

# Chapter 3

## Kinetic Concepts for Analyzing Human Motion

Basic Biomechanics, 6<sup>th</sup> edition  
By Susan J. Hall, Ph.D.

# Basic Concepts Related to Kinetics

What is **mass**?

“ quantity of matter composing a body  
(dog, tree, desk, swimming pool,  
you)

“ represented by **m**

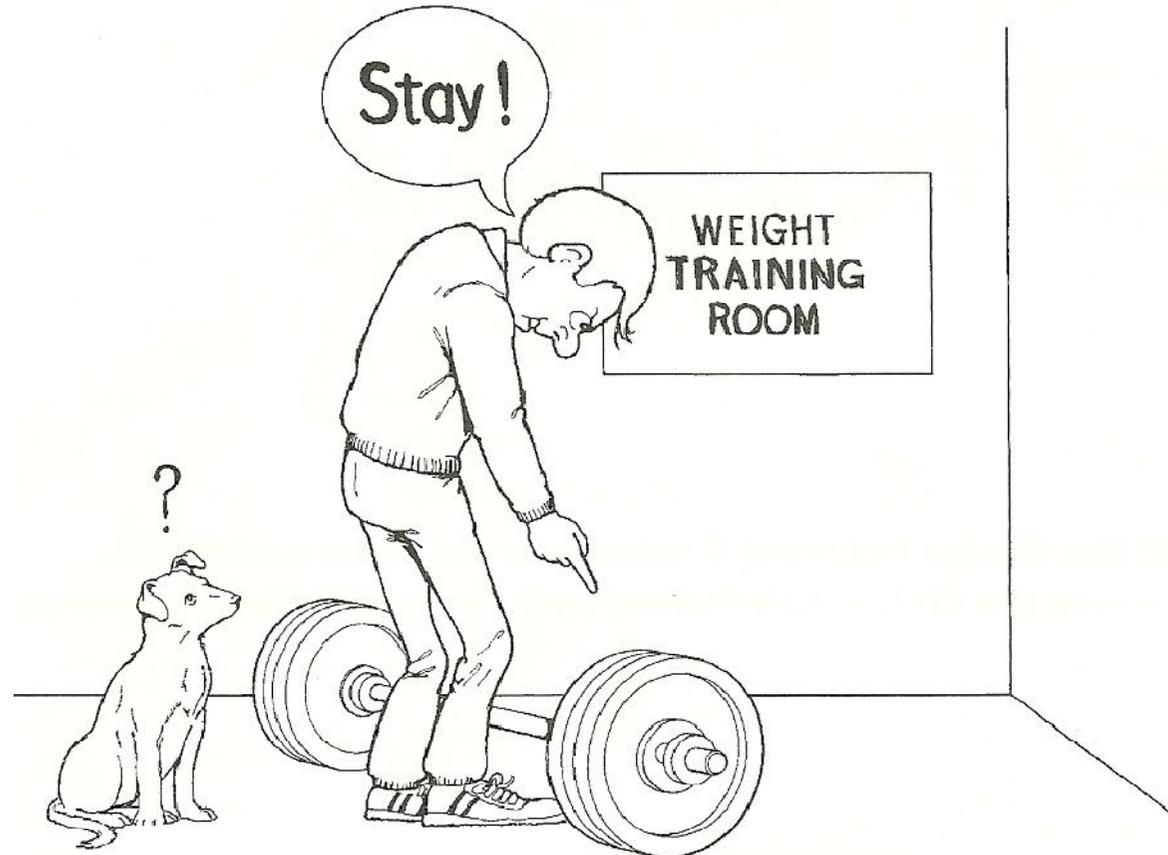
“ units are **kg**

# Basic Concepts Related to Kinetics

What is **inertia**?

- ” tendency to resist change in state of motion
- ” proportional to mass
- ” has no units!

# Basic Concepts Related to Kinetics



Clearly, the weight bar will stay in place in the absence of being lifted because of its **inertia**.

# Basic Concepts Related to Kinetics

What is **force**?

