

The Suspension System water → land

Static—fixed, gravity

Dynamic—motion

tail → limbs/girdles

Fish

Tetrapods

Early modes of locomotion

- Lateral undulations
- Mode of modern amphibians and reptiles.

The Suspension System water → land

Static—fixed, gravity

Dynamic—motion

tail → limbs/girdles

On land

specialized modes

Differentiation

Vertebral Column

Modes of Locomotion

- Fossorial - digging
- Arboreal - climbing (grip)
- Scansorial - climbing (claws)
- Saltatorial - jumping
- Aerial -flying
- Cursorial - rapid running

Cursorial Locomotion

Amphibians and present day Reptiles
lateral undulations of vertebral
column

Mammals
cursorial
(independent trend Dinosaurs)

Cursorial Locomotion and Biological Role

Maximum Speeds and Sizes of Cursorial Animals		
Animal	Maximum Speed (mph)	Weight (kg)
Fox	37	4.5
Horse	42	540
Lion	50	180
Cheetah	63	35
Pronghorn	59	90
Human	22	85
Coyote	42	10

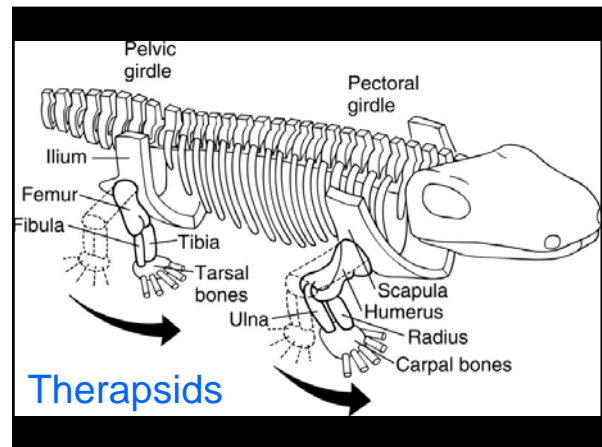
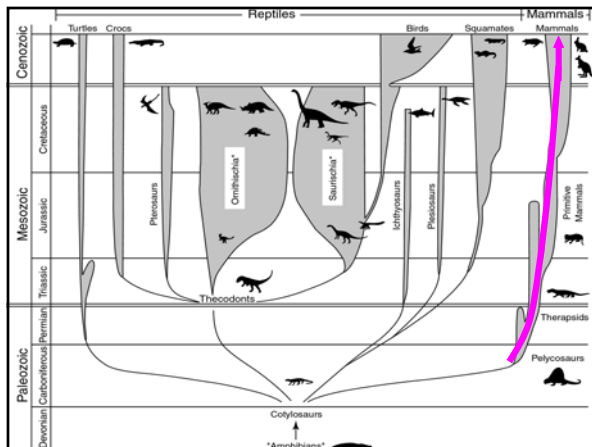
Cursorial Locomotion why evolve?

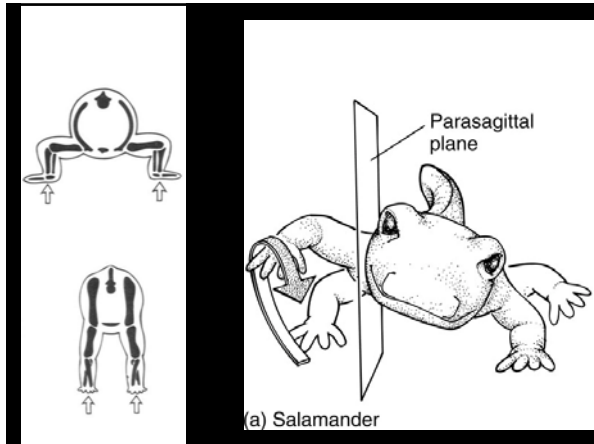


Catch

Escape

Dispersed
Resources





Early modes of locomotion

- **Lateral-sequence gait:** three of the four limbs are in contact with the ground at the same time.
 - More stable



Early modes of locomotion

- **Gait:** pattern of foot contacts with the substrate
- **Lateral-sequence gait:** three of the four limbs are in contact with the ground at the same time.



Early modes of locomotion



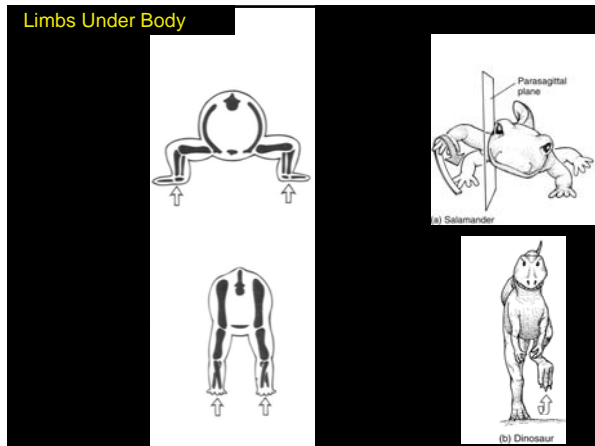
Lizard

--bipedal



Cursorial Locomotion: Running Fast, Running Long





ADAPTATIONS

Cursorial Locomotion: Running Fast

Limbs under the body

Speed = Stride Length x Stride Rate

Stride Length

- Lengthen limb
 - Distal elements lengthen

Lizard

Horse

Stride Length

- Lengthen limb
 - Distal elements
 - Change in foot posture

Ungulgrade

Digigrade

Plantigrade

Stride Length

- Lengthen limb
 - Distal elements
 - Change in foot posture
 - Add another joint to locomotor mechanism

