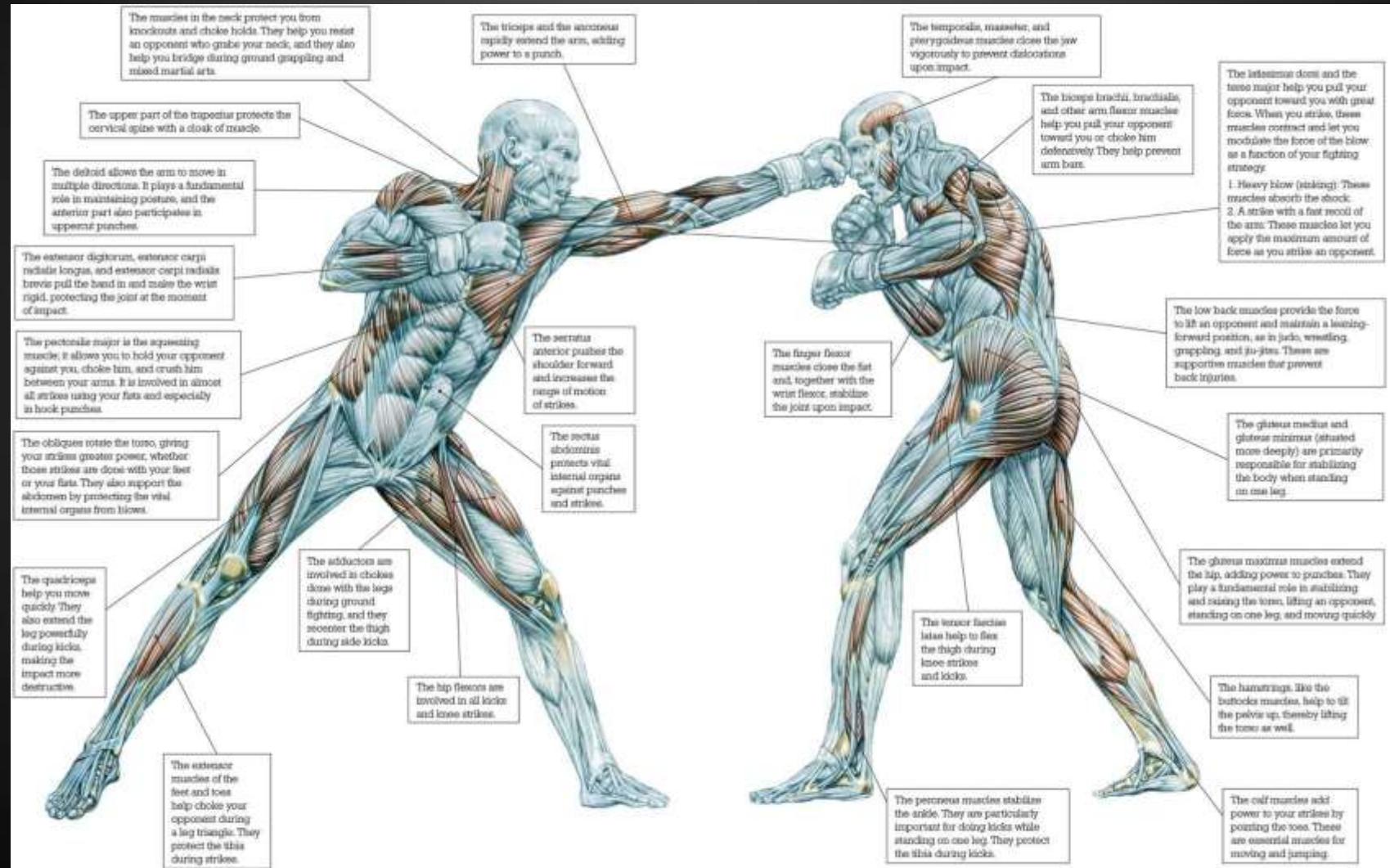
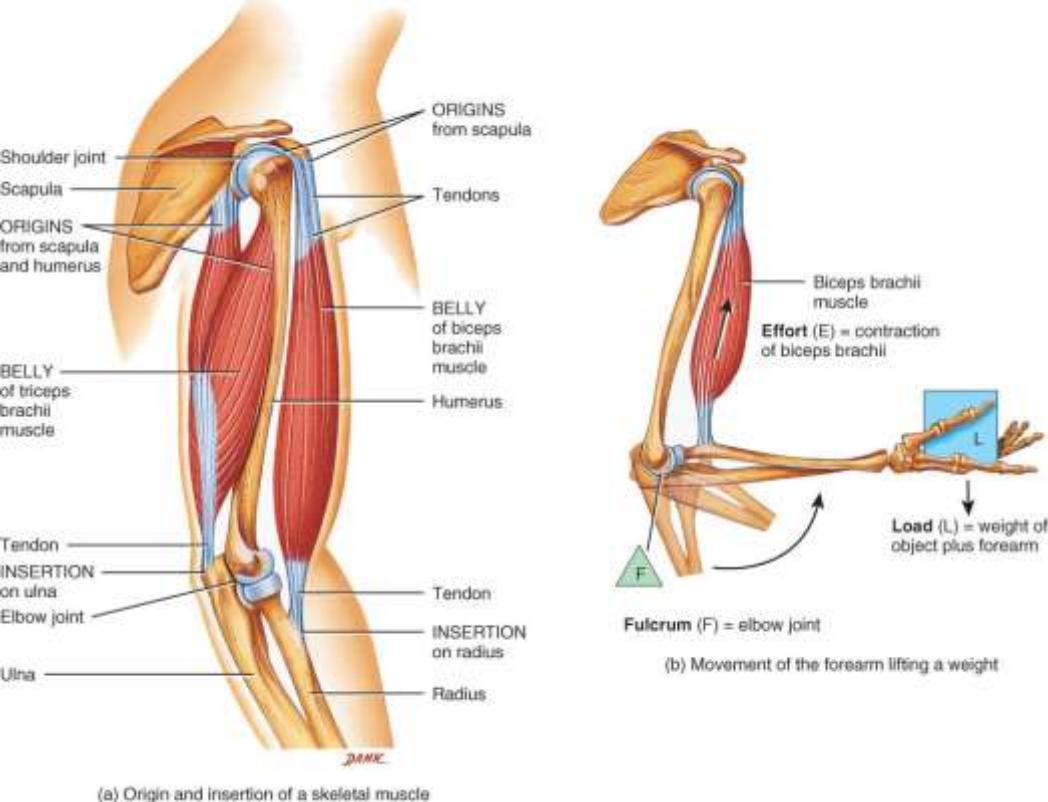