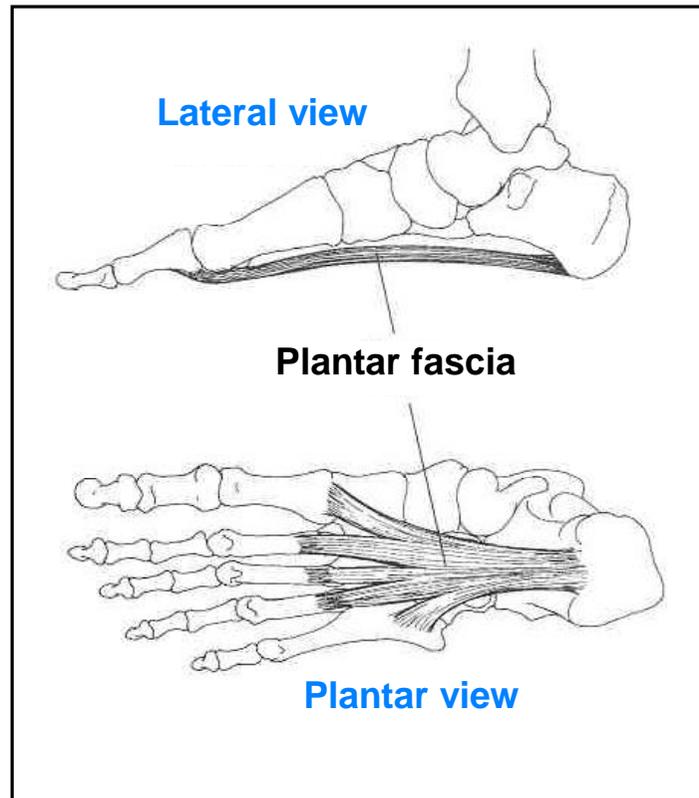
“ a push or a pull

“ characterized by magnitude,  
direction, and point of  
application

“  $F = ma$

“ unit is the Newton (**N**)

# Structure of the Foot



## The plantar fascia.

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# Basic Concepts Related to Kinetics

What is a **net force**?

- ” the single resultant force derived from the vector composition of all the acting forces
- ” the force that determines the net effect of all acting forces on a body

# Basic Concepts Related to Kinetics

What is a **torque** (T)?

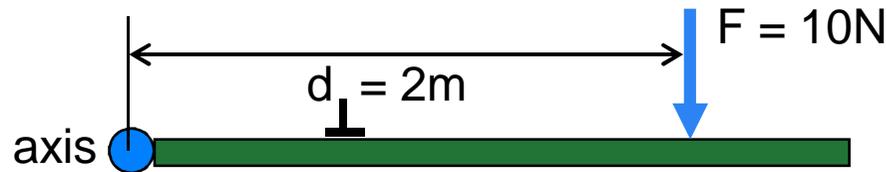
“ the **rotary effect** of a force

“ the **angular** equivalent of force

“ also known as **moment of force**

# Basic Concepts Related to Kinetics

What is a **torque**?



$$T = Fd_{\perp}$$
$$T = (10\text{N})(2\text{m})$$
$$T = 20 \text{ Nm}$$

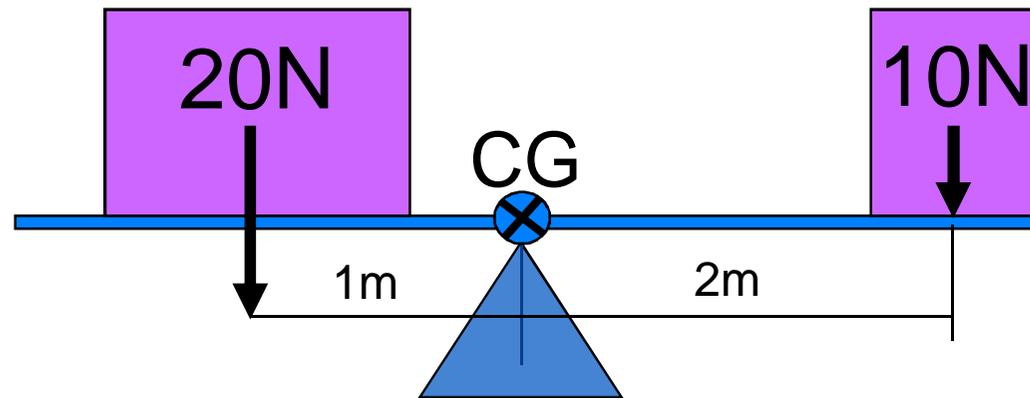
$T = Fd_{\perp}$  (the product of force and the perpendicular distance from the force's line of action to the axis of rotation)

# Basic Concepts Related to Kinetics

What is the **center of gravity**?

