Week 2
Stability

Terms used:
- Balance
- Equilibrium
- Stability

Burkett: Chapters 4&5

Mass

- Quantity of matter of which a body is composed (kg)
- What you are made of
- Only changes if lose or gain mass

Weight

- Measure of the force which the earth pulls on a body's mass (N)
- Fluctuates
- Eg. If on moon we will be lighter because no gravity pulling on body's mass

Centre of Gravity (CoG)

- Point of a body through which the force of gravity acts
- Central point when all weight is placed
- Balance point
- Also centre of mass (COM)
- Each body segment has own mass, weight and CoG (usually closer to more massive end – proximal)
- Does not need to within physical substance of body
- If more mass towards bottom of object/person = CoG moves lower

Location of CoG

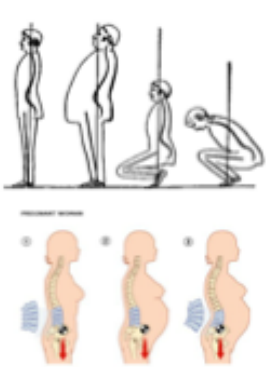
Depends on
- Position of body segments (CoG moves anytime body segments move)
- Arrangement of body segments at any given time
- ROM ~12cm
- More massive segments have greater influence on CoG location than smaller segments
- Eg. Arm won't effect as much as torso

Men
- 57% of height due to inverted triangle shape

Women
- 55% of height to more oval shape

Line of CoG

- Line of action of the force of gravity
- Gravity acts through CoG line affecting ability to balance
- Line of gravity must fall through base of support to ensure balance

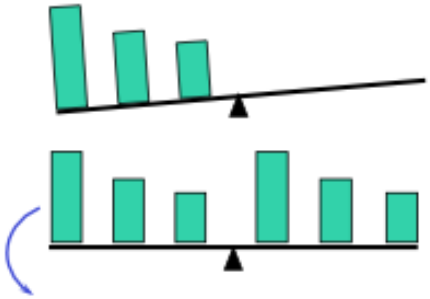


Torque

- Turning or rotary force
- Turning effect an 'off centre' or 'eccentric' force has on the body
- Rotating effect due to force changing CoG
- Also known as a moment

Net Torque

- Manipulate the weight to make a balance



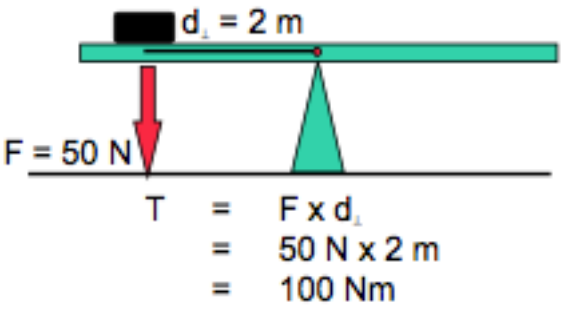
Principle of Moments

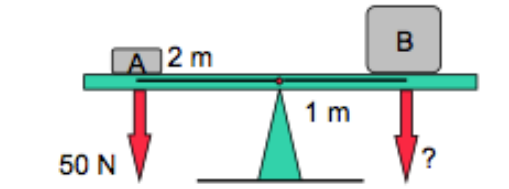
- Force equal on either side to balance

Calculating Torque

T = F x d

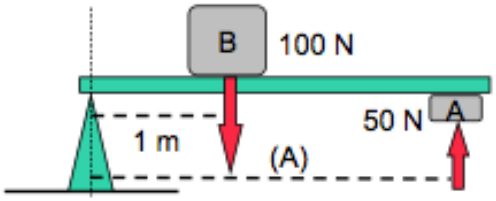
- Distance is from pivot (CoG) to force
- Force is weight of object





What is the weight of the 2nd load (N)?

- Torque A = Torque B
- Force A x d⊥A = Force B x d⊥B
- 50 N x 2 m = ? N x 1 m
- ? N = 100 Nm / 1 m



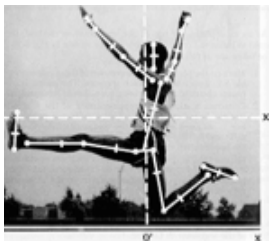
What is the distance (A) (m)?

