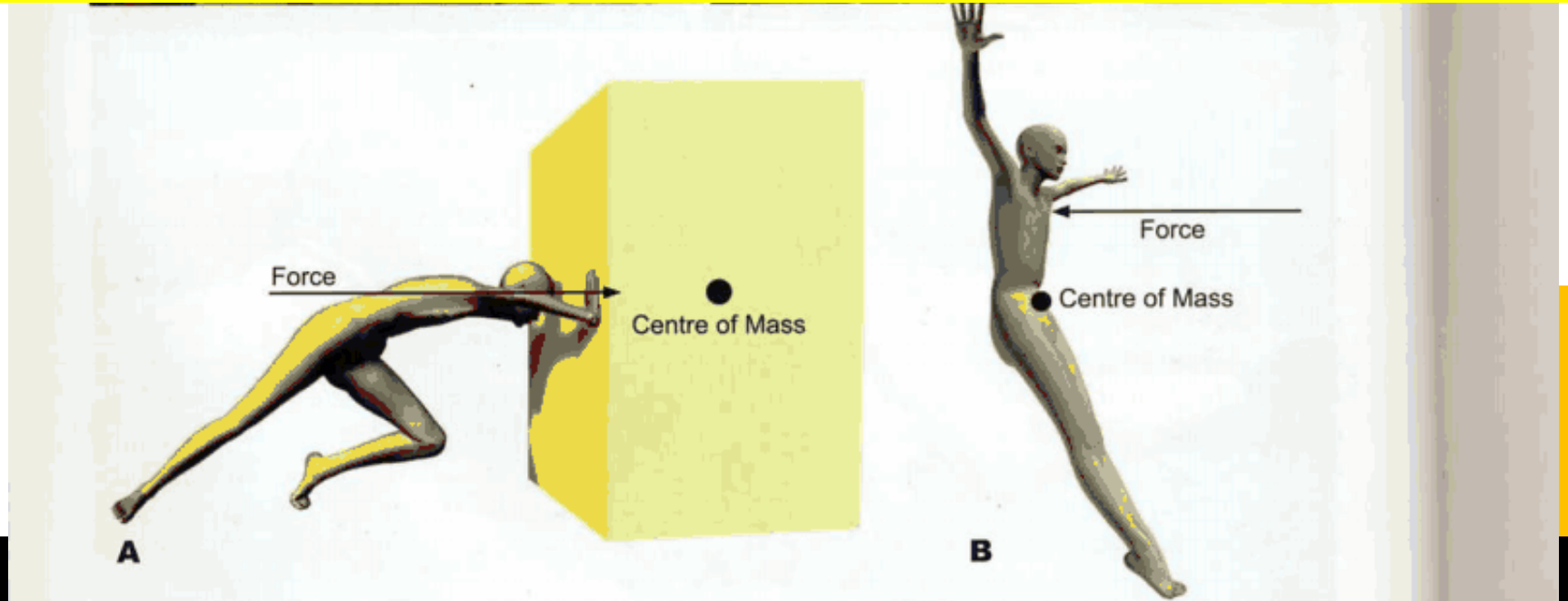
LINEAR MOTION

Recall Newton's 3 Laws

Recall the Kinematic Variables



KINEMATIC VARIABLES (UNITS)

Time

Displacement

Velocity

Acceleration

Angular displacement

Angular velocity

Angular acceleration

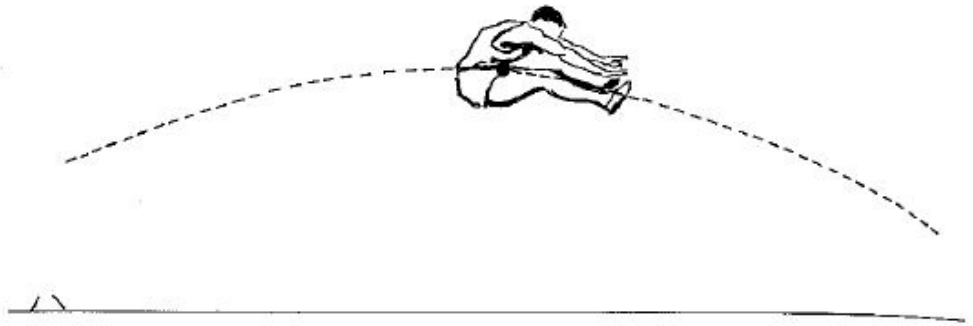
3 TYPES OF MOTION:

A) LINEAR - Centre of gravity (CofG) travels in a straight line

ex. gliding on skates

Also ‘Curvilinear’ - CofG travels in a curved line (parabolic path)

ex. a ball flying through the air (or a long-jumper)



