## Lecture 2: Terrestrial Locomotion I Simple Analyses of Ballistic Movement.

- 1. Recap: Jumping...
- 2. Current approaches for analyzing terrestrial locomotion.
- 3. Gaits and patterns of limb motion
- 4. Ballistic walking and the inverted pendulum

Comfort level with physics:  $3.32 \pm 0.84$ 

Comfort level with calculus:  $2.80 \pm 1.12$ 



Survey question: the moon has 1/6 earth g. Because of that lower gravitational acceleration
(a)You would walk faster on the moon
(b)You would walk slower on the moon
(c)There would be no difference in your walking speed

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Cost (P/WV; E/Wd) of transport declines with body size



Muscle forces are manifest as ground reaction forces and energy (PE,KE) exchanges of the body







Is KE red or blue? KE =  $mv^2/2$ PE = mgh



Movement Biomechanics

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### GAITS



- stride length: distance between footfalls of the same foot
- stride frequency: number of footfalls per time
- duty factor: fraction of stride time that a foot is on the ground (human walking = 0.5 0.6, running = 0.35).
   Gaits with duty factors less than 0.5 imply airborne phases.
- relative phase: time a foot is set down as a fraction of the stride time.









# Survey question: the moon has 1/6 earth g. Would you be able to walk faster on the moon?





Modifiers of the radius of curvature

 $V^2$ 

Lumbar flexion Pelvic rotation Pelvic tilt





#### http://www.biomotionlab.ca/Demos/BMLwalker.html

#### How fast did *T. rex* run?





 $Fr = V^2/gL$