- Torque A = Torque B
- Force A x d⊥(A) = Force B x d⊥B
- 50 N x (A) = 100 N x 1 m
- (A) m = 100 Nm / 50 N

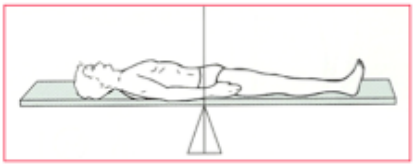
Calculating the CoG

- Suspension method

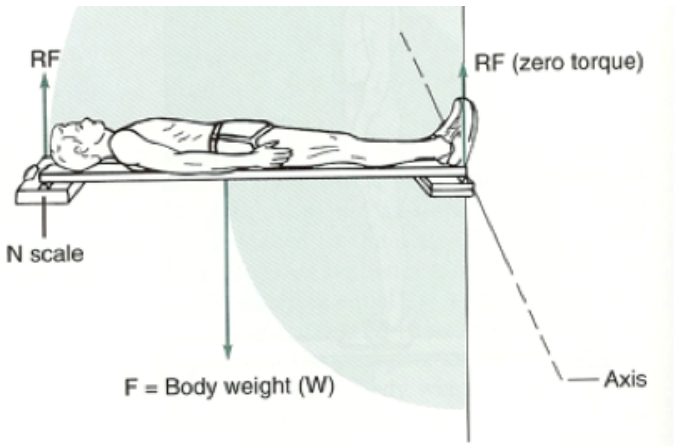
- Segmentation method



- Balance board method



- Reaction board method



Base of Support (BoS)

- Area defined by straight lines connecting most peripheral points of the body parts contacting the supporting surface

Equilibrium, Balance and Stability

Equilibrium = zero acceleration
Balance = ability to control equilibrium
Stability = resistance to a disturbance of equilibrium

Equilibrium

- State of a system that is not being accelerated (not changing its state of motion in terms of speed and direction – not changing velocity)
- Static equilibrium
- Dynamic equilibrium

Static Equilibrium

- When a body is at rest, not translating or rotating

Dynamic Equilibrium

- When a body is moving with constant speed and direction

Stable Equilibrium

- Large base of support – easy to balance

Unstable Equilibrium

- Narrow base of support

Neutral Equilibrium

- Spherical object – neither stable or unstable

Balance

- Process whereby body's state of equilibrium is controlled for given purpose
- Movement control

Stability

- Difficulty with which equilibrium can be disturbed
- Dynamic stability
- Enduring stability – want to maintain static position for long period
- Linear stability
- Rotary stability – rotating stability

Depends on:

- Weight of body
- Position of line of gravity relative to limits of BoS (edge before fall over)
- Width of BoS
- Height of CoG relative to BoS – lower to BoS = more stable
- Principle of moments

Principle 1

For a given stance, stability is proportional to the mass of the body

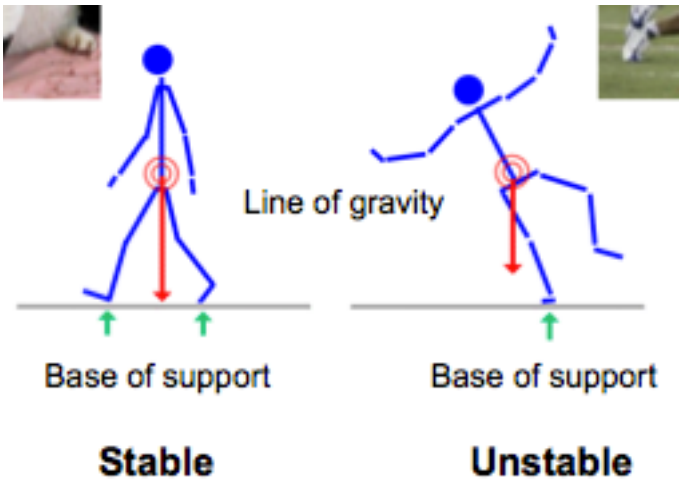
- Lighter you are = less mass you have = more easily disturbed (off balance)
- Heavier = more mass = harder to move

1st guy easier to move then second but harder then 3rd guy

Principle 2

A body is more stable when the line of gravity falls well within the area of the BoS. It loses stability when the line of gravity falls outside the base of support

- Have to realign line of gravity within BoS of will fall over



Principle 3

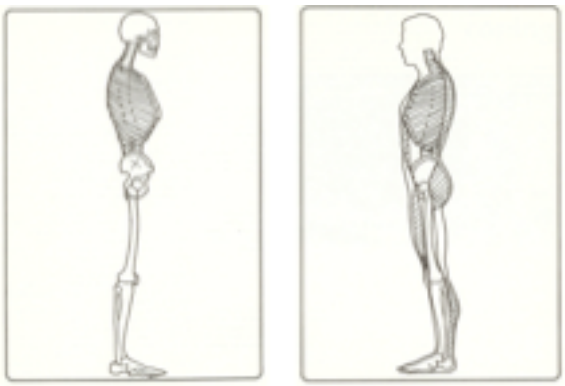
Stability against a force from a given direction is proportional to the distance, in that direction, from the point at which the line of gravity to the edge of the BoS.

