

# 2A/2B BIOMECHANICS 2<sup>nd</sup> ed.



# CONTENT

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- Benefits of Biomechanics

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- General

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- Simultaneous force summation
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- Stability
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- Factors affecting balance and stability

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  - Air resistance
  - Spin



# COORDINATION CONTINUUM.FORCE SUMMATION FOR MAXIMAL OR SUBMAXIMAL FORCE

## 2. SEQUENTIALLY

- Where body parts are moved in sequence to produce a force.
- Generally used to produce maximal force in whole body actions such as throwing, kicking and striking
- E.g. A baseball pitcher, striking in golf, kicking in rugby



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# SUCCESSFUL SUMMATION OF FORCE/MOMENTUM

- Body parts move in a sequence to generate the largest force or acceleration possible.
- To sequentially produce maximal force effectively, the following principles need to be applied:
  1. The stronger and larger muscles of the thighs and trunk are moved first followed by the smaller and faster muscles
  2. Sequentially accelerate each body part so that optimum momentum passes from one body part to the next.
  3. Each body part should be stable so that the next body part accelerates around a stable base to transfer momentum
  4. Use as many body parts as possible, so force can be applied over the maximum possible time
  5. Follow through is important to prevent deceleration of last segment and safe dissipation of force.
  6. Ensure all forces are directed towards the target





# SEQUENTIAL SUMMATION OF FORCES - THROWING



**Big body parts of legs and trunk initiate movement**

**Wide base provides stable base for acceleration of each segment**



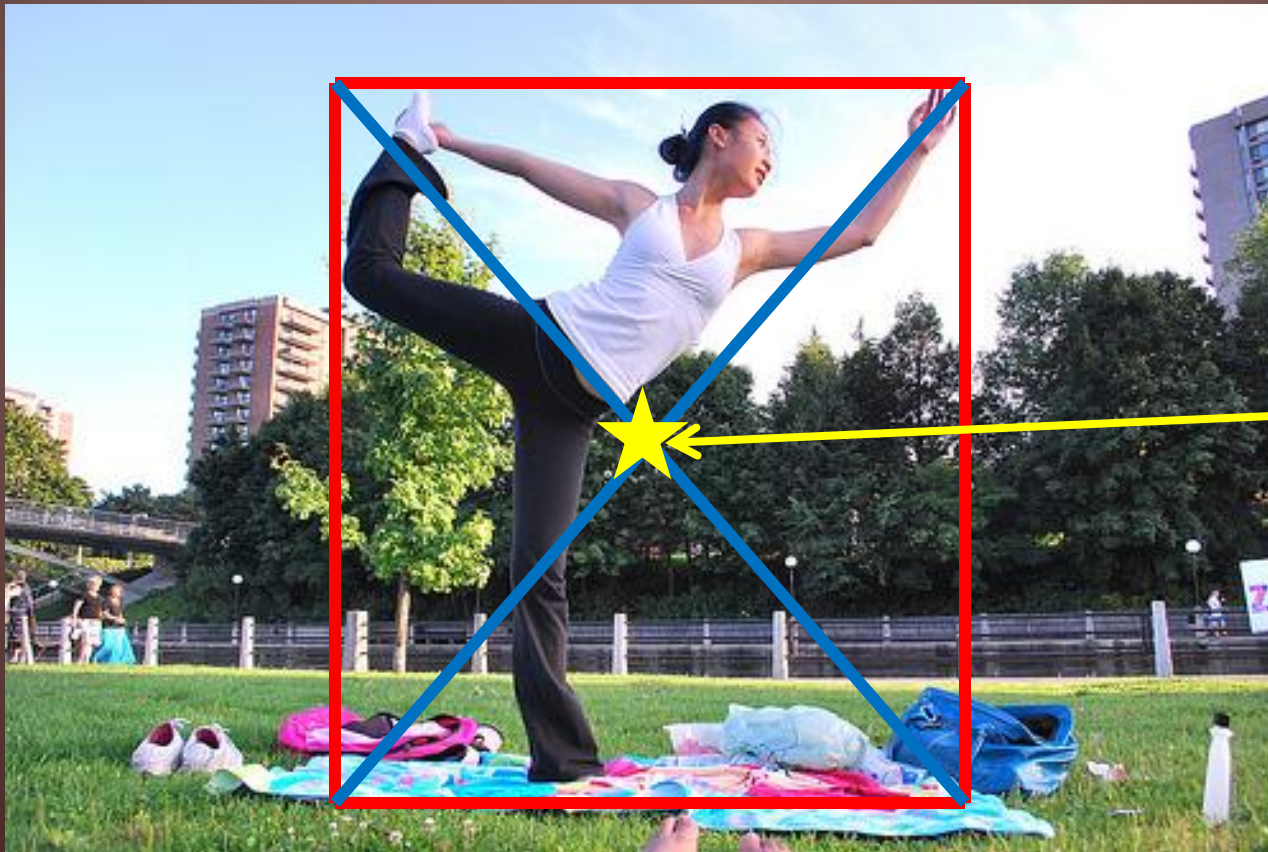
**Maximise number of segments used**

**Follow through towards the target to prevent deceleration of final segment and maximise momentum towards the target**



# DETERMINING THE CENTRE OF GRAVITY

- To determine ones COG, simply draw a box around the objects outer extremities
- Then draw diagonal lines through the box, with the point of intersection determining the objects approximate COG.



