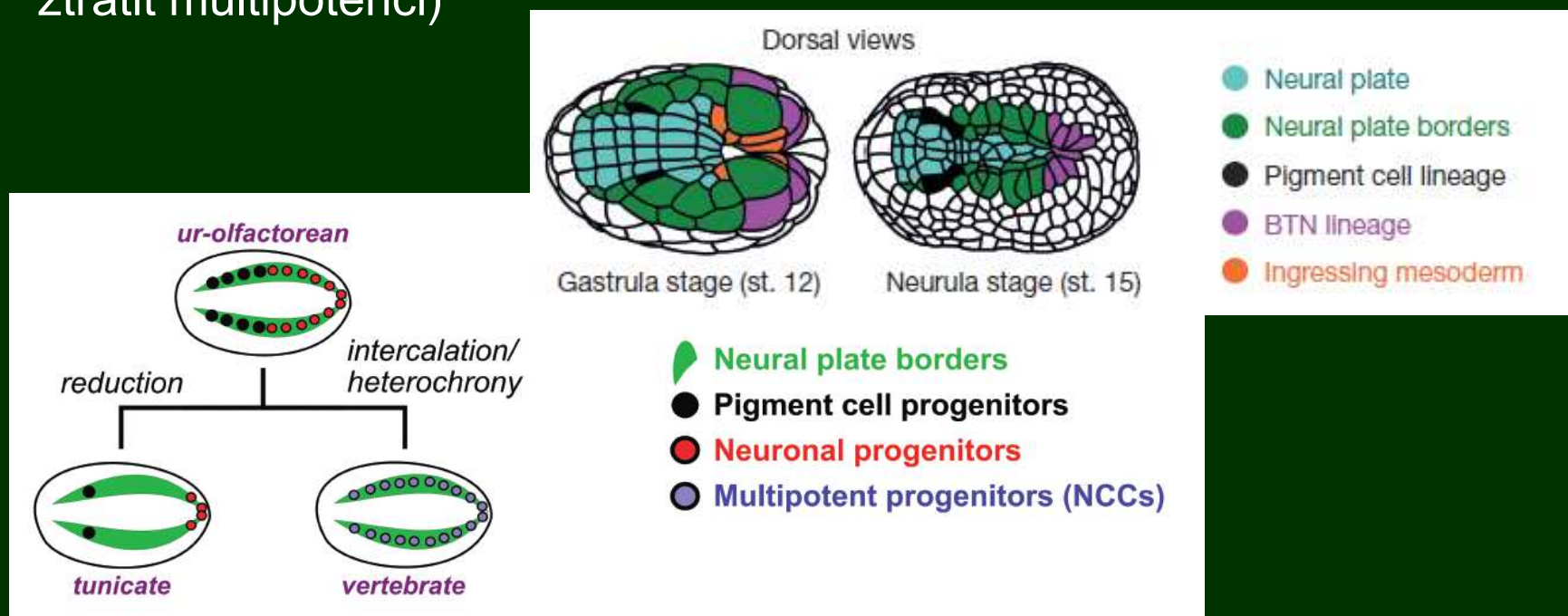
# Vznik neurální lišty



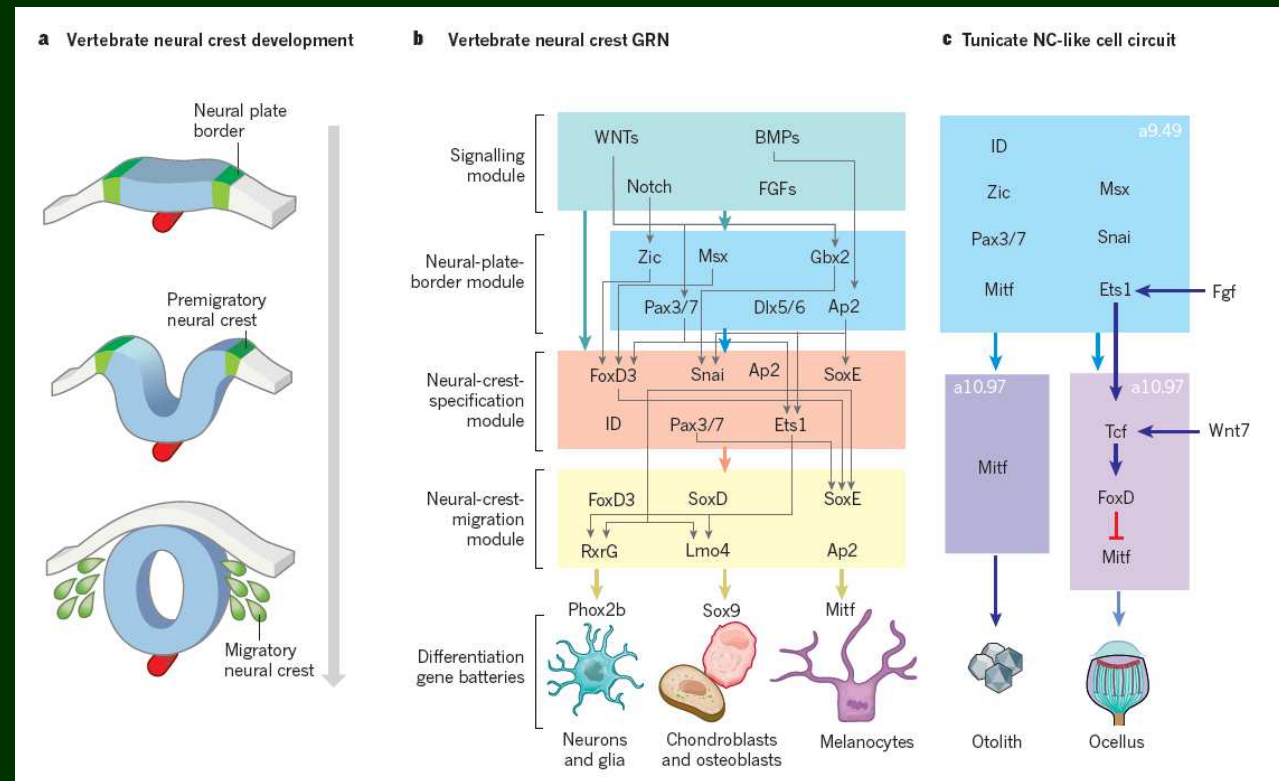
- homologické buňky u pláštěnců: vznik pigmentových buněk v plášti

# Vznik neurální lišty

- okraje neurální destičky u kopinatců a pláštěnců: buňky melanocytového typu se podílejí na tvorbě pigmentových fotoreceptorů v NS (tj. nemigrují)
- pigmentové buňky a *bipolar tail neurons* (BTN) se oddělují v raném vývoji, pak konvergují do jednoho typu buněk okrajů neurální destičky a pak se zase rozcházejí
- u obratlovců jsou buňky NC multipotentní (heterochronie? zapomněly ztratit multipotenci)

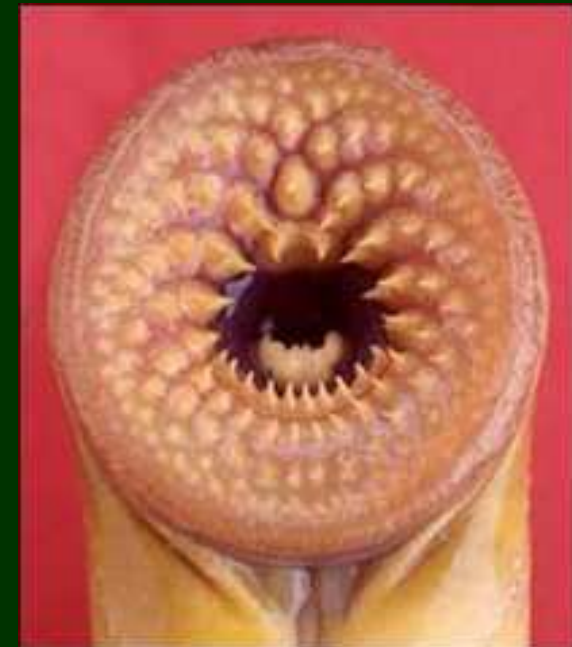
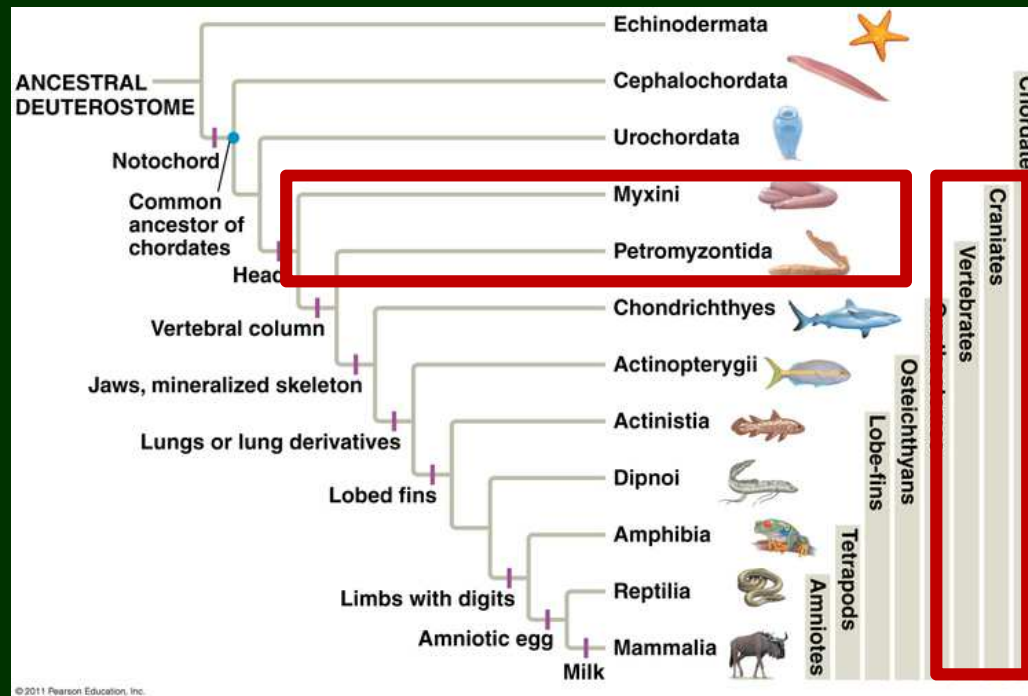
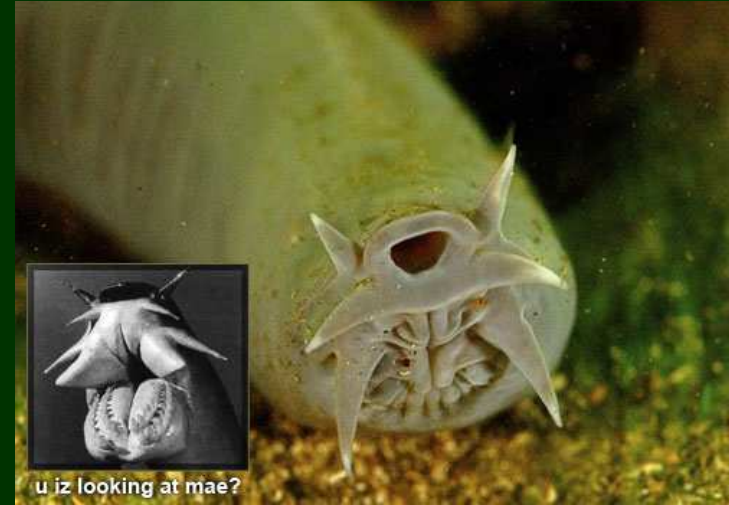


# Vznik neurální lišty

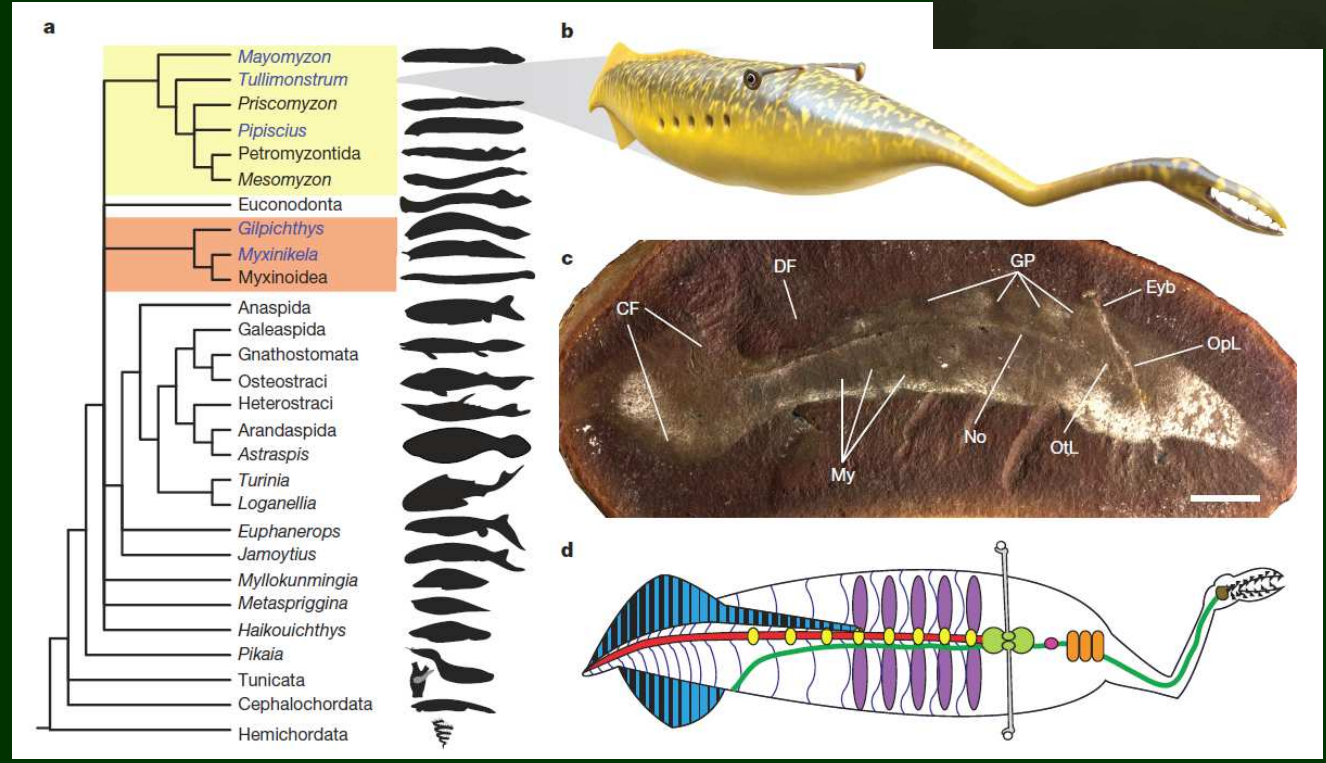


- x buňky sumek nejsou multipotentní, ani nemají mimořádné disperzní schopnosti
- aktivní v pigmentových smyslových buňkách otolitů a očí