Muscles Continued:

Lever Systems, Fascicle Arrangements, Coordination, and Naming Conventions

HOW SKELETAL MUSCLES PRODUCE MOVEMENT





Muscle Attachment Sites: Origin and Insertion

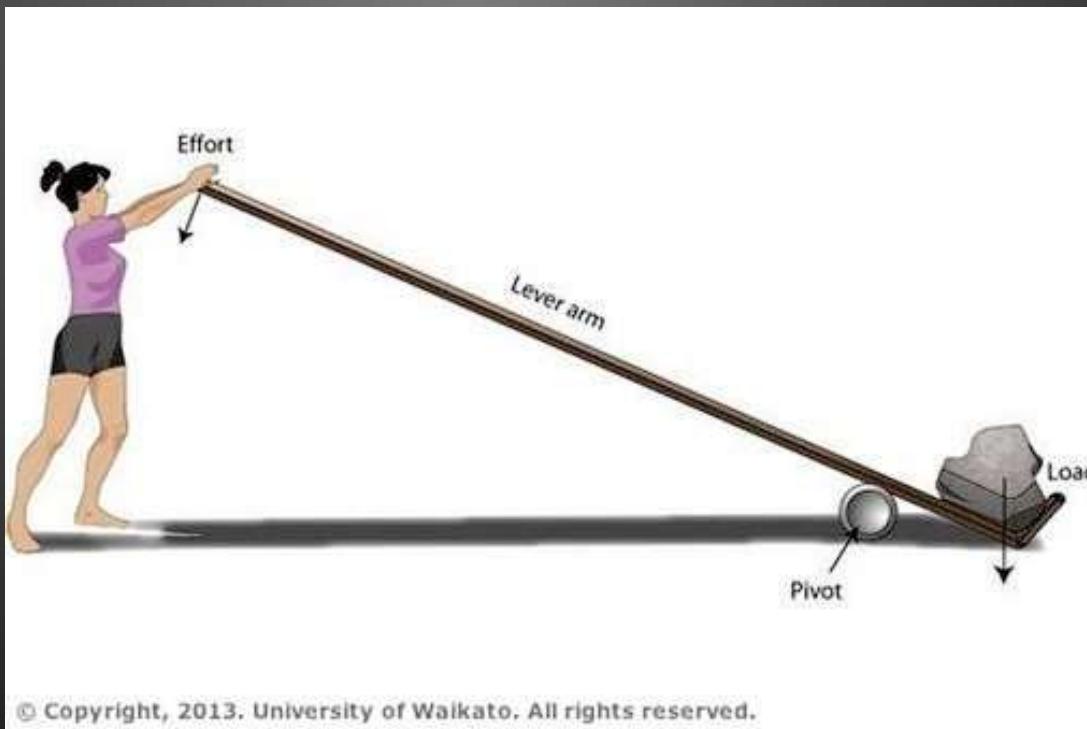
- Skeletal muscles shorten & pull on the bones they are attached to
- **Origin** is the bone that does not move when muscle shortens (normally proximal)
- **Insertion** is the movable bone (some 2 joint muscles)
- Fleshy portion of the muscle in between attachment sites = **belly**