***BOTH are produced by applying a force directly THROUGH the CofG**

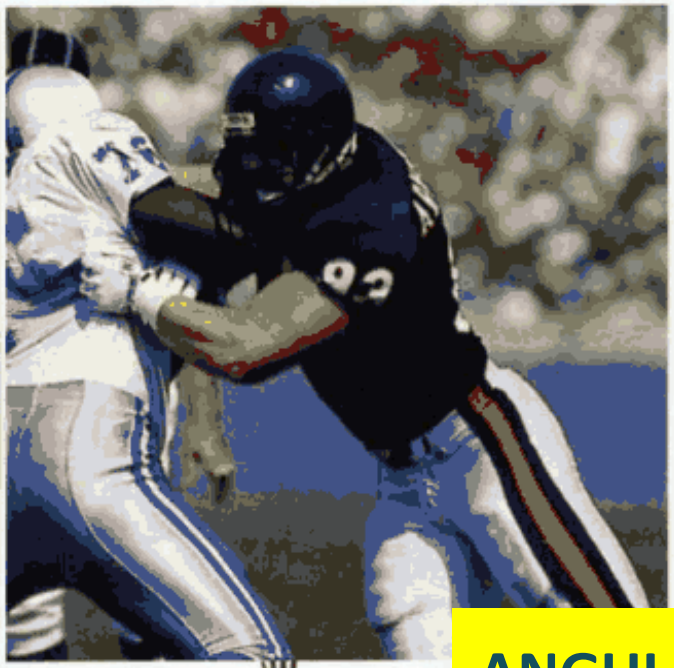
B) ANGULAR - when an object or body rotates about an axis

ex. figure skating spin, gymnast rotating around the high bar, karate chop

***produced by applying a force ('torque') at a point AWAY from the Centre of Gravity**

C) GENERAL - a combination of the two (C. of G. moves in a straight line, but arms & legs are rotating)