- If you want to be stable and you know where force is coming from then you alter your BoS to furthest away from force (edge/limit of BoS)
- Widen BoS to furthest direction from pulling force

Principle 4

If stability is the primary consideration, the CoG should be kept as low as possible

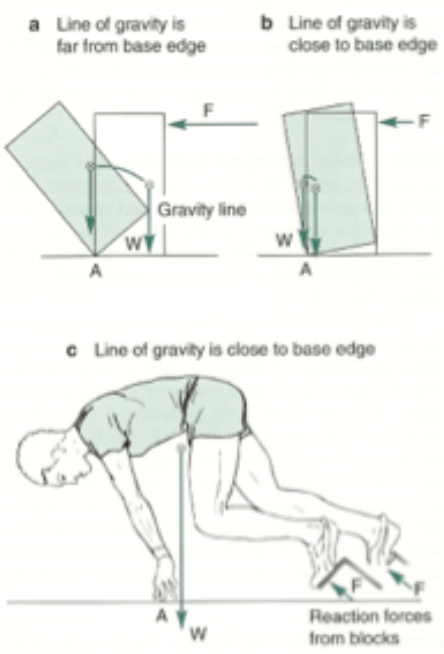
- More mass towards ground = harder to move
- More skeleton and muscle towards top of body hence the 57/55%



Dynamic Stability

Facilitate movement from:

- Relatively high CoG
- Relatively narrow BoS
- Move the CoG to edge of BoS
- Minimising body weight



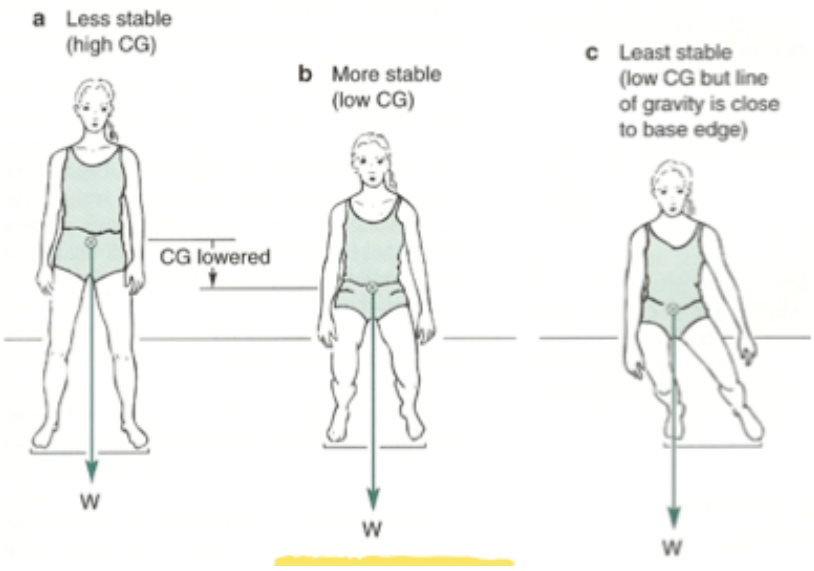
More unstable to can get more momentum..
eg. Moving off sprint mark quickly

Enduring Stability

Improved by:

- Lowering CoG
- Ensuring line of gravity is positioned well within area of BoS
- Widening area of BoS
- Maximising body weight

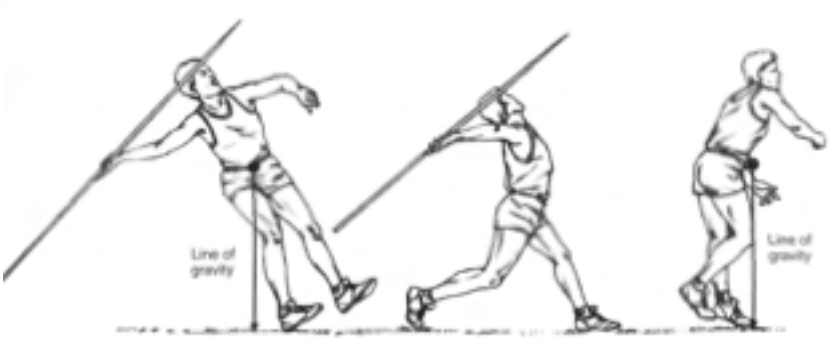
Stay in one spot for long period of time



C depends on direction of force whether its more or less stable then A and B

EXAM HINT

Person A VS Person B – more stable because?
What could happen and why?



Need to break movements down to identify important phases and CoG/BoS changes