Lever Systems and Leverage

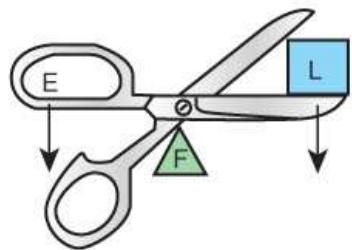
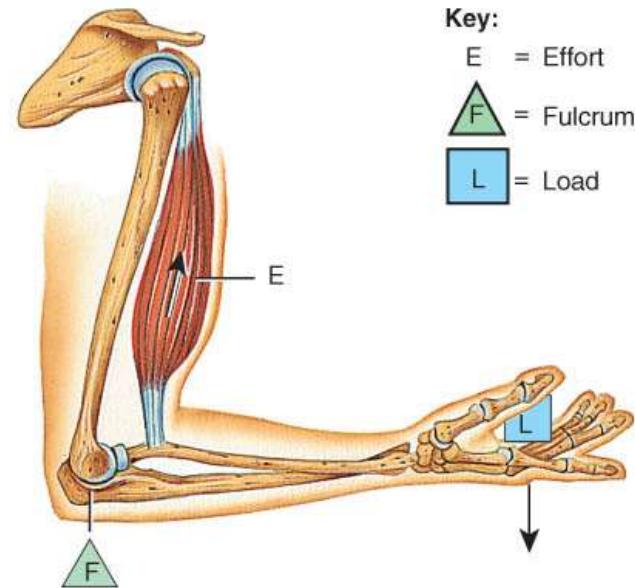
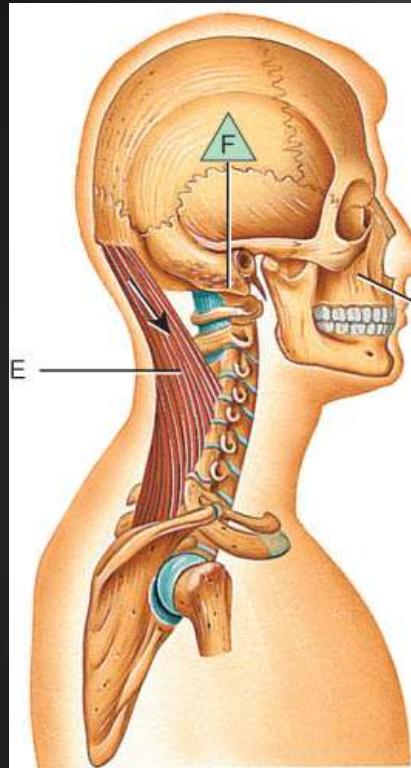
- A lever is a rigid structure that moves around a fixed point, the *fulcrum* (F)
- The lever is acted on by two different forces:
 - *resistance (load)* (L), which opposes movement
 - *effort* (E) which causes movement Bones serve as *levers* and joints serve as *fulcrums*.
- Leverage, the mechanical advantage gained by a lever, is largely responsible for a muscle's strength and range of motion (ROM), i.e., the maximum ability to move the bones of a joint through an arc.