# Vertebrata ~ Craniata (Craniota)

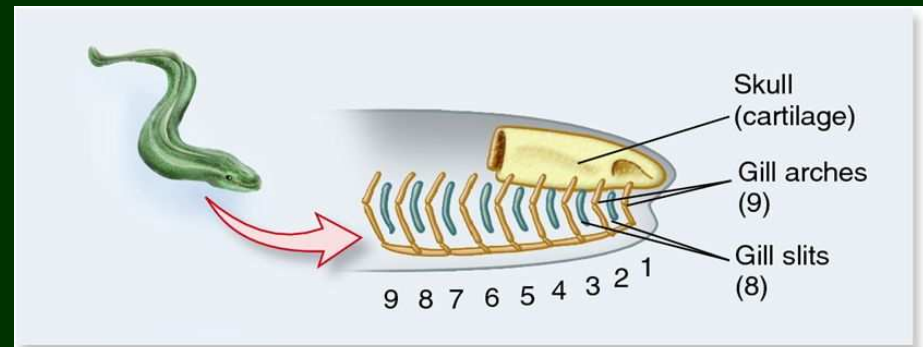
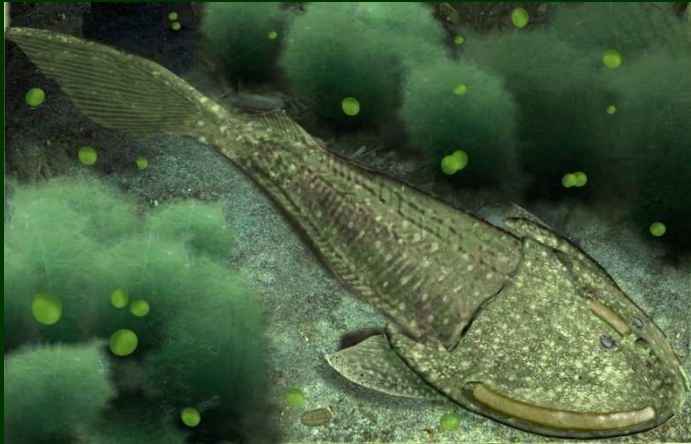


# Tullimonstrum

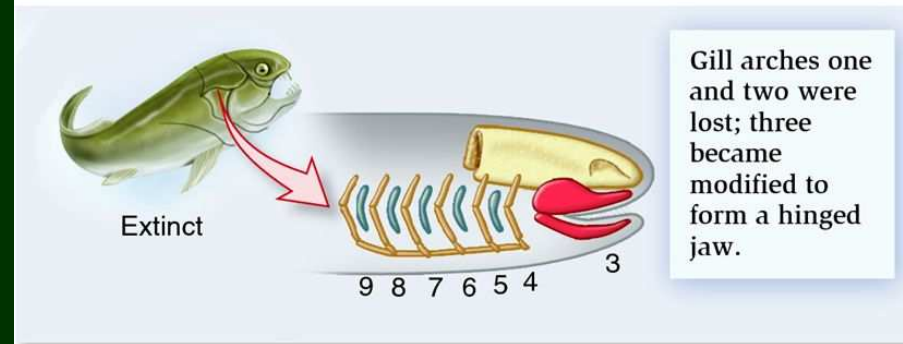


Mazon Creek, karbon

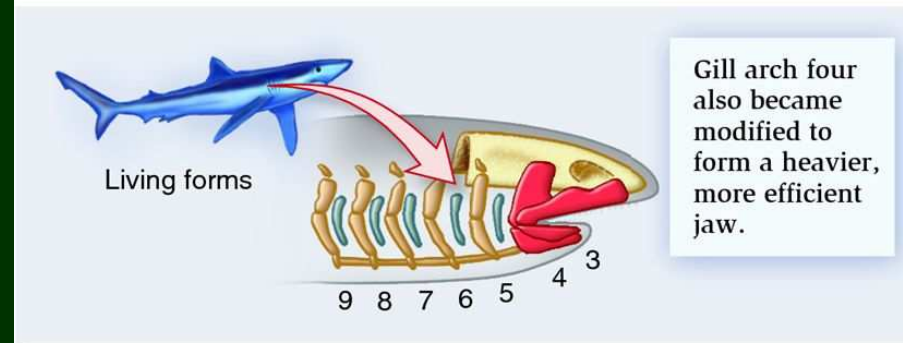
# „Agnatha“



(a) Ancestral jawless fishes

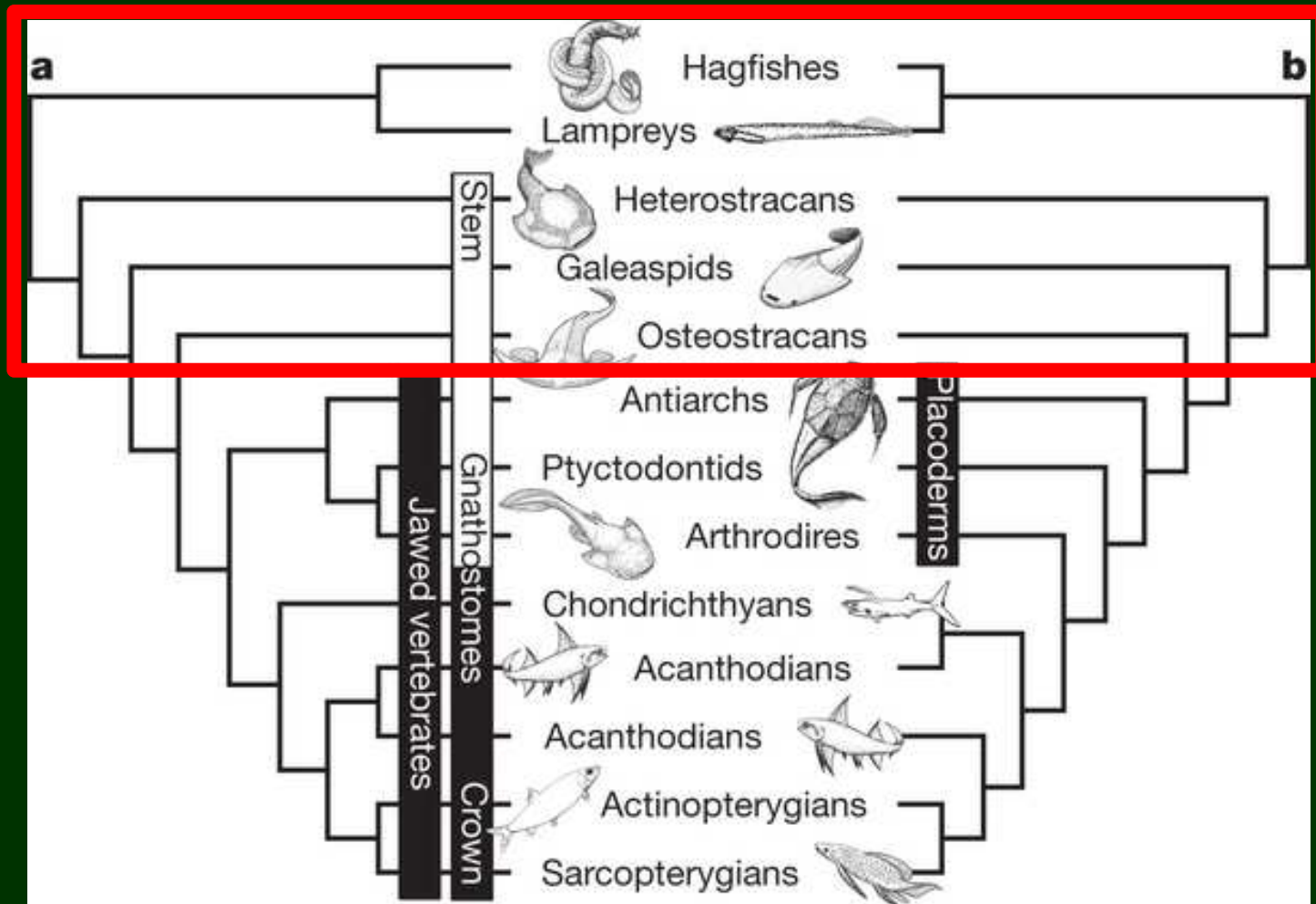


(b) Early jawed fishes (placoderms)

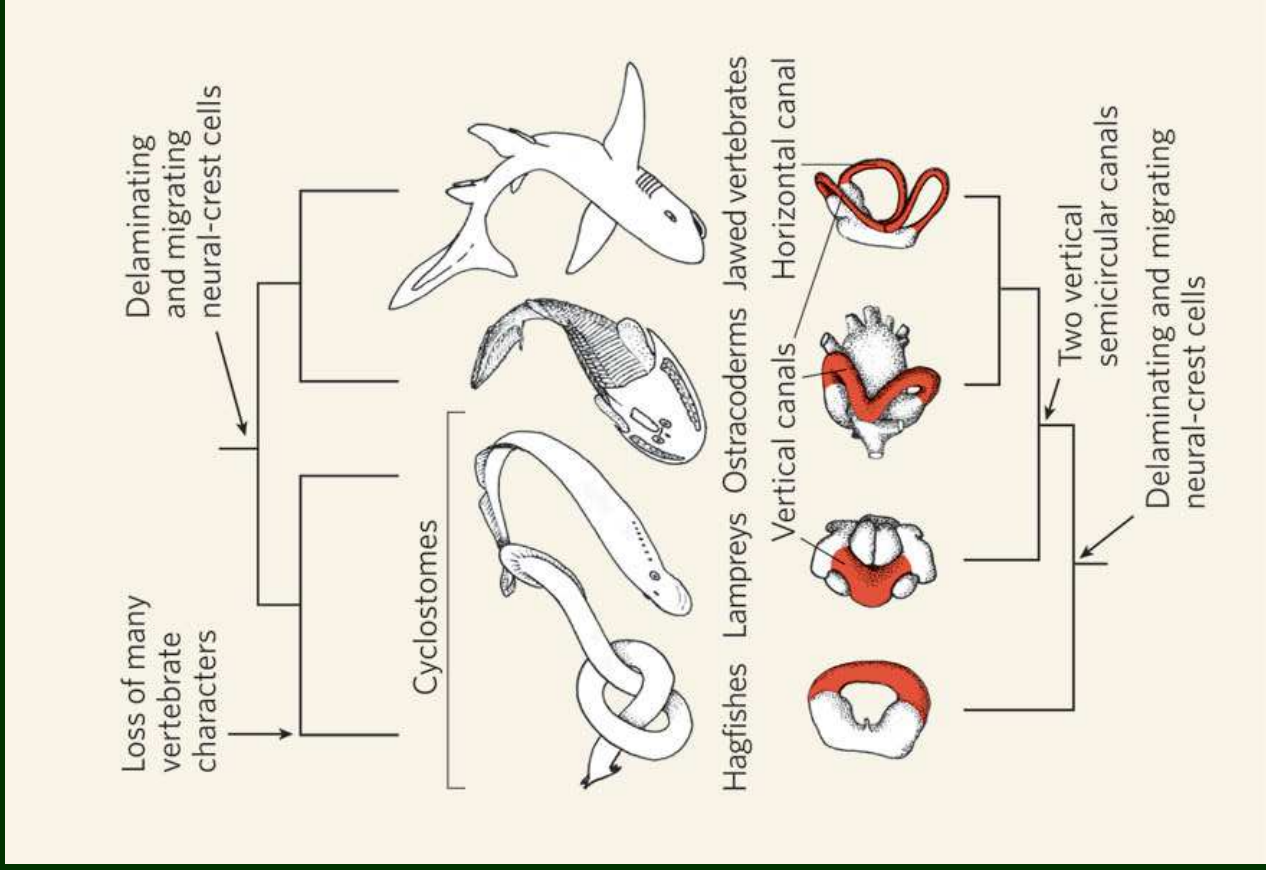
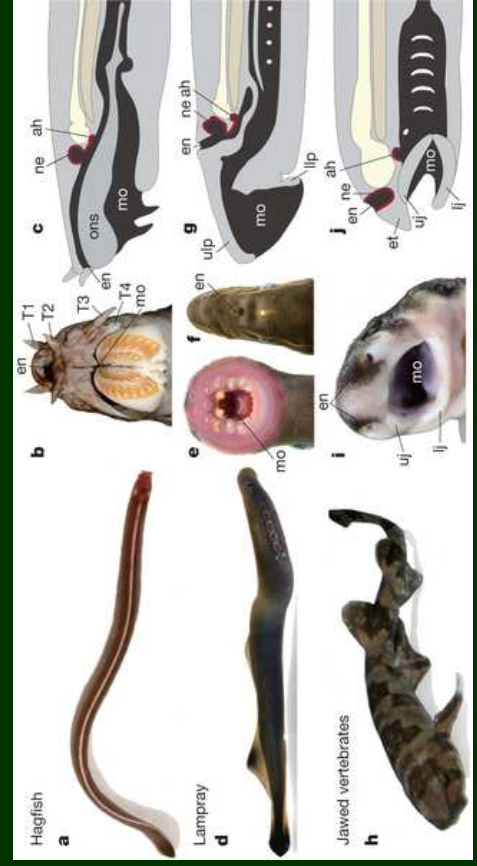
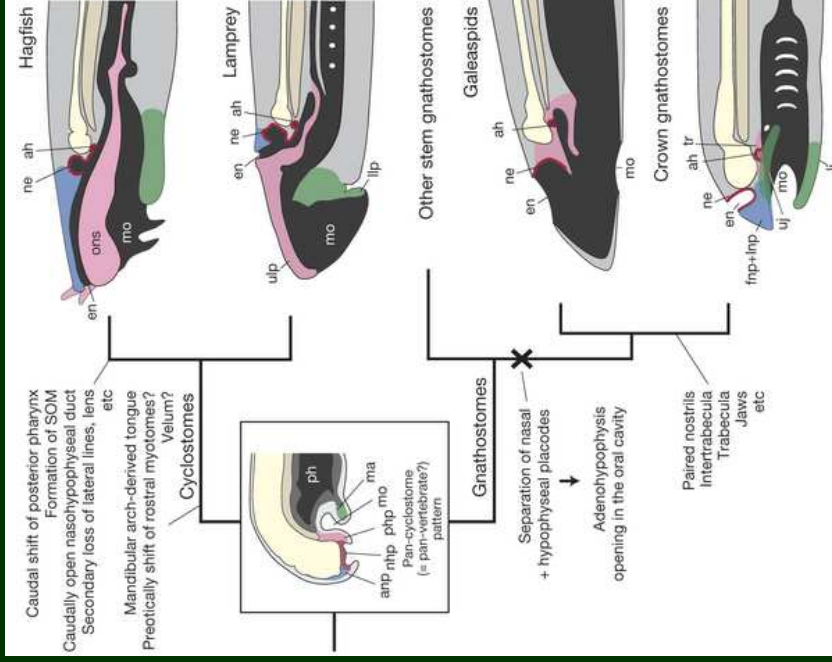


