The Origin of Mammals

"Squishy" Traits
- Mammary Glands – big, oozing modified sweat glands
- Hair
- Endothermy/High metabolic rate

"Hard" Traits
- Three ear bones
- Complex teeth
- Reduced number of bones in the lower jaw
- Big, complex brains

Mammal Teeth
- Teeth have complex shapes
- Different types of teeth in jaws
- Complex occlusion
The evolution of mammal hearing has involved several stages. In reptiles, the inner ear is located within the skull and is connected to the middle ear by a fenestra. In early mammals, the inner ear moved outside the skull, and the middle ear became more developed. In later mammals, the inner ear became even more specialized, allowing for improved hearing.

In more advanced mammals, the temporal bone, which supports and encloses the inner ear, became more pronounced to form a more robust ear—such as in your chuckled.

Polycaus and earlier therapsids had lower jaws made up of several dental bones and a single parabenchial and polycaus.

Therapsids, the teeth-bearing bricks, the long, single, “bathe over” the rest of the jaw, and all other bones are lost.

Mammals

The Evolution of Mammal Hearing

- Dentary
- Angular
- Quadratojugal
- Articular
- Quadratojugal
Probainognathus – on the way to the mammalian ear

• Expansion of the dentary bone
• Reduction of articular and quadrate bones
• First mammals have a dentary-squamosal articulation
• Initially ear bones were still connected to lower jaw; did not move to the inner ear region until later

Ear evolution is progressive

Mammal Locomotion and Breathing

• Mammals dealt with the problems of Carrier’s Constraint by shifting breathing contractions from the rib muscles to the diaphragm.
• How can we track this transition? Count the ribs!
Mammal Locomotion and Breathing

Chewing and Breathing

Evolution of a More Complex Brain
Earliest Mammal: *Morganucodon*

- Late Triassic
- Small insectivore
- Climber/Jumper
- True mammal ear but still attached to jaw, not in the skull
- Upright hindlimb
- More than one bone in lower jaw and sprawling forelimbs

The Monotremes

- Cretaceous to Recent
- Lay eggs!
- No breasts; milk oozes from skin
- Hair
- Ear bones shift from lower jaw to skull during development
- Electroreception
- Modern forms: insectivores, one species is semi-aquatic, only poisonous mammal
The Multituberculates
- Jurassic to Eocene
- Important small herbivore in Cretaceous and Cenozoic
- Single bone in lower jaw
- Many types of teeth: incisors, premolars, and molars
- Evidence of hair in fossil record
- Some may have given birth to live young

The Marsupials
- Cretaceous to Recent
- Live young (embryos) crawl to pouch, attach to nipple and continue development
- Share complex molar tooth shape with placentals
- Cretaceous forms mostly opossum-like in terms of ecology
- Modern forms diverse – peak diversity in Australia and South America

The Placentals
- Cretaceous to Recent
- Give birth to fully developed young
- Fetus nourished by the Placenta
- Cretaceous forms mostly shrew-like in terms of ecology
- Modern forms are the dominant group in most ecosystems
How do Marsupials and Placentals Differ?

<table>
<thead>
<tr>
<th></th>
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<th>Placentals</th>
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<tbody>
<tr>
<td>Growth Rate</td>
<td>Slow</td>
<td>Fast</td>
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<tr>
<td>Brain Size</td>
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<td>Large</td>
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<td>Metabolic Rates</td>
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Mammals of the Mesozoic

Triassic

Climate-TECTONICS: Supercontinent is shut of Triassic, Warm climate, 7 km cap ice gone, Uniform temperature gradients, first bees and eusocial insects. Angiosperms and pollen, Eutherians continued to grow.

Plants
Ferns ground cover, Conifers & Trees, Ferns dominated forests, gymnosperms, cycads, cordaites, ginkgos appear.
Dinosaur Faunas

<table>
<thead>
<tr>
<th>Era</th>
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In addition: archaic archosaurs and therapsids remain important + first mammals, turtles, ichthyosaurs (long), pterosaurs (small), nothosaurs, placodonts

Jurassic

Climate-Tectonics
Warm, equable climate
Continents routinely flooded
Extensive rifting and volcanism

Plants
Cycads, Ginkgos, Ferns - down low
Conifers - up high

Dinosaur Faunas

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In addition: mammals (nocturnal insectivores), lizards & amphibians (daytime insectivores, ichthyosaurs (long), pterosaurs (small), pliosauurs, first birds
Cretaceous

Climate-Tectonics
Equable climate, but some seasonality
Continued rifting, volcanism, and inland seas

Plants
Cycads, Ginkgo, & Ferns decline
Angiosperms take over down low
Conifers continue, but increasingly restricted in range by Angiosperms

Dinosaur Faunas

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<th>Ornithopoda</th>
<th>Thyreophora</th>
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<td>Tyrannosaurs</td>
<td>Coelurosauria</td>
<td>Hadrosaurs</td>
<td>Ankylosaurs</td>
<td>Polacanthusauria</td>
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<td>Early Cret.</td>
<td>Poorly known</td>
<td>Small sauropods</td>
<td>Large ornithopods</td>
<td>Poorly known</td>
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<td>Cret.</td>
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In addition: mammals (nocturnal insectivores), lizards & amphibians (daytime insectivores), ichthyosaurs (fish-like), pterosaurs (large), plesiosaurs, small diversity of birds

Overarching Issues

1. Dinosaur diversity (counts of species) may be strongly biased by the amount of rock deposited at any time.
2. That said, dinosaurs do appear to be more diverse at the global level in the late Cretaceous than they were earlier.
3. Endemism increases from Triassic to Cretaceous as Pangea falls apart.
4. “Jurassic” style communities continue on the isolated southern continents into the Cretaceous.