Lever Systems and Leverage

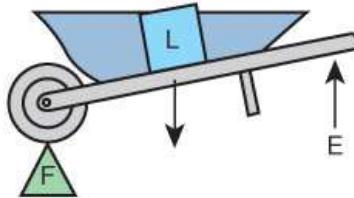
- Mechanical advantage
 - the muscle whose attachment is farther from the joint will produce the most force
 - the muscle attaching closer to the joint has the greater range of motion and the faster the speed it can produce



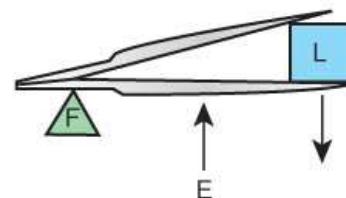
Levers: Components & Types



(a) First-class lever



(b) Second-class lever

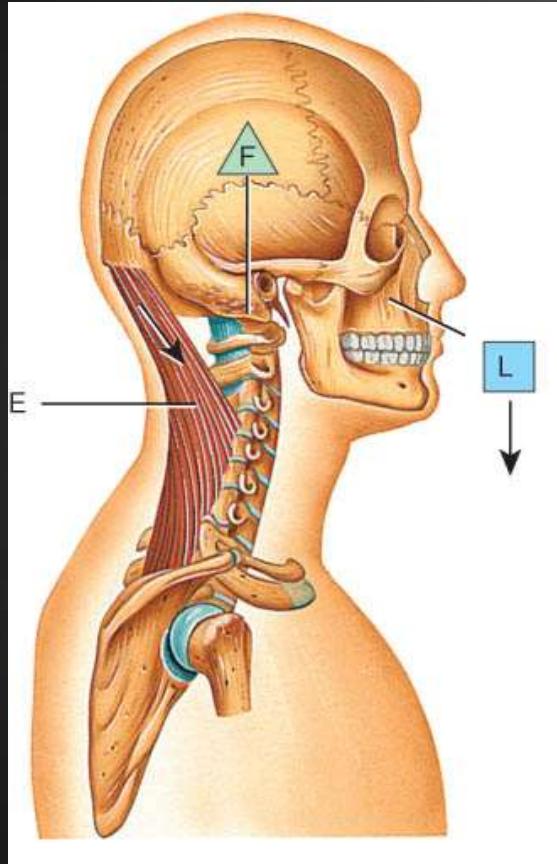


(c) Third-class lever

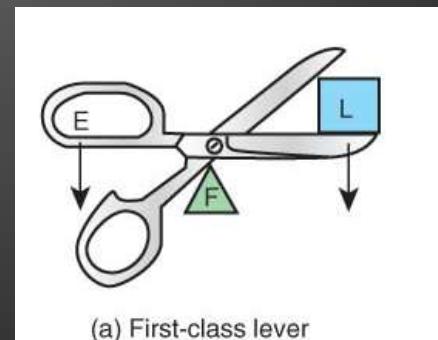
Key:

- E = Effort
- F = Fulcrum
- L = Load

First - Class Lever

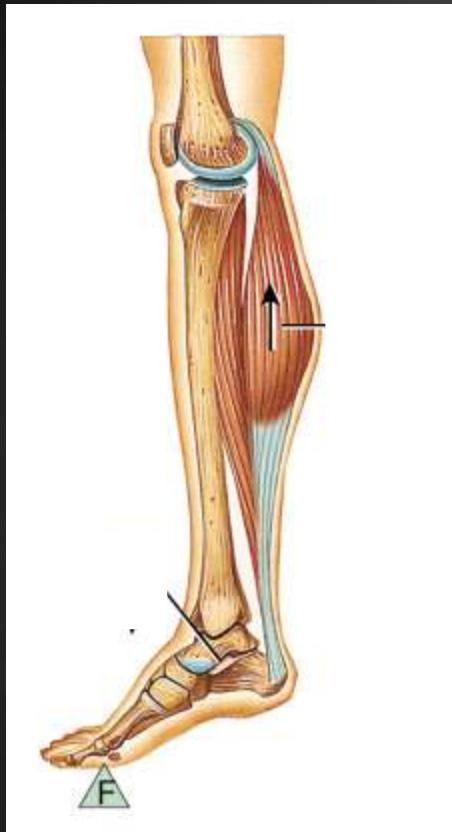


- Head resting on vertebral column
 - weight of face is the resistance
 - joint between skull & atlas is fulcrum
 - posterior neck muscles provide effort