(c) Modern jawed fishes (cartilaginous and bony fishes)

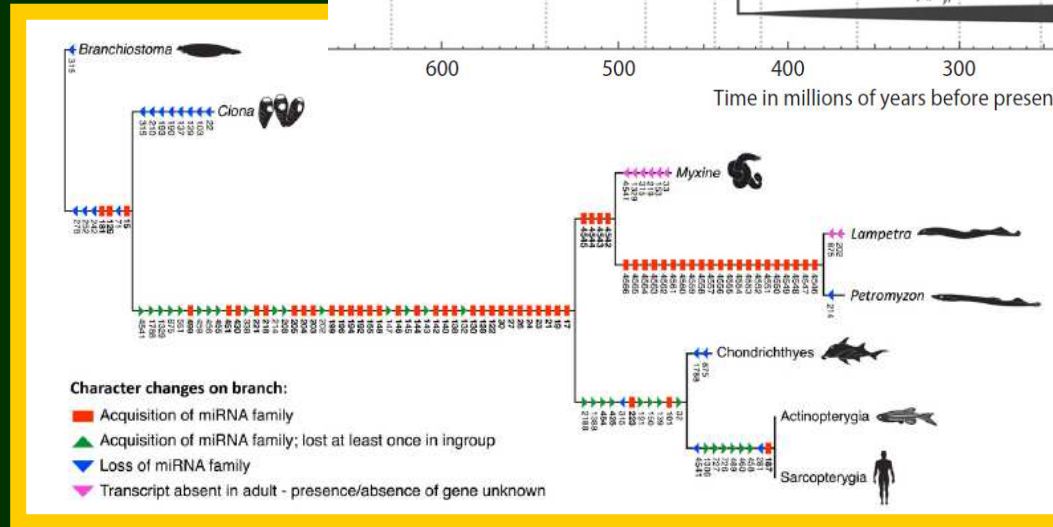
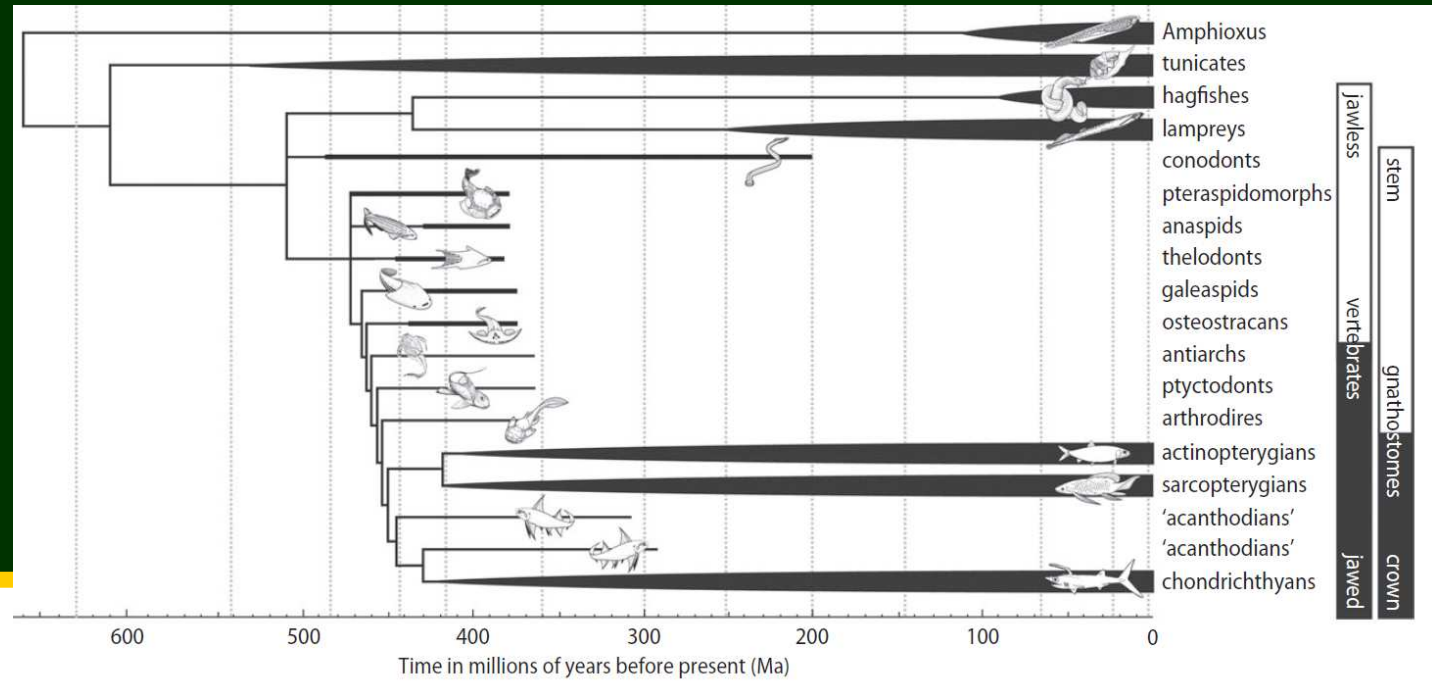
# „Agnatha“







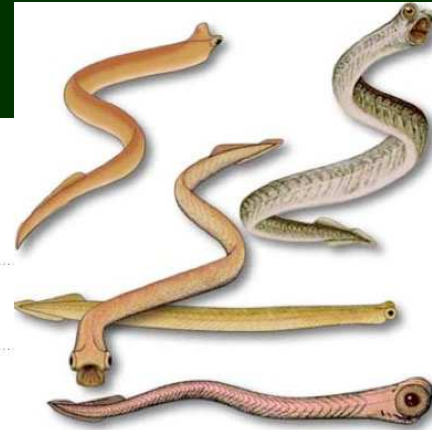
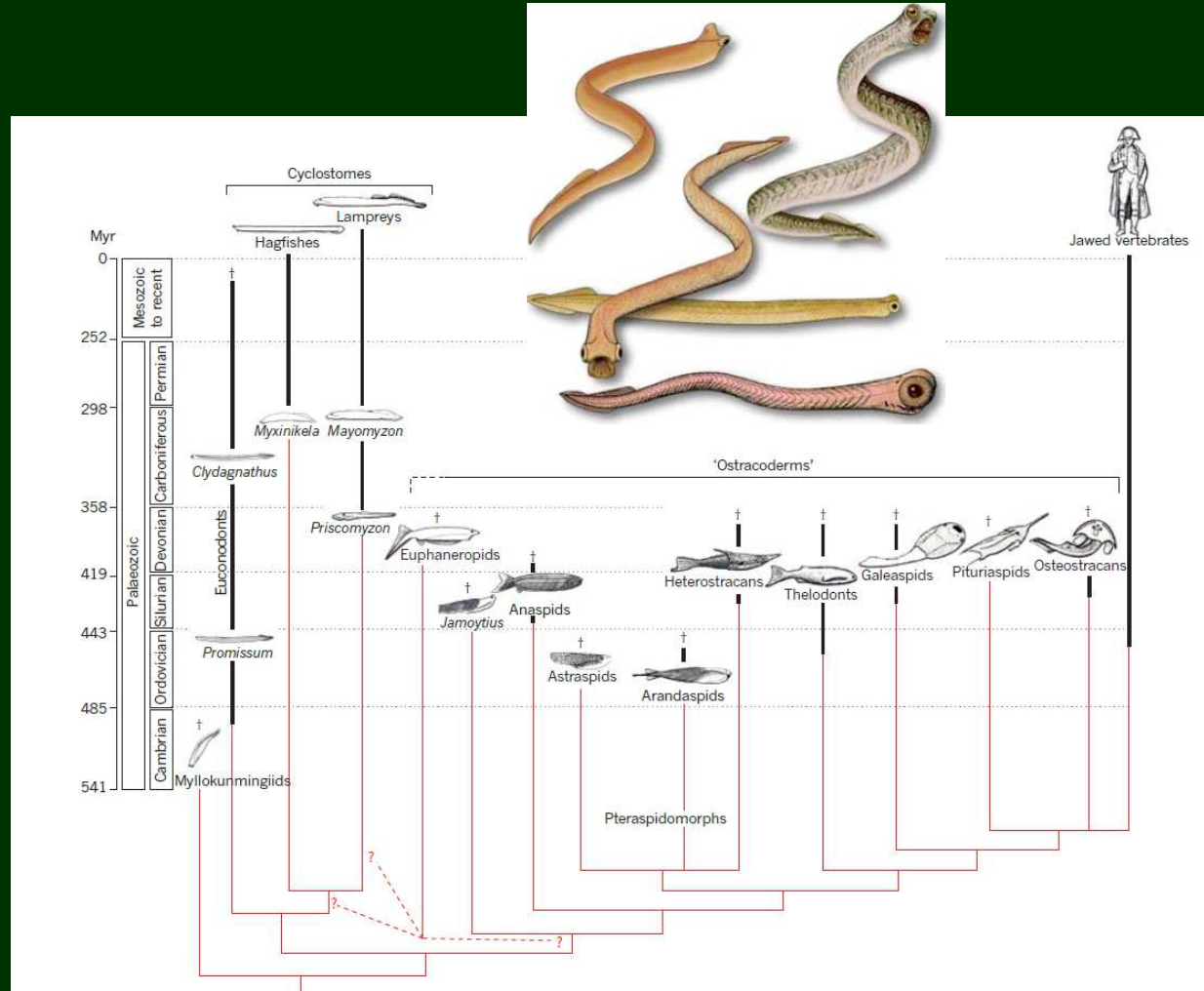
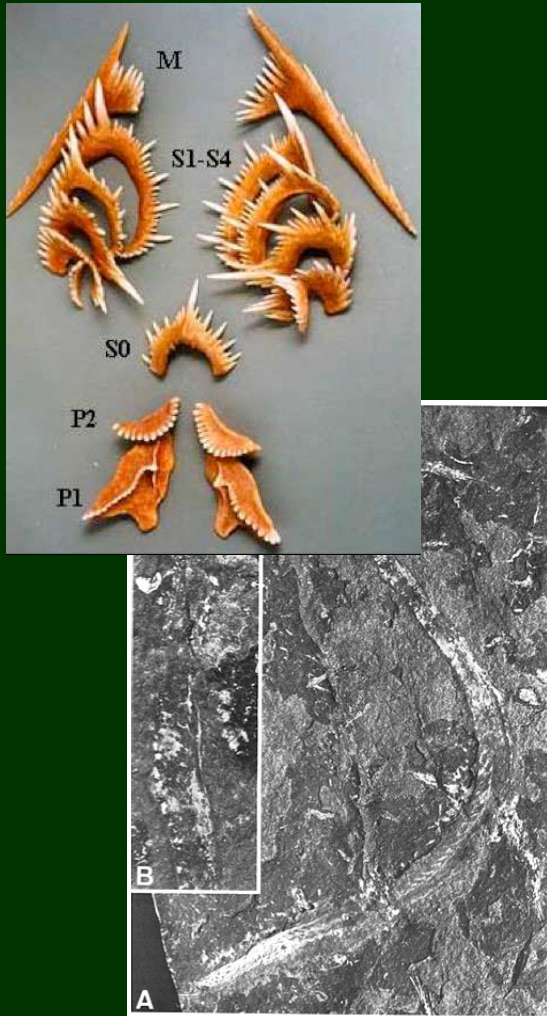
# Cyclostomata

