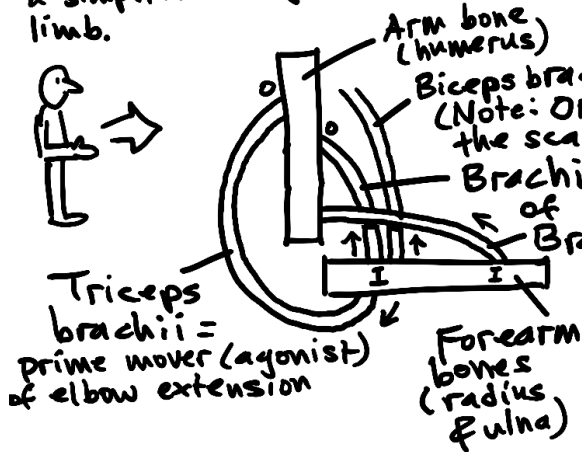


## MUSCLE ACTIONS

To discuss the different roles that muscles can play, we'll use a simplified diagram of the upper limb.

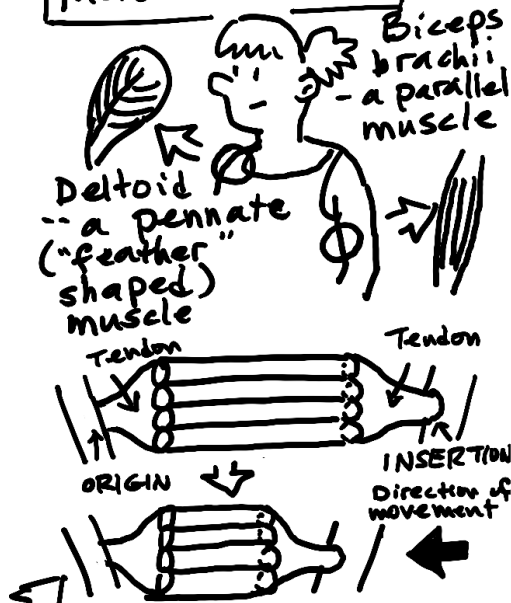


O = Origins (proximal, stationary attachments)

I = Insertions (distal, more movable attachments)

The terms "synergist" and "antagonist" are relative: Biceps brachii and brachioradialis are synergists (helpers) to brachialis in flexing the elbow, but they (like brachialis) are antagonists to triceps brachii.

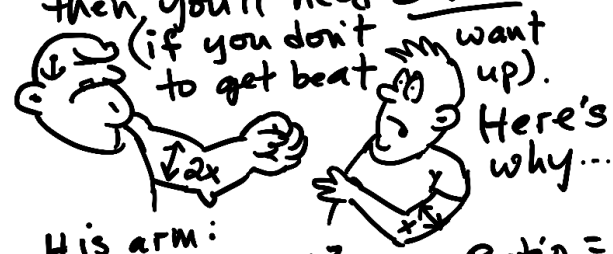
## MUSCLE TYPES



Parallel muscles are better at allowing a greater change in length, but pennate muscles are stronger because they have more muscle cells pulling on the tendon (four times as many, in this example).

## MUSCLE STRENGTH

Muscle strength is proportional to cross-sectional area. So if your opponent has arms twice as thick as yours, then you'll need 3 friends

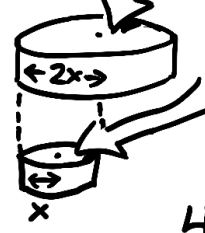


His arm:  
 $Area = \pi (2x)^2$   
 $= 4\pi x^2$

Ratio =  $\frac{4\pi x^2}{\pi x^2} = 4$

Your arm:  $x$   
 $Area = \pi x^2$

4 times as strong!



∴ For equivalent strength, you need 4 times as many arms.