ex. running ex. wrestling



LINEAR

ANGULAR

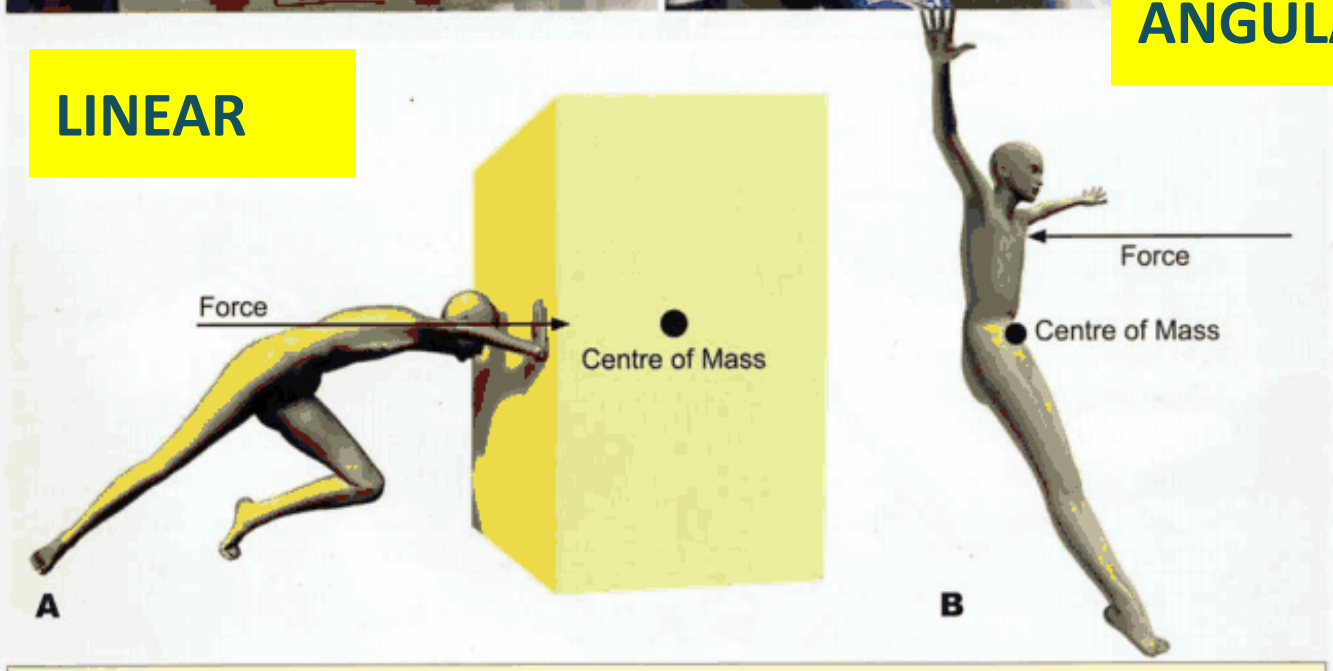
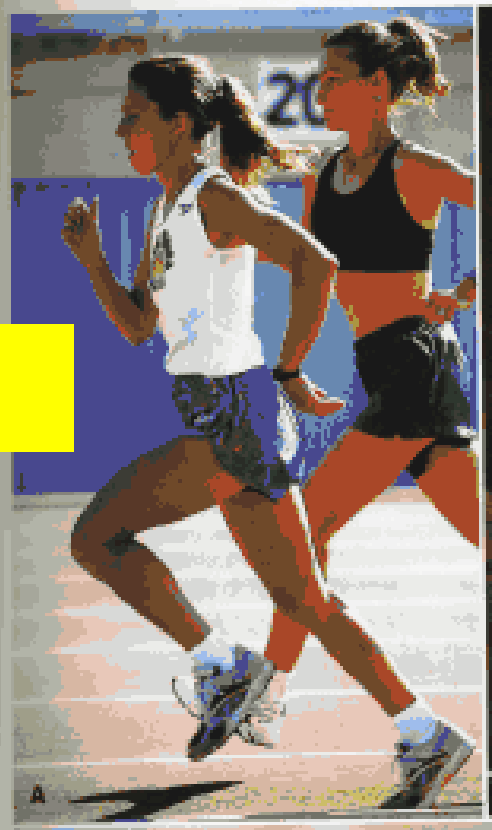
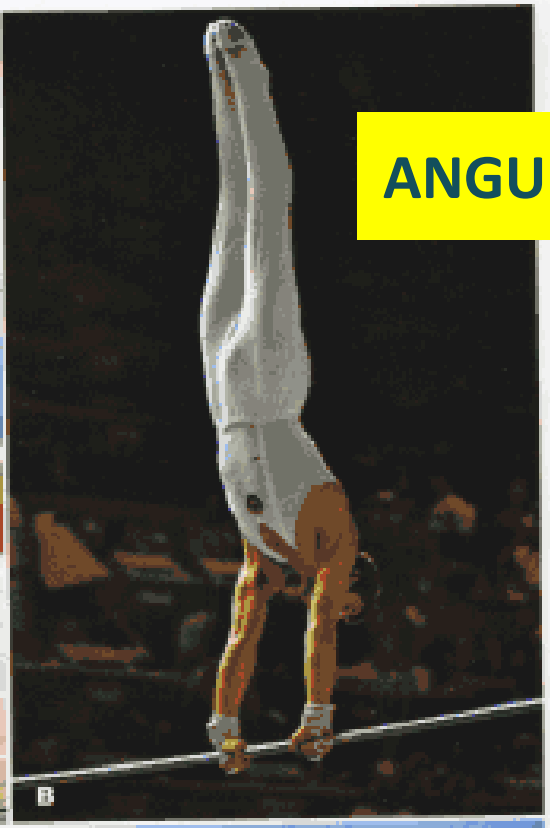


Figure 7.6 Causes of linear and angular motions. **A.** Linear motion results when the forces are applied through the centre of mass. **B.** Angular motion results when forces are applied away from the centre of





GENERAL

ANGULAR

GENERAL

IMPULSE

What is **‘IMPULSE’**? - the application of Force over a period of Time

IMPULSE (Q) = FORCE X TIME

Principle 4 states: The greater the IMPULSE the greater the acceleration

Ex. Hitting a baseball

IMPULSE

<u>Application for sports</u>: an athlete who moves joints through a larger <u>‘Range of Motion’</u> is able to apply force for a longer period of time. Ex’s: baseball swing, discus throw

Force and Acceleration

Recall Newton's 2nd Law: Force is proportional to acceleration ...***provided mass is constant***

In other words: **F α a** and therefore **F = m x a**

Ex. Given an <u>equal application of Force</u>…

if mass is greater, acceleration is less

F = m x a

if mass is lighter, acceleration is greater

F = m x a

DIRECTION OF FORCE

"Movement usually occurs in the direction *opposite* that of the Force applied"

(relates to Newton's 3rd Law: equal & opposite)

Ex. Starting blocks

Momentum (M)

‘Momentum’ - is the amount of ‘motion’ that an athlete or object has developed. - it is a factor of mass and velocity

(i.e. a very heavy object that is moving fast is very hard to stop!)

MOMENTUM = mass x velocity

M = m x v (kg·m/s)

Momentum (cont'd)

Ex. A skier weighs 70 kg and is traveling 30 m/s. What is her momentum?

$M = m \times v$ $M = 70 \times 30 = 2100\ kg \cdot m/s$

Implication for sports: momentum plays a key role during 'impact' situations. The outcome of the impact depends largely on the momentum of each of the bodies involved (*ignoring STABILITY factors)

Ex. football tackle