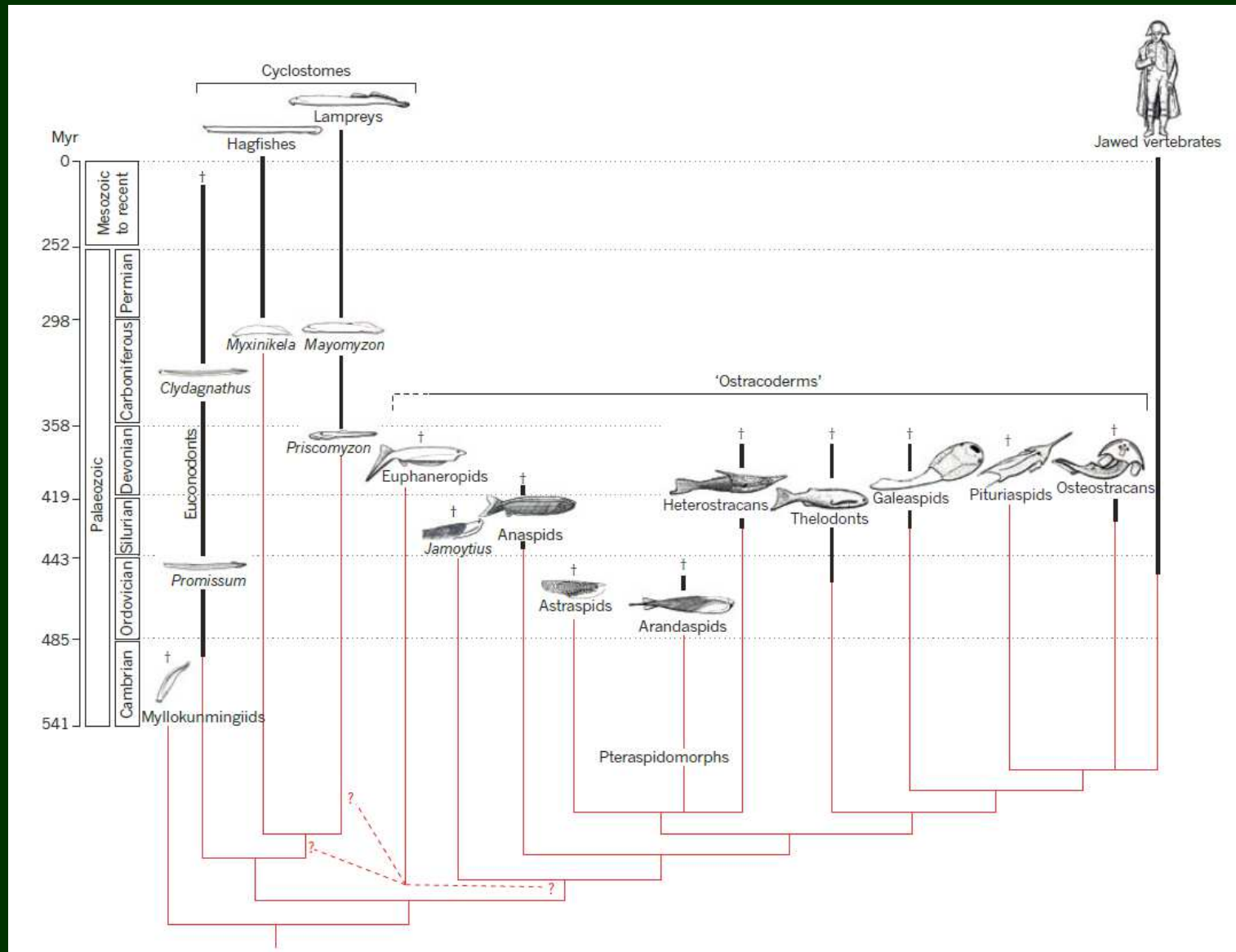


miRNA

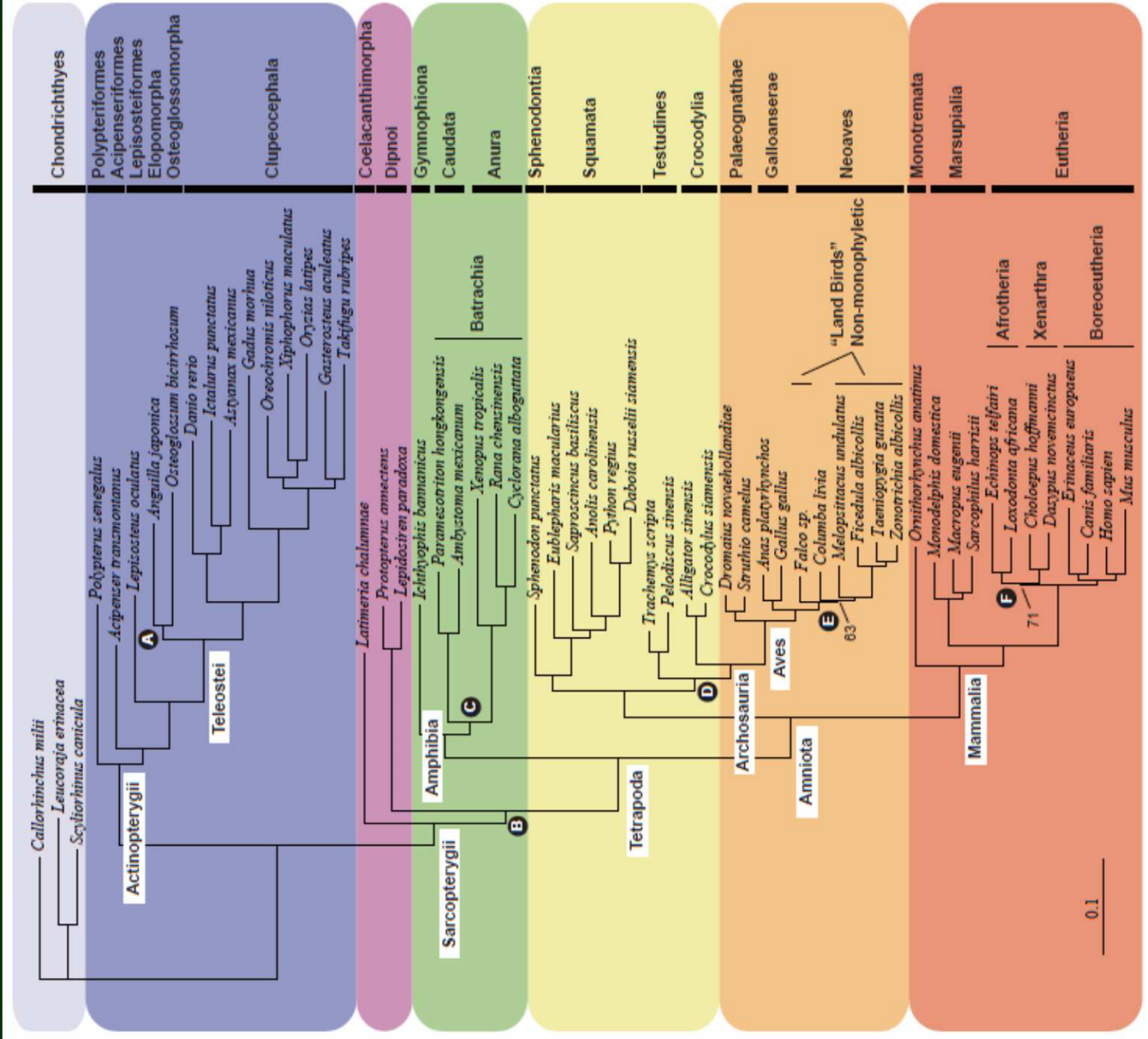
# Conodonts

(Conodontochordata, Conodontophorida...)

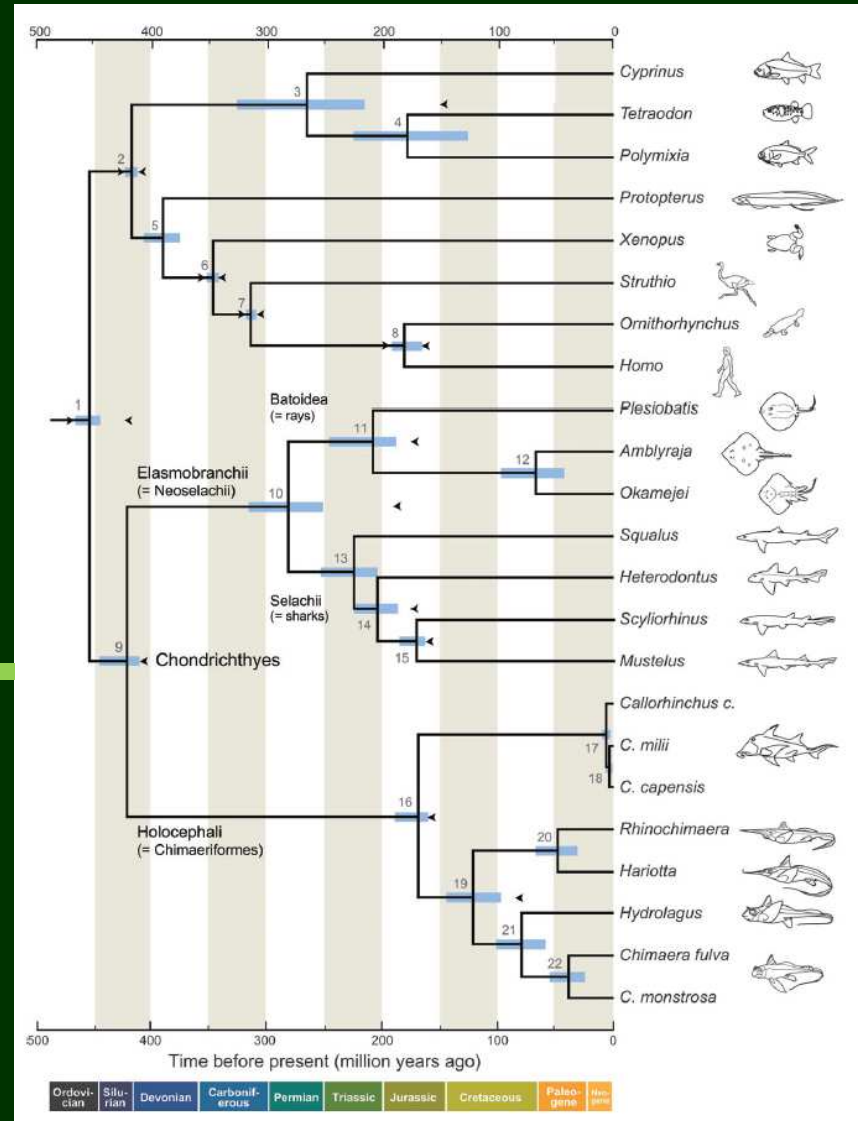
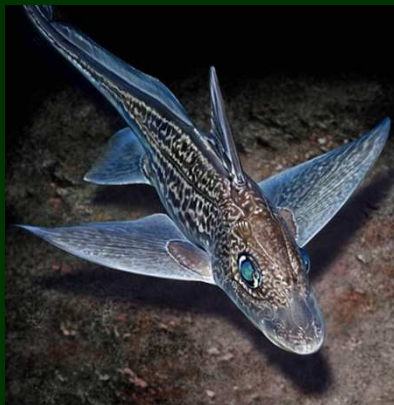




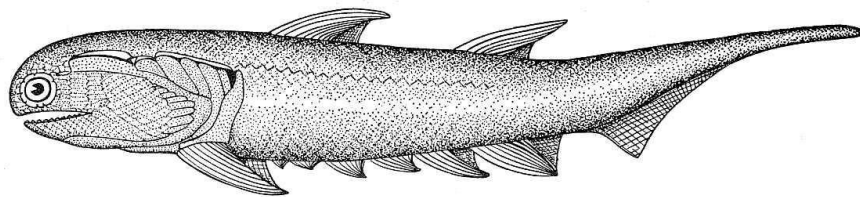
- alternativní postavení konodontů: bazální kruhoústí?



