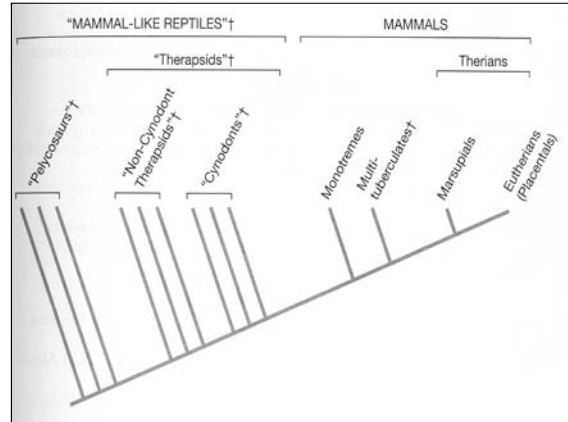


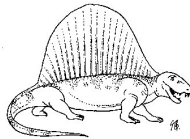
## Synapsid Traits

- Diaphragm
- More Upright posture
- Alveolar lungs
- High metabolic rate
- Endothermy
- Can't see color well (except primates)
- Better olfaction
- Complex teeth
- Increased jaw musculature
- Hair/fur
- Kidney can regulate salt/water balance
- Convert ammonia to urea



## Pelycosaur

- "sailbacks" from late Paleozoic (300mya)
  - The sail was probably a thermoregulatory device and not all these had sails
- No evidence of increased locomotion or metabolic rate
- Generalized carnivores, semiaquatic fish eater, some herbivores
- Canine-like teeth



*Dimetrodon*  
a sail-backed mammal-like reptile (synapsid)

## Therapsids

- Middle Permian to Early Cretaceous--dominant large land mammals in Permian
- Some large herbivores that gathered in herds, also many small ones
- Some carnivorous top predators
- Longer canines, other specialized teeth
- Shoulder joints allowed more freedom of movement
- Only the mammals made it past the Early Cretaceous



## Cynodonts

- Generally carnivorous or insectivorous
- Downsized such that by the mid-Triassic they were the size of rabbits and by the late were down to mouse-size
- Multicusped teeth
- Hole under the eye where sensory nerves would have passed, suggesting a highly innervated face



## Synapsid Evolutionary Trends

- Increasing space in skull for jaw muscles
- Skull structure suggests masseter muscle
- Specialization of teeth
- Secondary palate separated nasal passages from mouth
- Limbs underneath
- Shrunk pelvic girdle
- Shortened toes, heel appears
- Loss of lumbar ribs makes room for diaphragm
- Shrinking tail

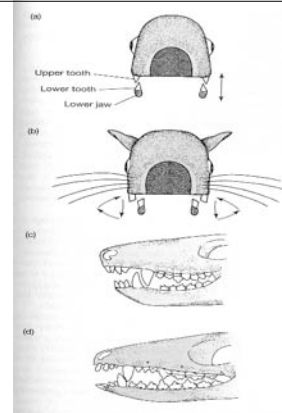
## Transition to Mammals

Early Jurassic Mammal



- Mammals characterized by hair and mammary glands, neither of which fossilize, so how do you tell?
- Cynodonts lack the Harderian gland, but need a good skull to see that
- Generally classification is based on size.
  - The smallest cynodonts were rat-sized, and the earliest mammal was smaller than that
  - Also distinct jaw joint and skull features suggesting enlarged brain and inner ear regions

## Cynodont vs. Mammal Teeth: Polyphyodont vs. Diphyodont



## Early Mammal Ecology/Behavior



- Monotremes are the most primitive mammal, but they don't work as models because they're relatively large and specialized
- Early mammals were small insectivores
- Probably nocturnal and solitary except for the mother-offspring bond
- Depended on sense of smell
- Capacity for sophisticated sensory processing



## Lactation and Suckling

- When did providing the young with milk originate, and did it coincide with the cynodont/mammal transition?
- How did milk and the mammary gland itself evolve?

## Lactation

- Diphyodonty may indicate lactation since one way to do without extra sets of teeth is to not need them early on
- That might explain how mammal teeth get lined up so well--they don't fully develop until the jaw has more or less fully grown

## How did it come about though?

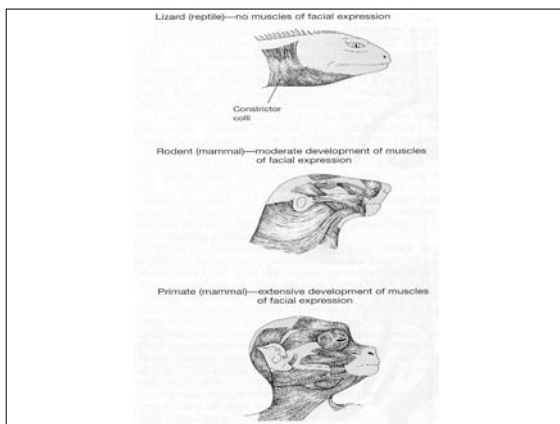
- Mammary glands are associated with sebaceous glands which still secrete some organic matter
  - Started as females secreting pheromones so the offspring could ID mom?
- Milk has antibacterial properties so maybe originally was to protect eggs in a nest
  - Any increase in secretions which could be taken up by offspring might improve their fitness?
  - This proto-milk would have first supplemented the yolk, and eventually supplanted it?

## What good is Lactation?

- It allows for production of offspring separate from dependence on seasonal food availability
- Only one parent is required to raise the young (is that good?)
- Makes viviparity less stressful for the mother because the offspring can be born in a relatively undeveloped state

## Suckling

- The ability to form a tight seal around a nipple while still being able to breathe is a unique mammal characteristic
- The mouth and throat is also arranged to allow for swallowing discrete, well-chewed boluses of food rather than, say, a whole rat
- Facial muscles are unique



## Age of Mammals?

- The Cenozoic Era is called this, but there was a lot going on in the Mesozoic as well, although the mammals then remained small and fairly homogenous
- There was a radiation of mammals in the Jurassic and again in the Cretaceous. The latter corresponded to the rise of the angiosperms and was also when the snakes showed up
- There was likely not direct competition with dinosaurs, but the loss of those freed up niches to allow for diversification in the Cenozoic
- The earliest eutherian fossil dates back to 125mya---a sort of arboreal hamster

