Dynamic, moving bridge

Locomotion modes

- Cursorial - running
- Arboreal - in trees
- Saltatorial - hopping
- Fossorial - digging
- Aerial – flying
- Bipedal – us!

Cursorial

Increasing speed is due to increasing:

1. Stride length - distance between footfalls during a whole stride
   and / or
2. Stride frequency - number of strides per unit time

Increasing stride length

- Limb length
Posture changes

- Drop scapula down to add to limb length – clavicle becomes reduced

Cursorial stride length

- Extension of vertebral column

- Add a suspension phase to gait

- Tradeoff of stability vs. speed
**Cursorial stride length**

- D. Fast gallop
- E. Half bound

**Increasing stride frequency**

- What is the tradeoff?

**Influence of in-lever vs out-lever**

- A. Design for speed (Cursor)
- B. Design for power (Non-cursor)
In-lever

Out-lever

Bone

Insertion close to joint

Stronger out force
Faster movement

Insertion far from joint

Weak out force
Slow movement

Insertion close to joint

Stronger out force
Faster movement

Insertion far from joint

Increasing stride frequency

Compare in-levers and out-levers

Fossorial limb

Increasing stride frequency

Added joints increases flexion

Summation of movement of each bone during a stride
**Increasing stride frequency**
Distal ends of limb have less muscle weight

**More extreme cursorial adaptations**
- Grooved joints, tendon recoil
  - Tendon arranged for elastic recoil
  - Cursors vs. Non-cursors

**Effect of body size**
- With an increase in body size, cursorial adaptations must get more extreme to still have speed

**Arboreal locomotion**
- Cling and leap
- Arm swingers
Becoming bipedal

- Energy-efficient movement
- Weapons and tools
- Carrying
- Thermoregulation
- See over tall grass

Bipedalism

- Structural changes to appendicular and axial skeleton
- Center of gravity much higher
**Bipedalism**

- Vertebrae hold weight of those above
- Change in hip musculature to stabilize trunk

**Bipedalism**

- Lumbar curvature and center of weight

**Bipedalism**

- Pelvis tilted so acetabulum is in line with ilio-sacral joint
- Illium flares out - pelvis tilt to adjust center of mass

**Bipedalism**
Bipedalism

- Angle of femur – a result of bipedal walking

Our big butt

Gluteus muscles stabilize hip when one foot is swinging, supporting body weight

Issues

- Lumbar region - weight distribution unbalanced along centrum
- Brain size

Bipedalism vs. big baby heads

- Tradeoff of locomotion efficiency and big brains
Saltatorial locomotion

- Lengthening & fusion of hind limb bones
- Weight distributed at sacrum

Frogs
- Flexion at sacroiliac joint to allow legs to extend and rotate under body
- Urostyle helps rotate pelvis
- Fusions in fore and hind limbs

Flight adaptations

Bat

Bird

Tibiotarsus

Tarsometatarsus
Limbs for flight

Wing shape and lift

Varying properties along wing

Adding a “slot” to enhance lift