**Topic 5: The Origin of Amniotes**

- Where do amniotes fall out on the vertebrate phylogeny?
- What are some stem Amniotes?
- What is an Amniote?
- What changes were involved with the transition to dry habitats?
- What are the three main groups of Amniotes?
- How are Amniote taxa related?

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**What are some stem Amniotes?**

- Palaeontological tree:
  - Anthracosauria, Seymouriamorpha, and Diadectomorpha as extinct outgroups to Amniotes
  - Split between Amniota and Amphibia ~360 Mya

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**What is an Amniote?**

- Synapomorphies associated membranes
  - fertilization
  - maxillary teeth
  - Various other skull and limb characters

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**The Amniotic Egg**

- Contains extraembryonic membranes (4):
  - Amnion
  - Chorion
  - Allantois
  - Yolk sac
The Amniotic Egg

- Surrounds embryo
- Forms space filled with amniotic fluid
- Contains exchange of gases and water
- Assists in development
- Connected to embryo
- Yolk sac
- Allantois
- Chorion

Amnion

- Outermost membrane
- Forms placenta in placental mammals
- Allantois
- Yolk sac

Yolk sac

Involved in formation of placental mammals

Chorion

Posterior part of GI tract

Can be calcified and hard or leathery and soft

What about the shell?

- Form outside embryo
- Connected to embryo
- The shell is deposited by the embryo
- Can be calcified and hard or leathery and soft
- Involved in:
  - Protection
  - Support of the embryo

What changes were involved with the transition to dry habitats?

- Amphibians began moving away from the water
- Many are terrestrial
- However:
  - Skin is still highly permeable to gases and water
  - Reproduction is mainly limited to

Photo © KP Bergmann

Photos © KP Bergmann, PJB
Amniote lifecycle of water

Many live in very dry habitats

Facilitated mainly by adaptation of the:
- ______ (amniotic)
- ______

Adaptations of the Egg
- Amnion, Chorion, Shell
- Protect embryo from
  - Forces are more jarring on land
  - Protect embryo from
    - Less permeable to water

Adaptations of the skin:
- __________
  - Deposition of ________ in epidermis
    - Evolved independently in several groups
  - ________, feathers, hair
- All act to limit water loss

Three different amniote conditions
- Different patterns of temporal fenestration
  - Temporal region of the skull is posterior to the orbit
  - A fenestra is an opening without a structure running through it (L. – “window”)
  - An~ none
  - Syn~ one
  - Di~ two

Three main groups of Amniotes:
- Synapsida – __________ and stem mammals
- Anapsida – __________ and stem turtles
- Diapsida – Archosauria (birds & crocodilians), Lepidosauria (squamates and rhynchocephalians) and various stem groups

Benton 1997 Fig 5.18

Photos © PJB

Photo © KP Bergmann
What are the three main groups of Amniotes?

How are Amniote taxa related?

- Which condition is ancestral?
- Derived?
- What implications do the alternative placements of Testudines (A or B) have on the evolution of the anapsid condition?
- What kinds of data might be brought to bear on this problem?

Pough et al 2004, Fig 2-1
How are Amniote taxa related?

- Which condition is ancestral?
  - __________
  - __________
  - __________

- Derived?
  - A: __________
  - B: __________

- What implications do the placements of Testudines (A or B) have on the evolution of the anapsid condition?
  - A:
  - B:
How are Amniote taxa related?

- What kinds of data might be brought to bear on this problem?
  - __________________________
  - __________________________
  - Each has been used and says something slightly different...

How are Amniote taxa related?

- Traditional hypothesis: A
  - Mainly based on extant taxa and _______________ data
  - Includes only some fossil taxa
  - Assumes that all __________ are related

Synapsida  Anapsida  Diapsida  Pough et al 2004, Fig 2-1
How are Amniote taxa related?

- **Traditional hypothesis:**
  - Basal anapsids
  - “Parareptiles”
  - Plesiosaurs
  - Procolophids

*Fig. 5.15 Benton*

- **Hypothesis B:**
  - Based on extensive fossil sampling and no *a priori* assumptions of relationship
  - Testudines have an anapsid condition
  - Sister to Parareptiles

*Fig. 2-9 Pough et al.*

- **Hypothesis B:**
  - Testudines fit in? (support for B)

- **Hypothesis C:**
  - Hypothesis B: What do ________
  - Extensive fossil sampling and no *a priori* assumptions of relationship
  - Testudines have an anapsid condition
  - Sister to Parareptiles

Testudines? Not the *Lepidosauria*

*Fig. 2-9 Modified from Pough et al.*

- **Hypothesis B:**
  - Testudines fit in? (support for B)

- **Hypothesis C:**
  - Hypothesis B: What do ________
  - Extensive fossil sampling and no *a priori* assumptions of relationship
  - Testudines have an anapsid condition
  - Sister to Parareptiles

*Fig. 2-9 Modified from Pough et al.*

- **Who are the Amniota?**
  - Crocodilians
  - Birds
  - Rhynchocephalia
  - Squamata
  - Snakes
  - Lizards
  - “Lizards”
  - “Lizards”

*Fig. 2-1 Pough et al. 2004*
Without birds is Archosauria

Reptilia (5)
- Includes the remaining amniotes to be monophyletic
- Without birds is
- Many obscure synapomorphies
- They have (even birds – on feet)

Aves (Birds)
- Birds are dinosaurs, & dinosaurs are Archosaurs
- Aves have many synapomorphies:
  - No teeth
  - Wings
  - Feathers (shared with some dinos)
- Not covered further in this course

Reptilia
- Lots of diversity
- ~8000 spp. without birds
- Online Reptile database:
  http://www.reptile-database.org/

Testudines
Rhynchocephalia
Squamata
Crocodilia
Aves

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