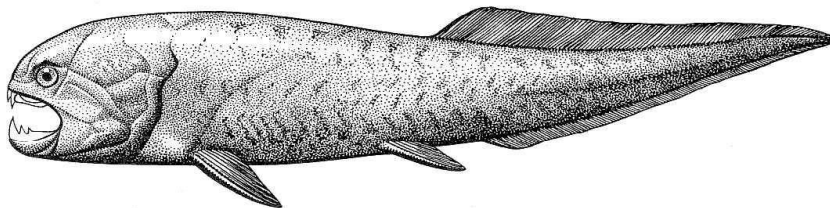
# Gnathostomata



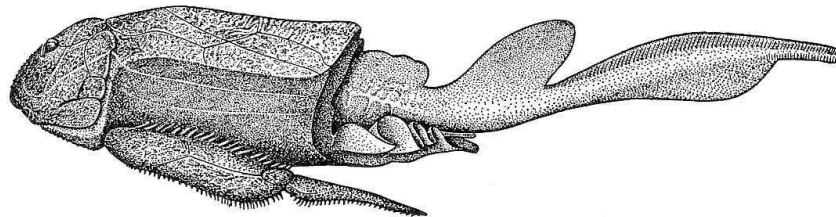
# Bazální Gnathostomata („Placodermi“)



A. Climatius

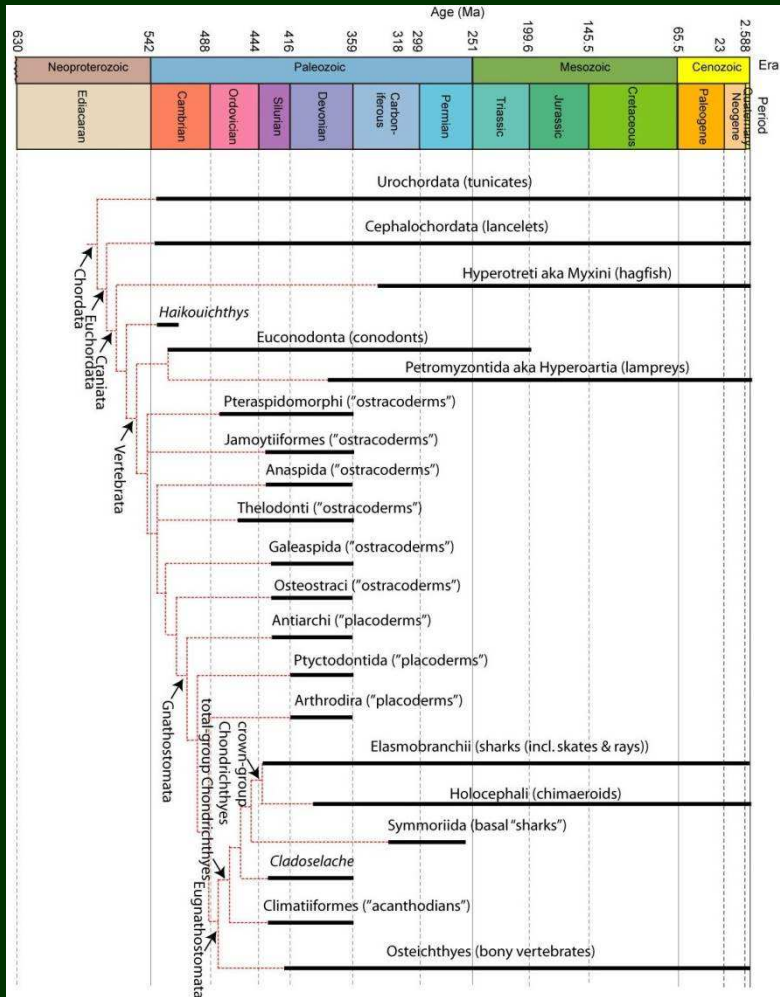


B. Dinichthys



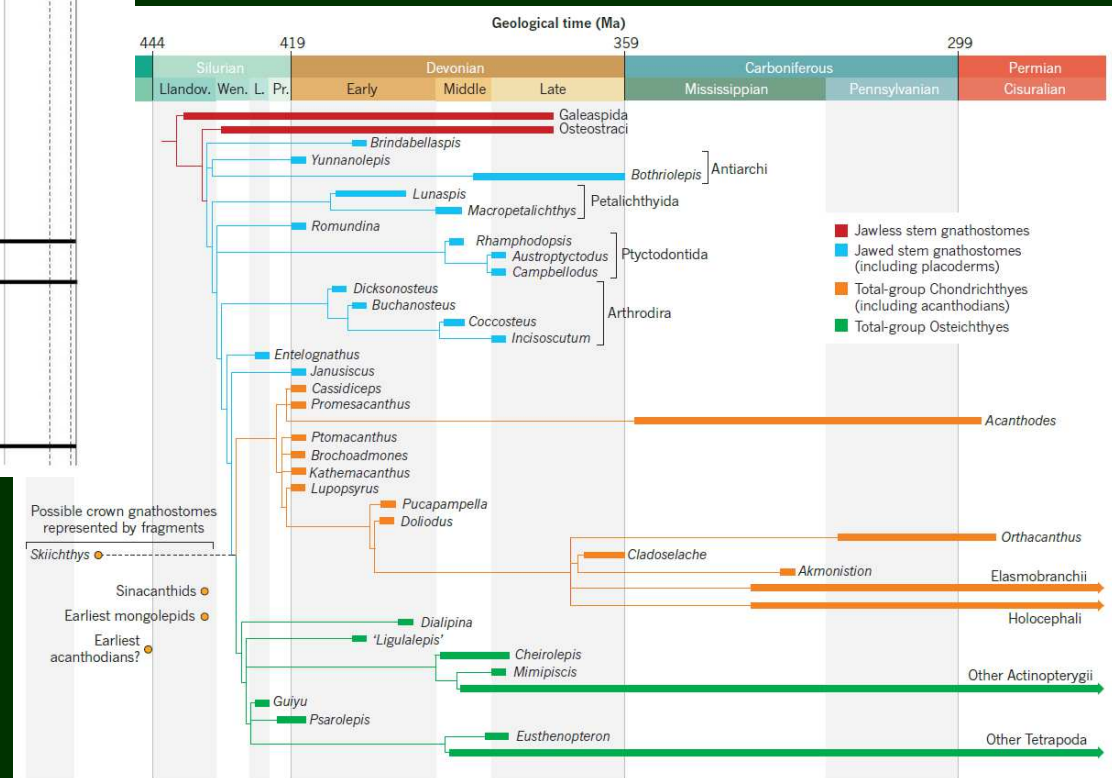
C. Bothriolepis





„Placodermi“ skoro určitě  
bazální čelistnatci

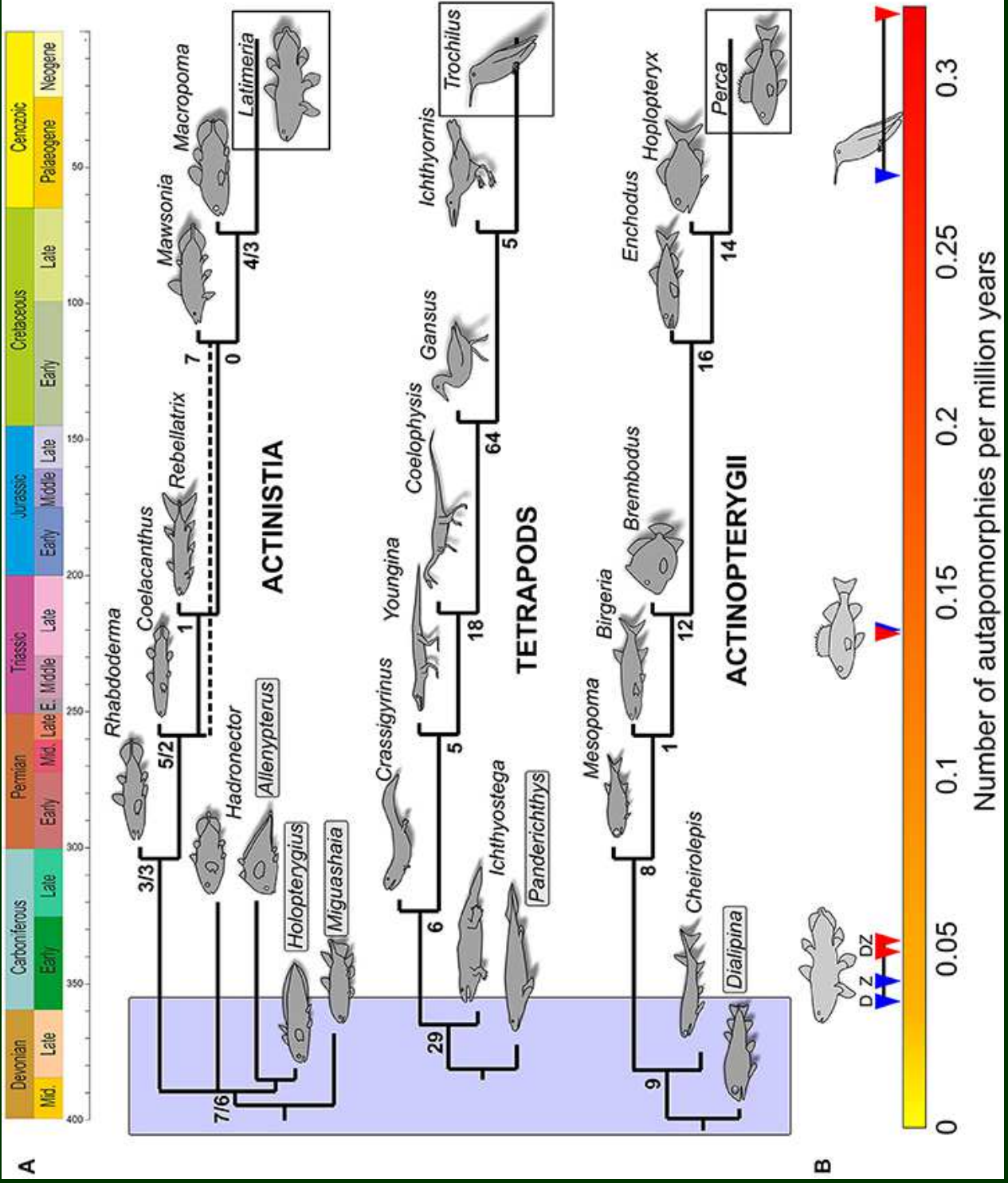
Acanthodii bazální paryby  
(pokud to není víc skupin...)



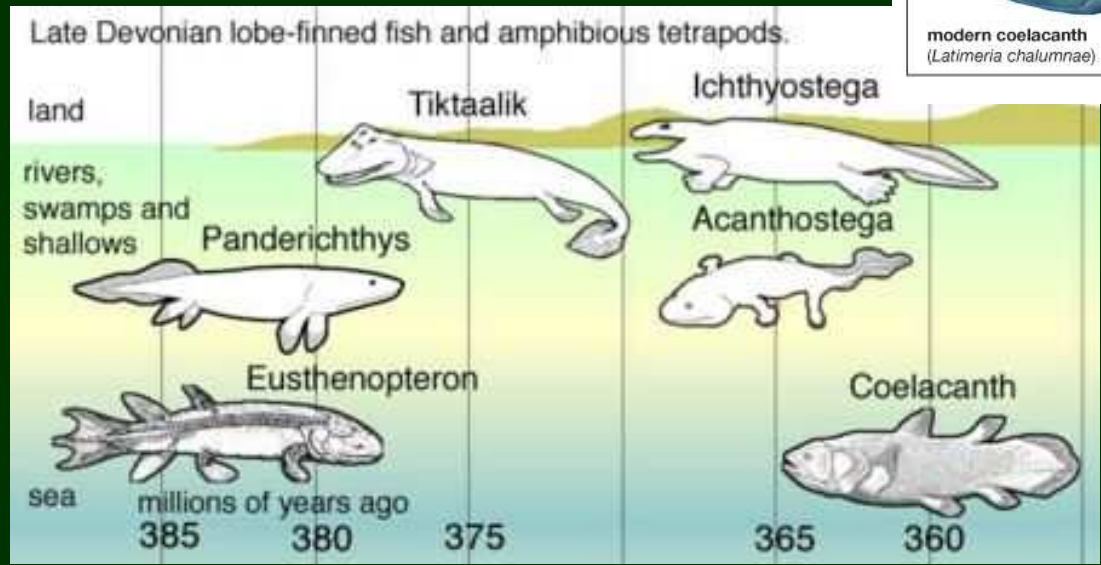
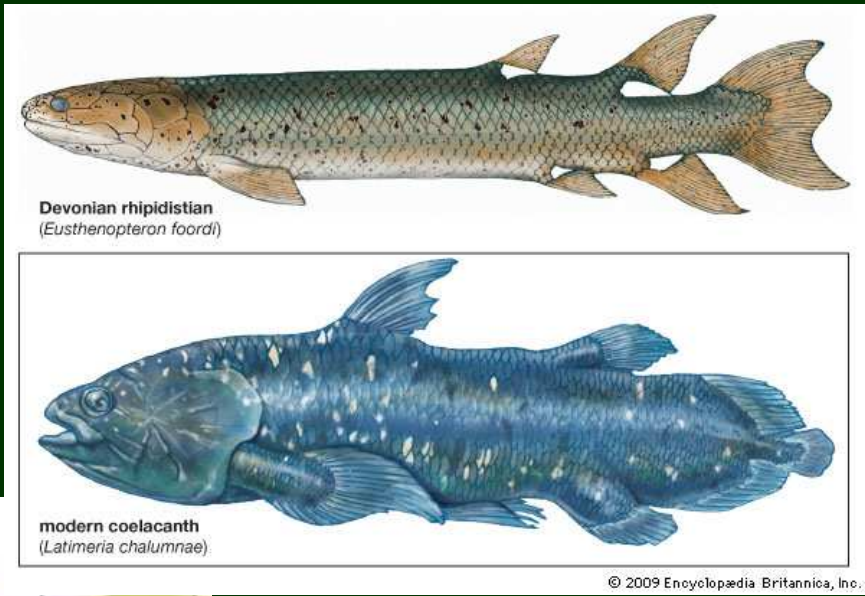
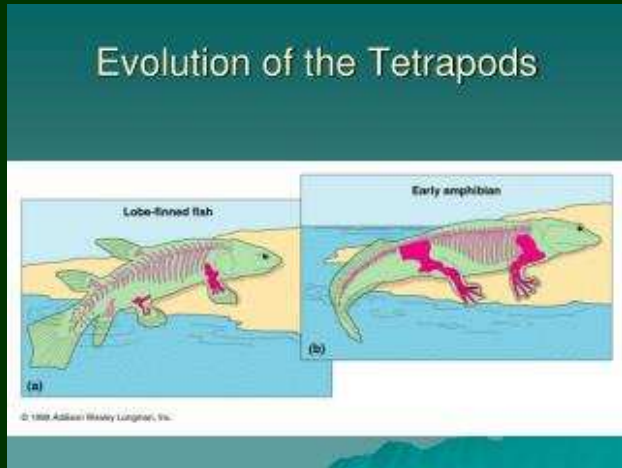