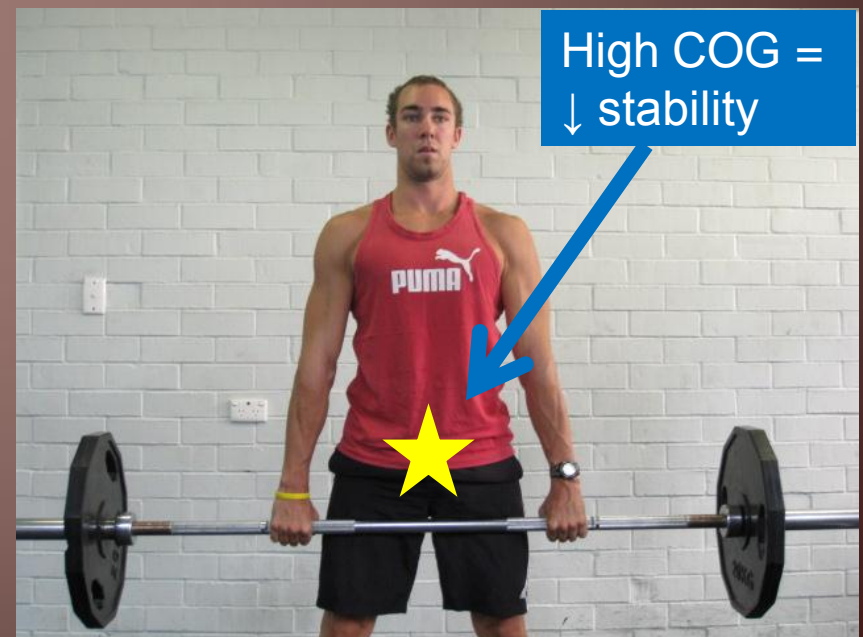
**Approximate  
COG**



# FACTORS AFFECTING BALANCE & STABILITY

## 3. THE HEIGHT OF THE COG ABOVE THE BASE OF SUPPORT

- The line of gravity or pull of gravity will always pass vertically through the centre of an object's mass.
- The higher the centre of gravity above the base of support, the less stable the object is. Athletes often lower their centre of gravity by bending the knees in order to increase their stability





# STABILITY VARIES WITH BODY POSITION



More stable

Less stable

Low COG

Wide base of support – 4 point contact

Line of gravity in middle of support

Higher COG

Small base of support – 2 point contact

Similar line of gravity



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# NEWTON'S 1<sup>ST</sup> LAW OF MOTION

## Newton's First Law of Motion - Inertia

“A body continues in its state of rest or state of motion unless acted upon by a force”.

The size of the force required to change the state of motion of an object depends on the mass of the object. The greater the mass of the object, the greater the force needed to move it.



The 8kg medicine ball has a greater inertia because of its greater mass and therefore requires a greater force to move it



The golf ball on the left will remain stationary on the tee until a force (applied by the club) is applied to it



# NEWTON'S 2<sup>ND</sup> LAW OF MOTION

## Newton's Second Law of Motion – acceleration / momentum

“The rate of change of acceleration to a body is proportional to the force applied to it”.

The greater the force applied to an object, the faster the acceleration will be. Acceleration is directly proportional to the force applied.



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A small force applied to a ball using a putter results in slow acceleration



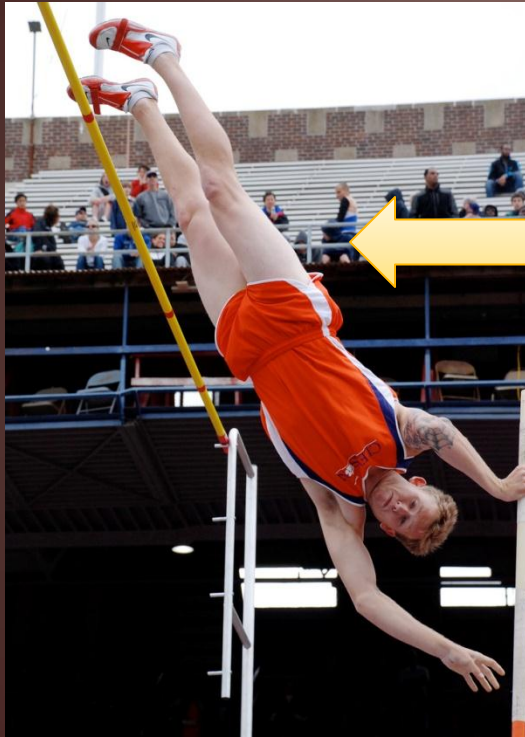
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A large force applied to a ball using a driver results in faster acceleration



# 1. ANGLE OF RELEASE

- If all other factors are constant (i.e. Speed of release, height of release, spin, air resistance);



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- An angle of greater than  $45^\circ$  results in shorter horizontal distances, greater vertical distances and longer flight times.
- This might be useful in the following sports;
  - High Jump, Pole Vault, punting in American Football

- An angle of less than  $45^\circ$  results in shorter horizontal distances, shorter vertical distances and shorter flight times
- This might be useful in the following sports;
  - Throwing in softball, cricket etc, stab pass in AFL



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# 1. ANGLE OF RELEASE