Ungulgrade

Cursorial Locomotion


- Increase the distance through which the limbs move while they are off the ground
- Flexion of the vertebral column

PLAY

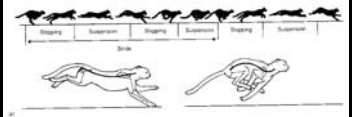
Hildebrand

Stride Length

Increase the distance through which the limbs move while they are off the ground



Flexion of the vertebral column



Speed = Stride Length x Stride Rate

Stride rate

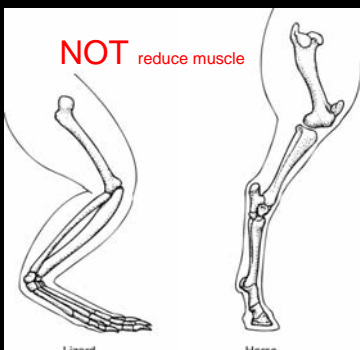
- 1) muscle
- 2) mass limb
- 3) shorten limb

Stride Rate

Massing of muscles close to body

NOT reduce muscle

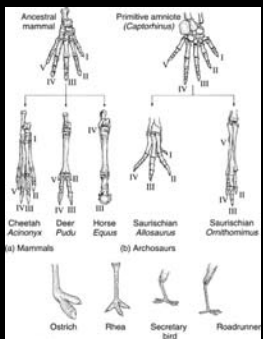
Lighten limb (distally).
Reduce moment of inertia



Stride Rate

Digits reduced


Lighten limb (distally).
Reduce moment of inertia



Stride Rate

summary

- Flexion of the limb during recovery effectively shortens it, increasing the rate of oscillation.
- Lighten the distal end of the limb.
 - muscle mass
 - Reduction in digits






GAITS

footfall: pattern of foot touches

- Functional Significance
- Why change gaits?



Gaits: The Amble

- Fore- and hindfeet on the same side more or less in unison.
- Long-legged animals
- A fast amble is called a pace.


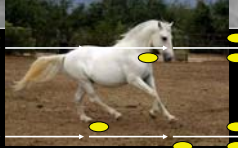
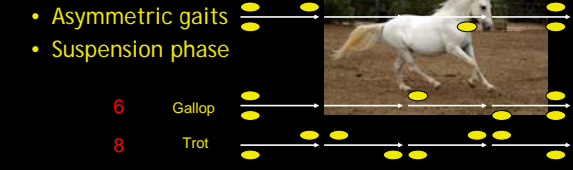
Gaits: The Trot

- Moves diagonally opposite feet together.
- Connecting line of support runs directly under the center of mass.



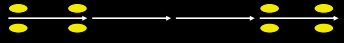
Half bound and Gallop

- Fast speeds.
- Halfbound: hindfeet contact at same time, forefeet display a distinct leading and trailing pattern.
- Gallop: both fore- and hindfeet display a distinct leading and trailing pattern.
- Asymmetric gaits
- Suspension phase

Gaits: The Bound (Pronk)

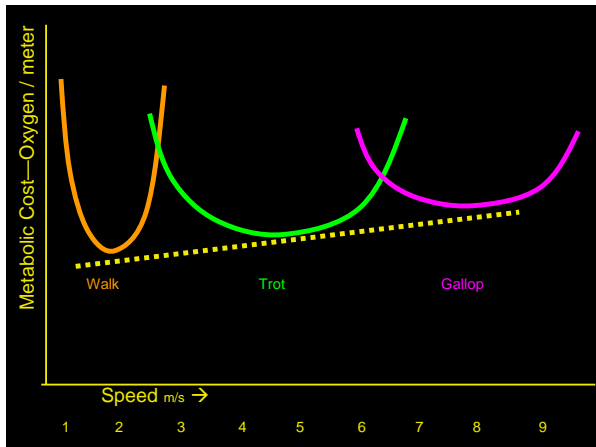
- All four feet strike the ground in unison.
- Decelerates the animal
- Allows them to clear low brush?
- Advertise?




Cursorial Locomotion and Biological Role

- Gait and mass



Cursorial Locomotion and Biological Role

	Horse	Cheetah
Physics:	large	small
Biology:	endurance	speed



Saltatorial



Comparative Anatomy

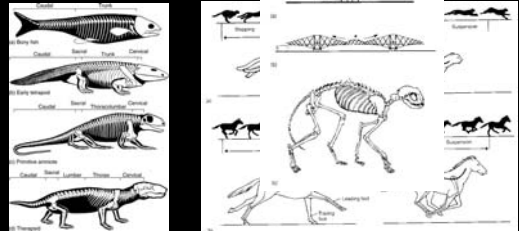
Changes in vertebrate body with the passage of time

SIGNIFICANCE OF THOSE CHANGES

a) Functional Significance

Water → Land

Biomechanics



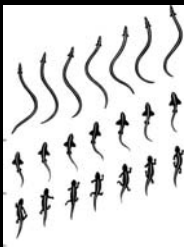
Comparative Anatomy

Changes in vertebrate body with the passage of time

SIGNIFICANCE OF THOSE CHANGES

b) Evolutionary significance

Remodel



Relax →

Preadaptation