# Sarcopterygii

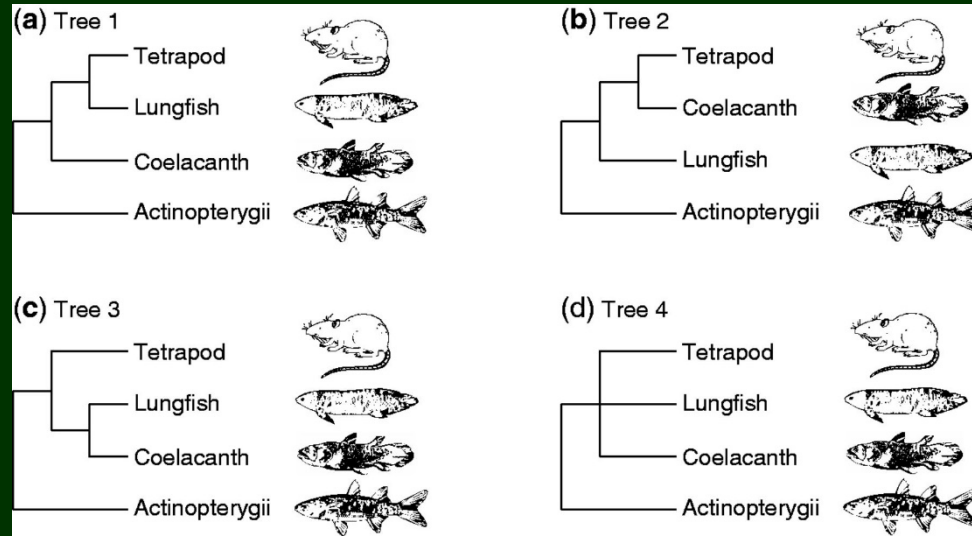




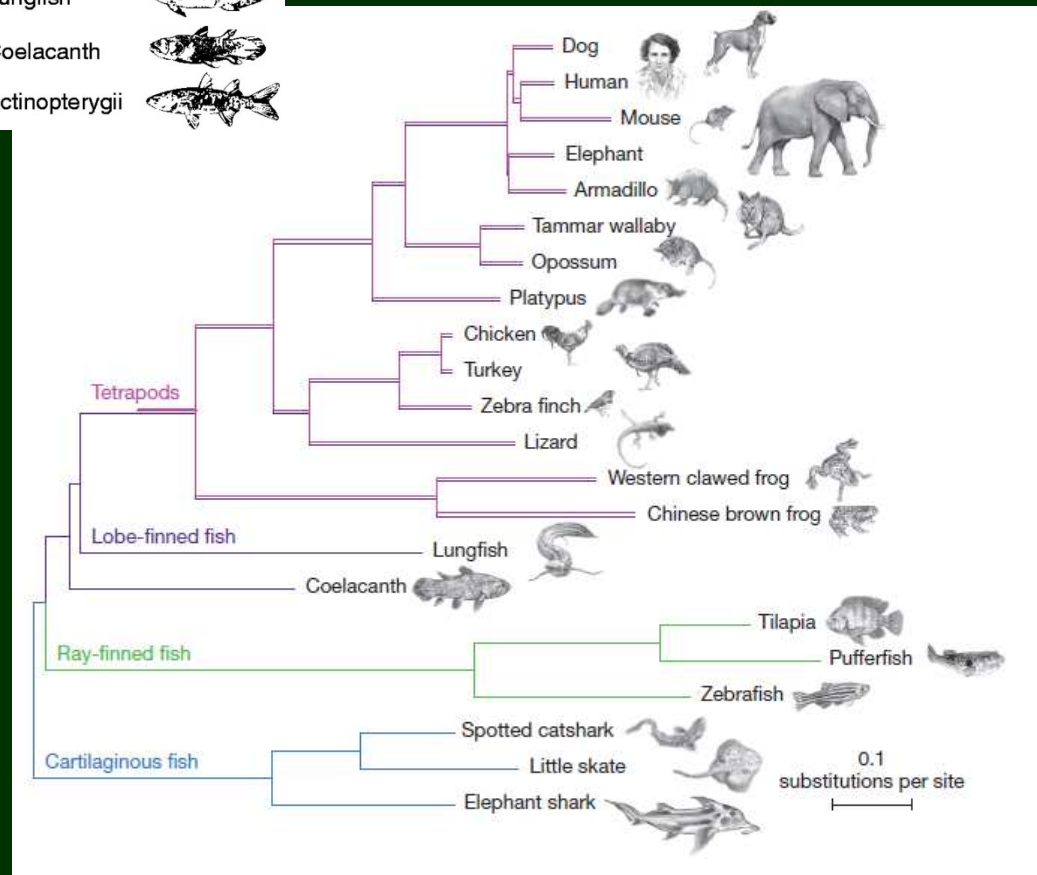
# „Crossopterygii“



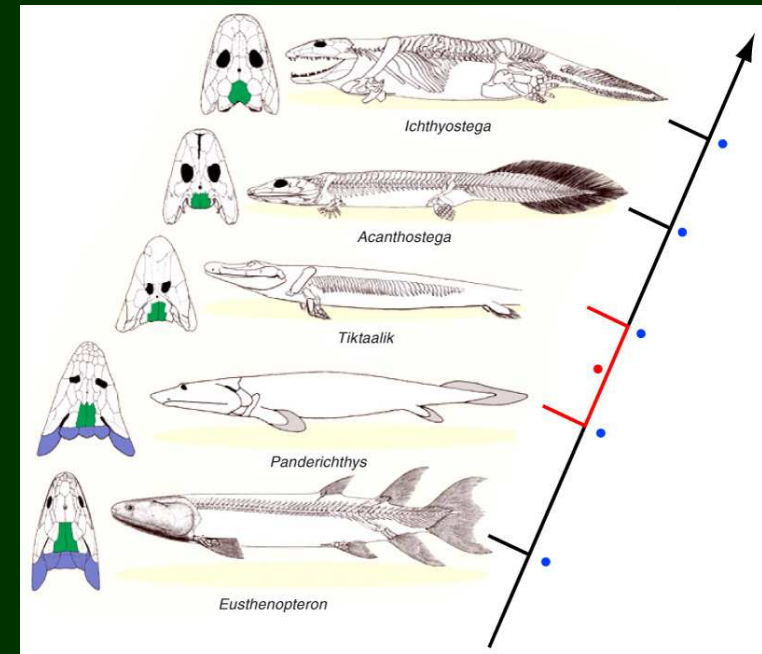
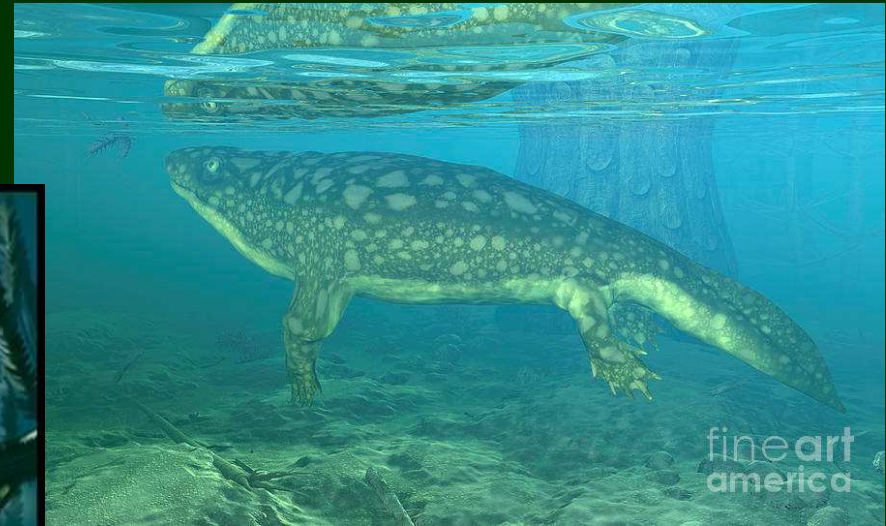
# Sarcopterygii



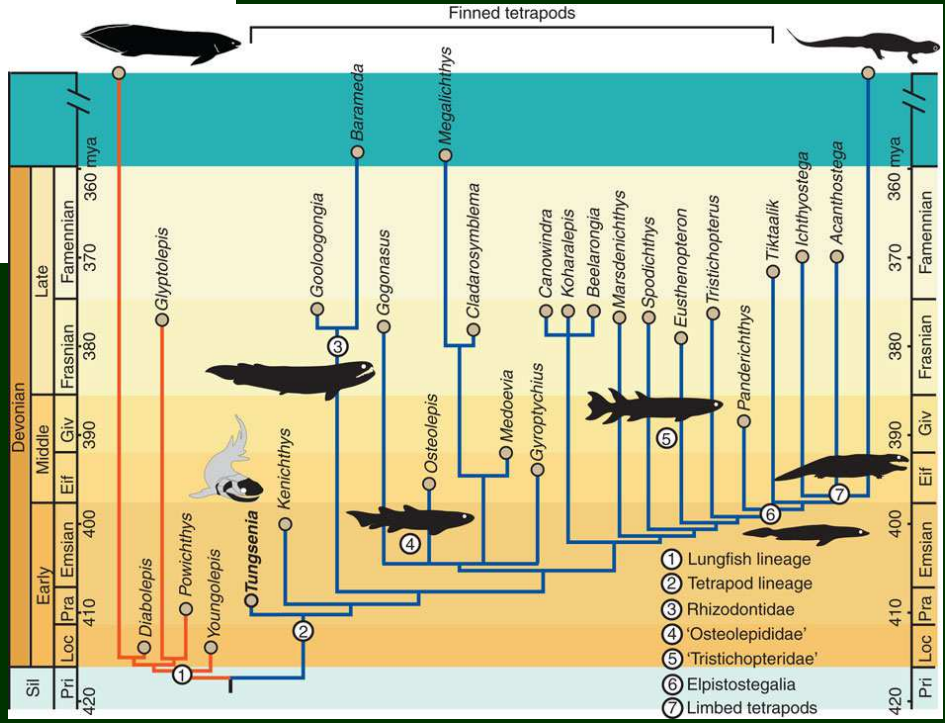
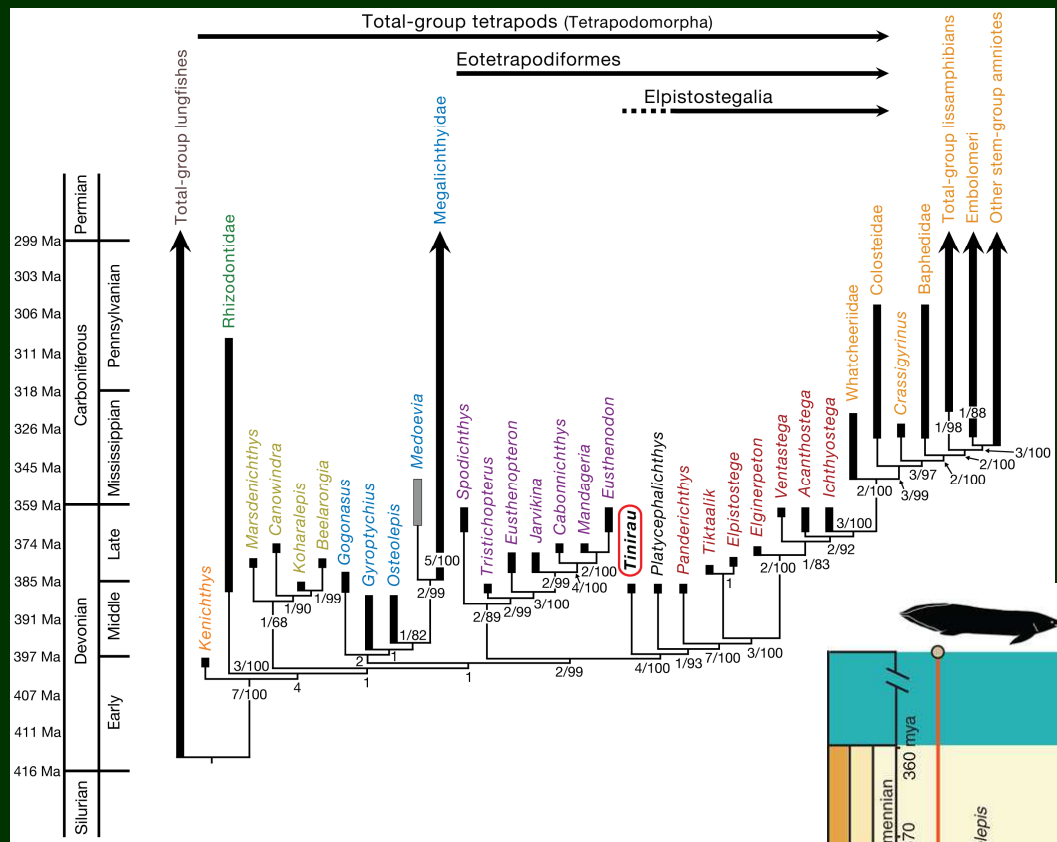
251 genů,  
kompletní  
genom  
latimerie