- “ point around which a body's weight is equally **balanced** in all directions
- “ point that serves as an **index** of total body motion
- “ point at which the weight **vector** acts
- “ same as the **center of mass**

# Basic Concepts Related to Kinetics



The weights are balanced, creating equal torques on either side of the fulcrum.

# Basic Concepts Related to Kinetics

What is **weight**?

- ” attractive force that the earth exerts on a body
- ” wt. =  $ma_g$  (product of mass and the acceleration of gravity:  $-9.81 \text{ m/s}^2$ )

# Basic Concepts Related to Kinetics

What is **weight**?

- “ the point of application of the weight force is a body's center of gravity
- “ since weight is a force, units of weight are units of force: **N**

# Basic Concepts Related to Kinetics

What is **volume**?

” space occupied by a body

” has three dimensions (width, height, and depth)

” units are  $m^3$  and  $cm^3$

# Basic Concepts Related to Kinetics

What is **density**?

“ mass per unit of volume

“ represented with the small Greek letter rho:  $\rho$

“ units are  $\text{kg/m}^3$

# Basic Concepts Related to Kinetics

What is **impulse**?

“ the **product of force and the time**  
over which the force acts  
(**Ft**)

“ units are **Ns**

# Basic Concepts Related to Kinetics

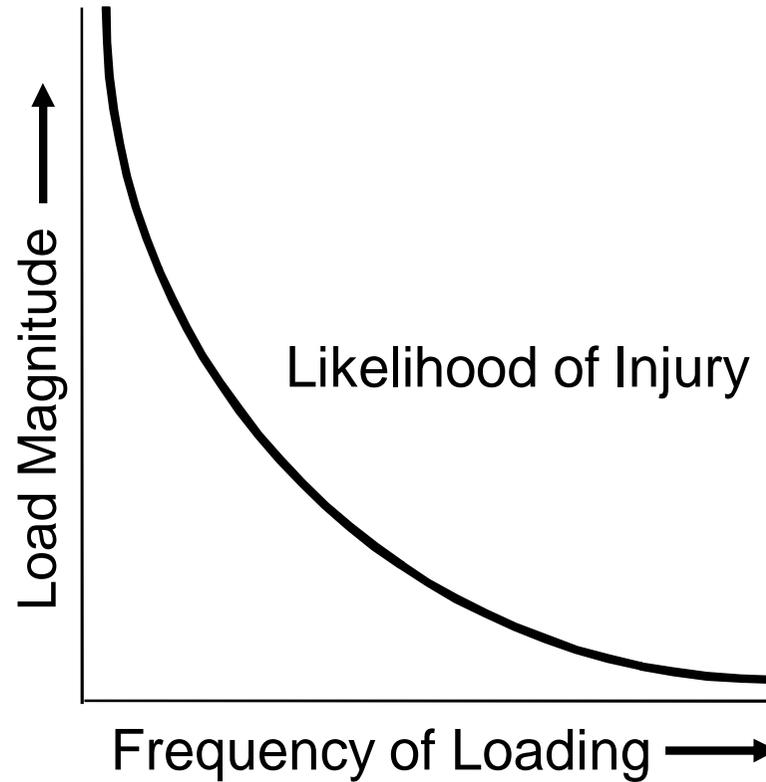
What are **repetitive** and **acute** loading?

” **repetitive**: repeated application of a **subacute load** that is usually of relatively low magnitude

” **acute**: application of a **single force** of sufficient magnitude to cause injury to a biological tissue

# Basic Concepts Related to Kinetics

## Repetitive vs. acute loading



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