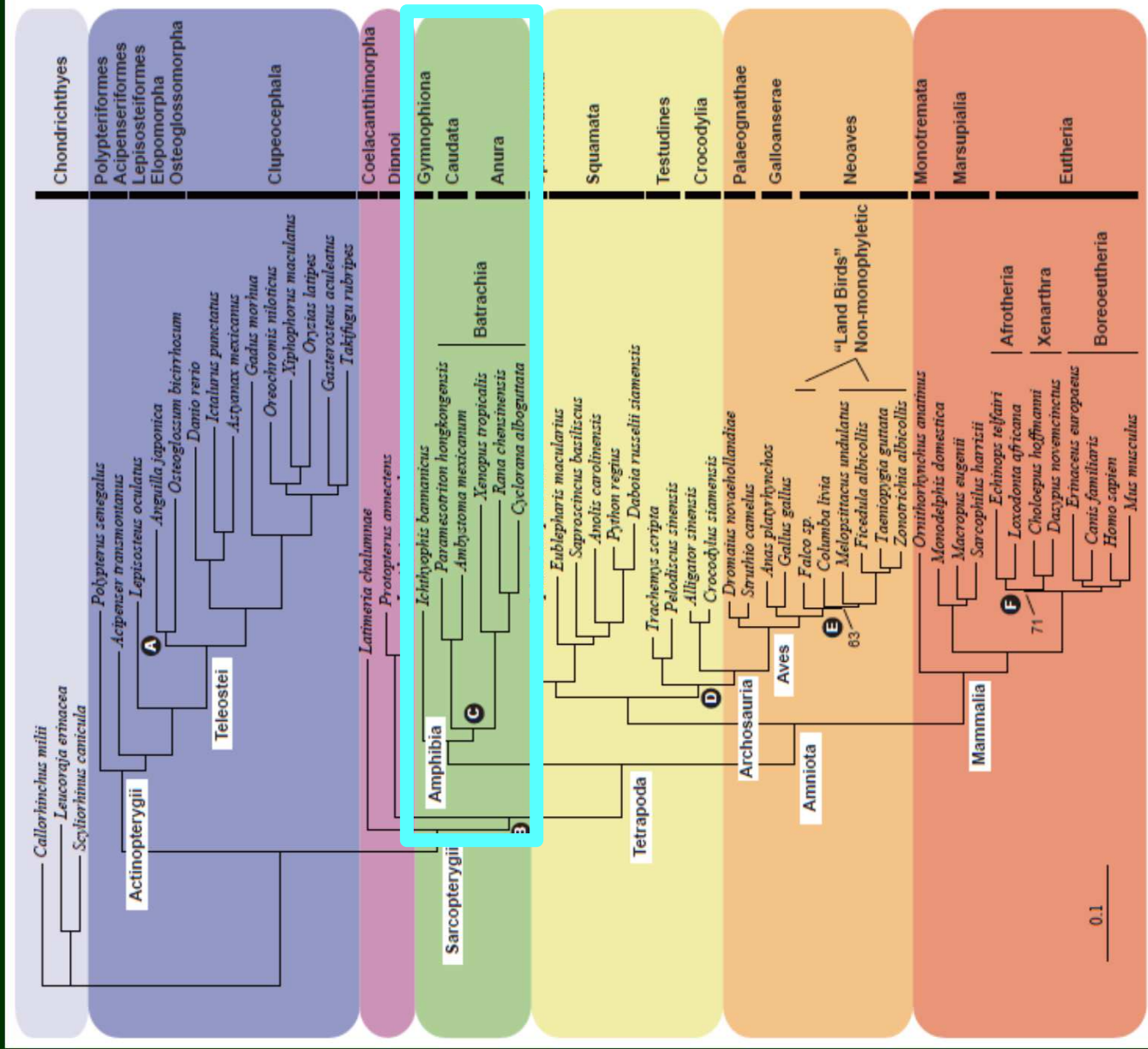
# „Crossopterygii“



# Bazální Tetrapoda



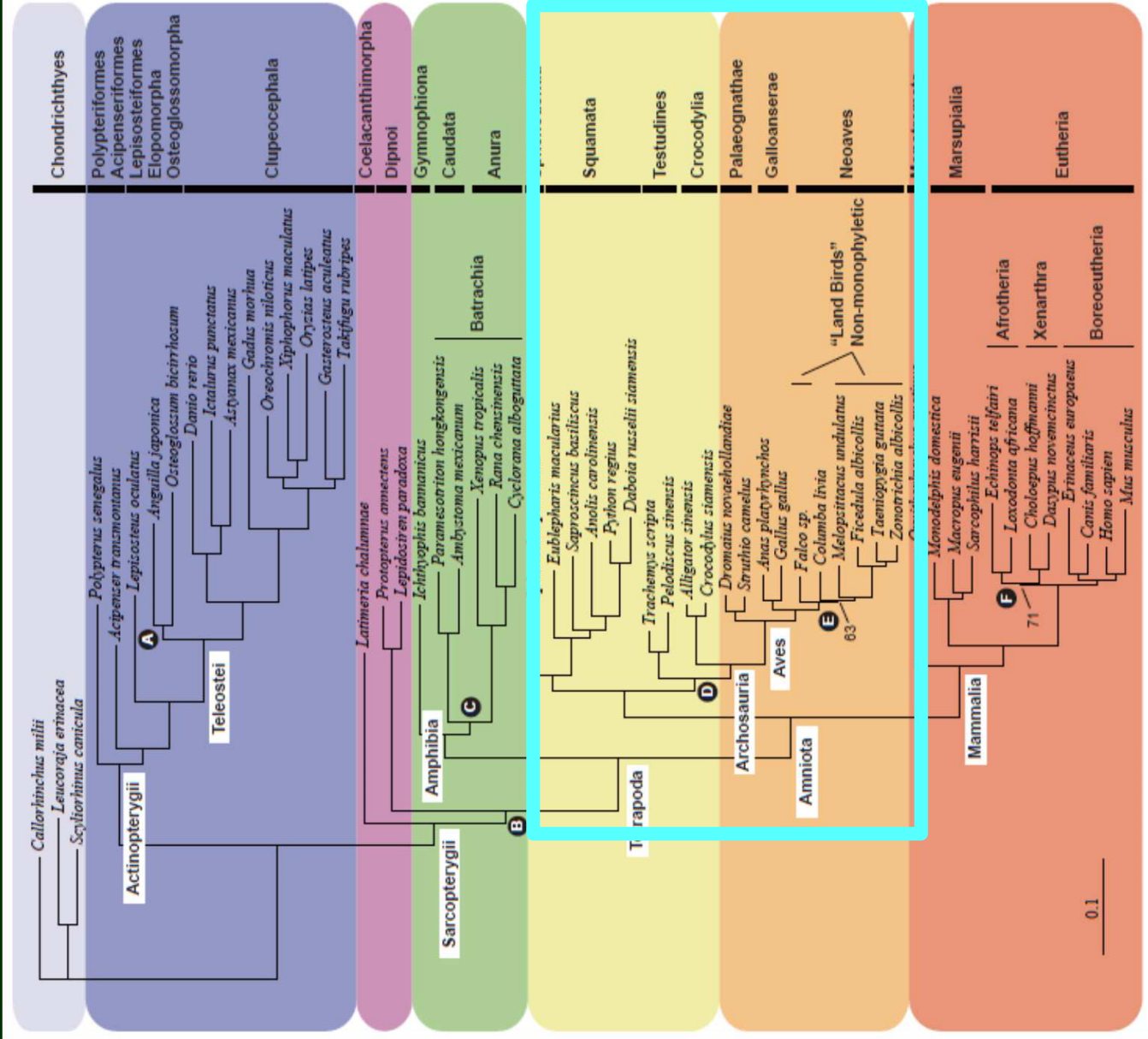
- ① Lungfish lineage
- ② Tetrapod lineage
- ③ Rhizodontidae
- ④ Osteolepidae'
- ⑤ 'Tristichopteriidae'
- ⑥ Elpistostegalia
- ⑦ Limbed tetrapods



# Tetrapoda: Lissamphibia

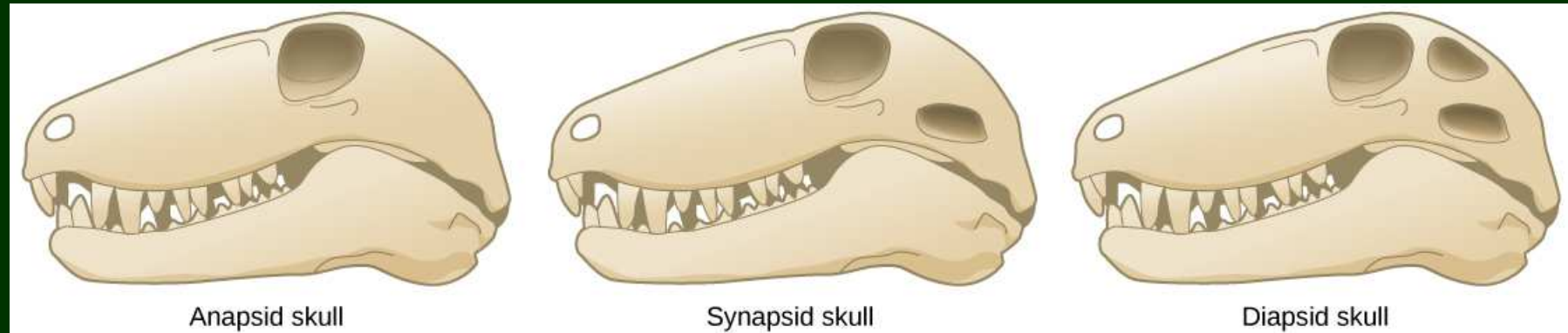






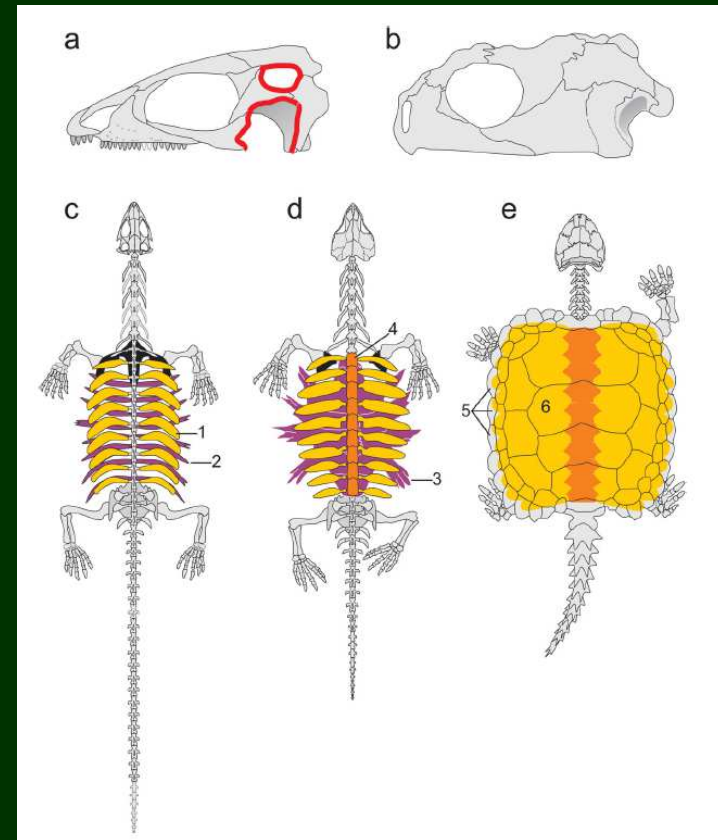
# Amniota: Diapsida (= Reptilia s. lat.)





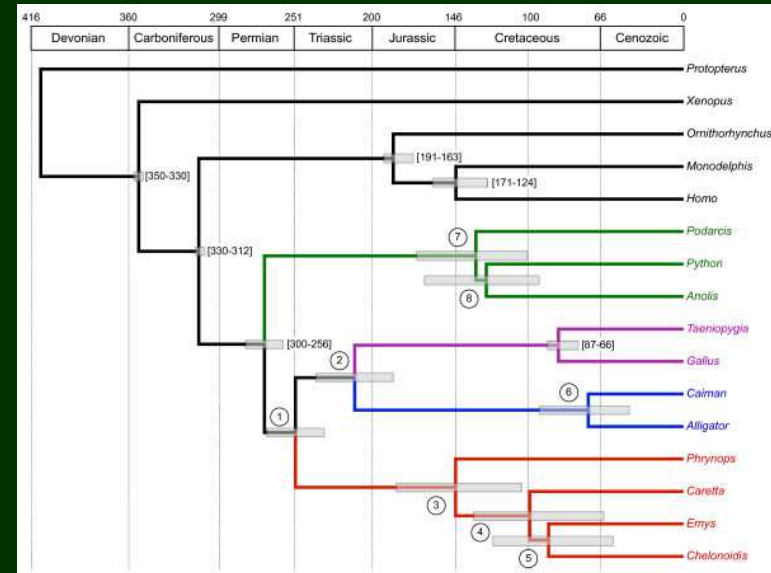
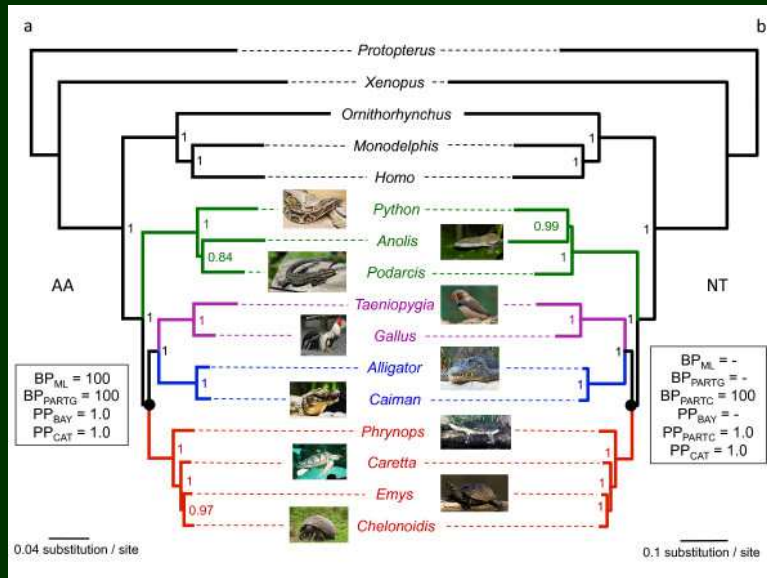
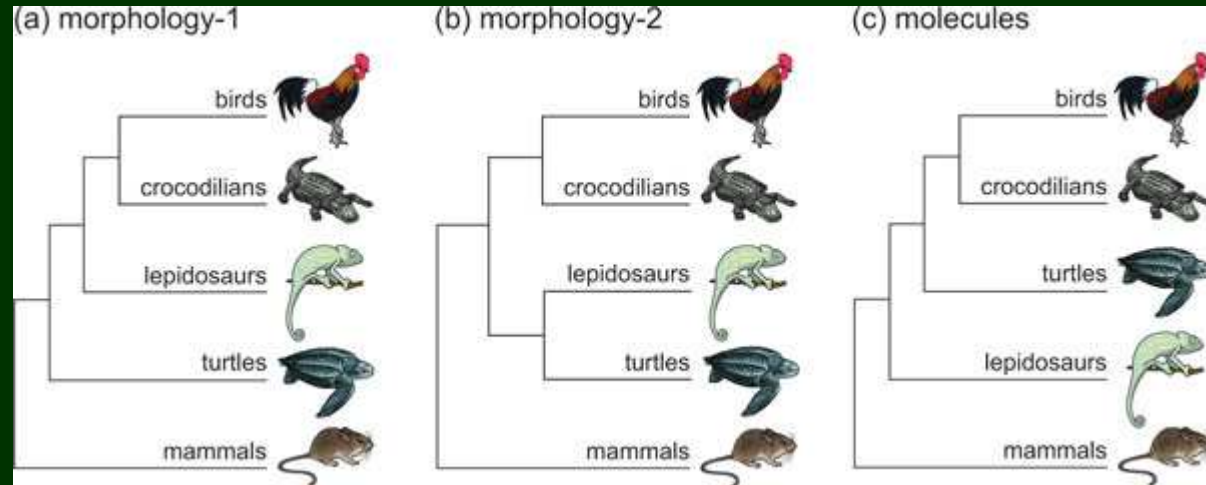
## Postavení želv

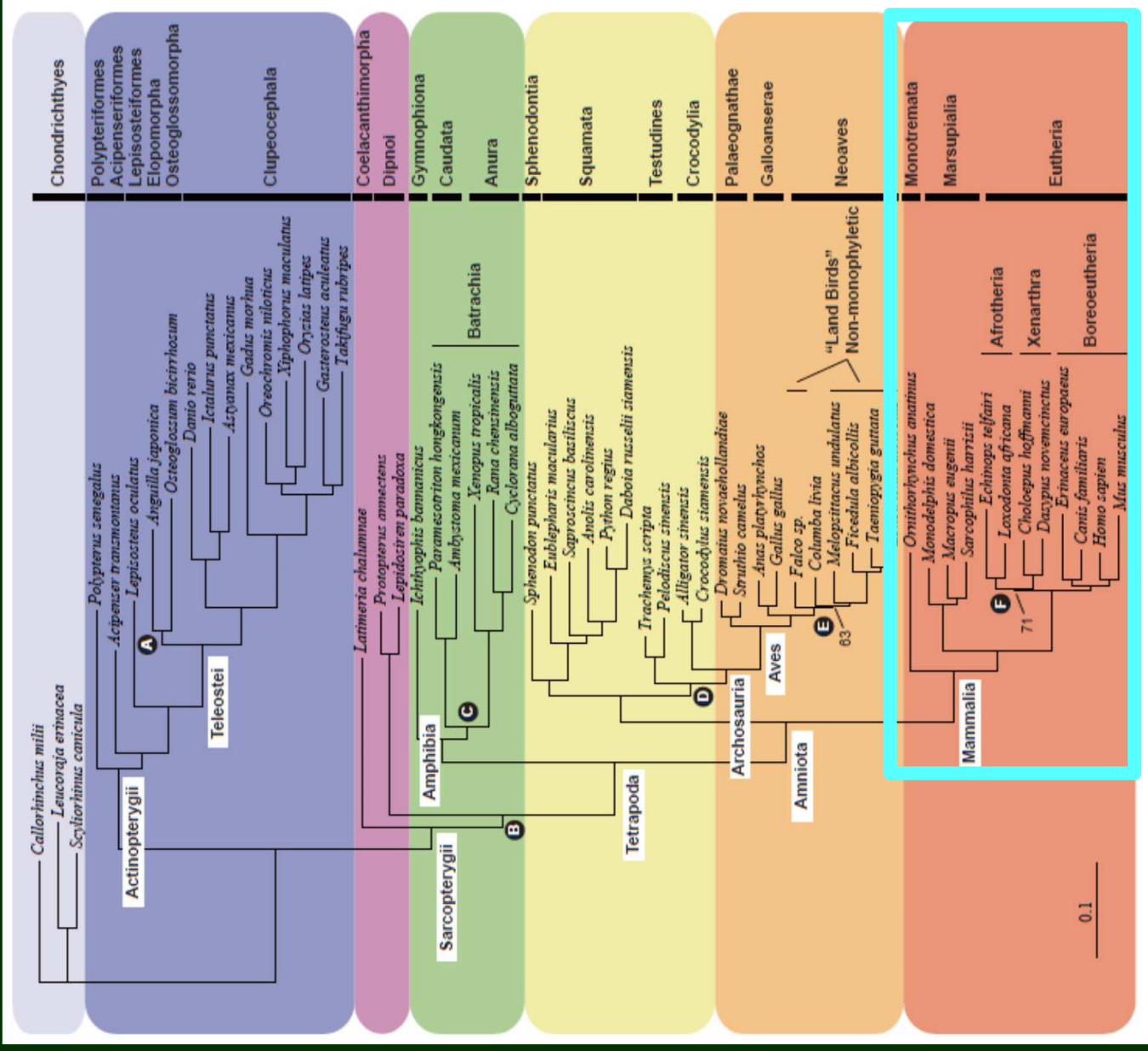
- bazální plazi (Parareptilia) x Archosauromorpha
- želvy původně diapsidní



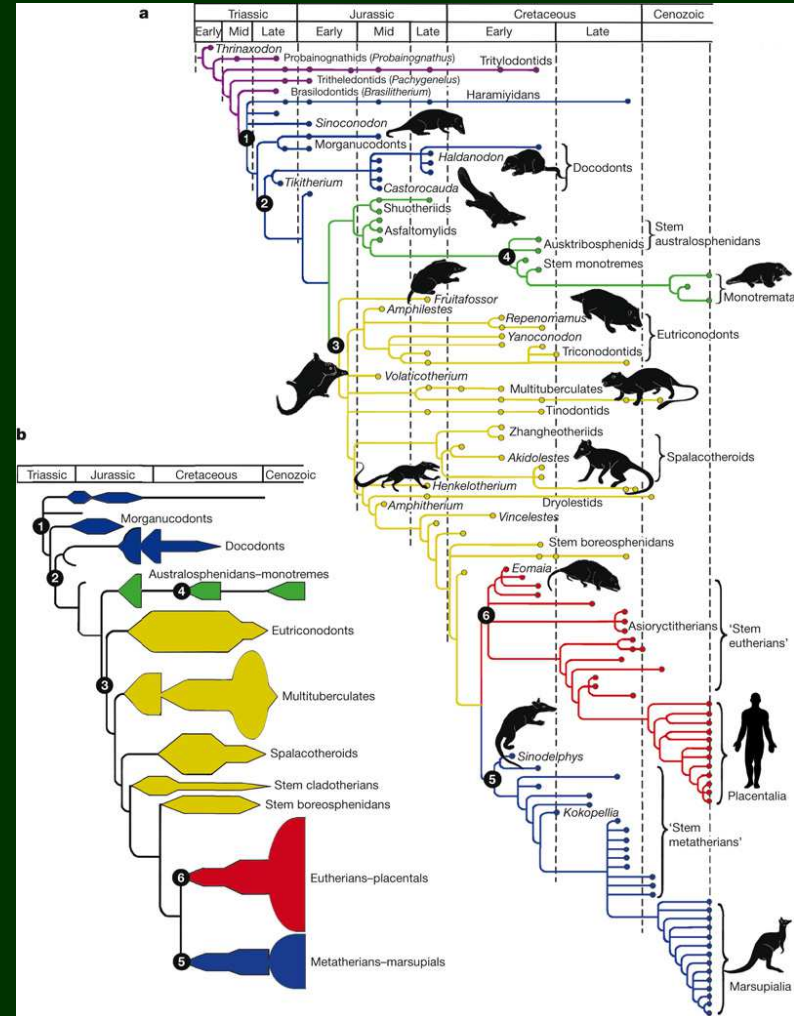
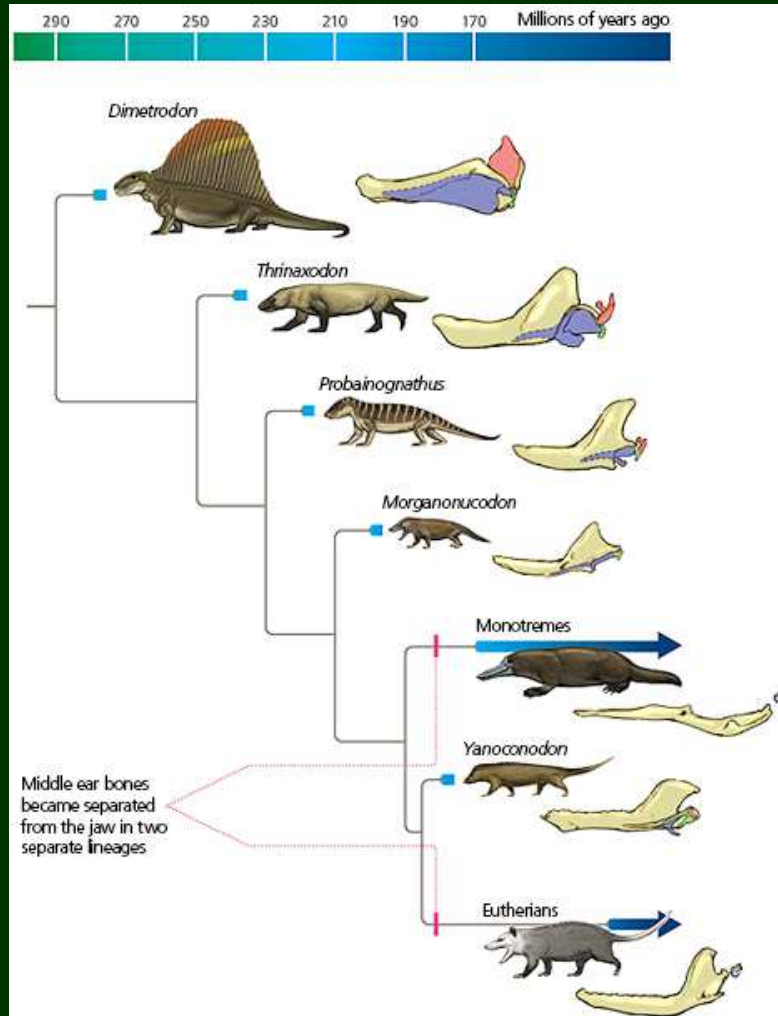
# Fylogenomika a postavení želv

248 genů





# Mammalia (Synapsida)



# Mammalia (Synapsida)