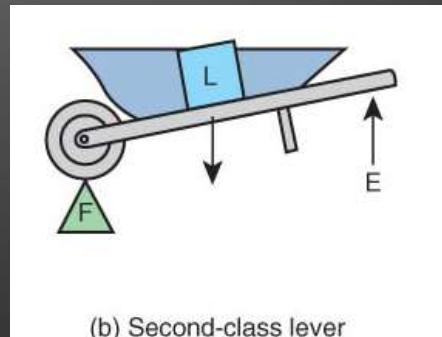


(a) First-class lever

Second - Class Lever

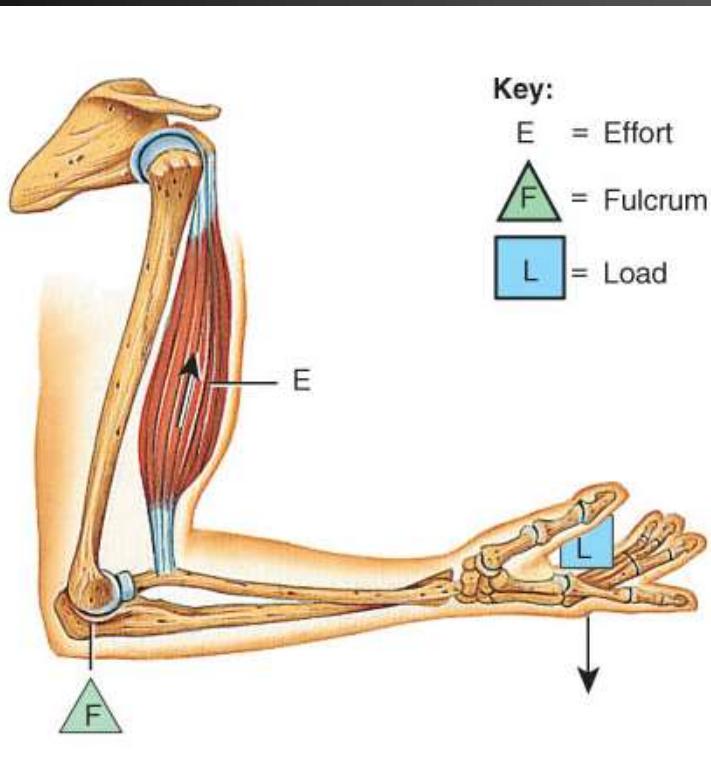


- Similar to a wheelbarrow
- Raising up on your toes
 - resistance is body weight
 - fulcrum is ball of foot
 - effort is contraction of calf muscles which pull heel up off of floor

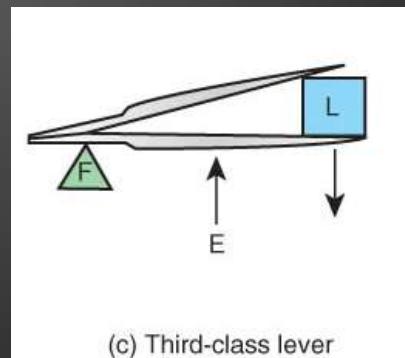


(b) Second-class lever

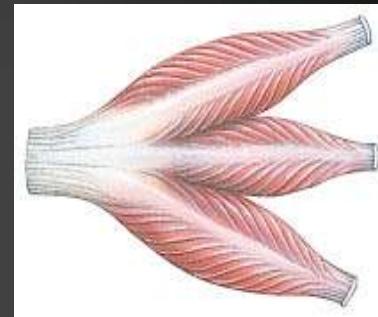
Third - Class Lever



- Most common levers in the body
- Favors speed and range of motion over force
- Flexor muscles at the elbow
 - resistance is weight in hand
 - fulcrum is elbow joint
 - effort is contraction of biceps brachii muscle



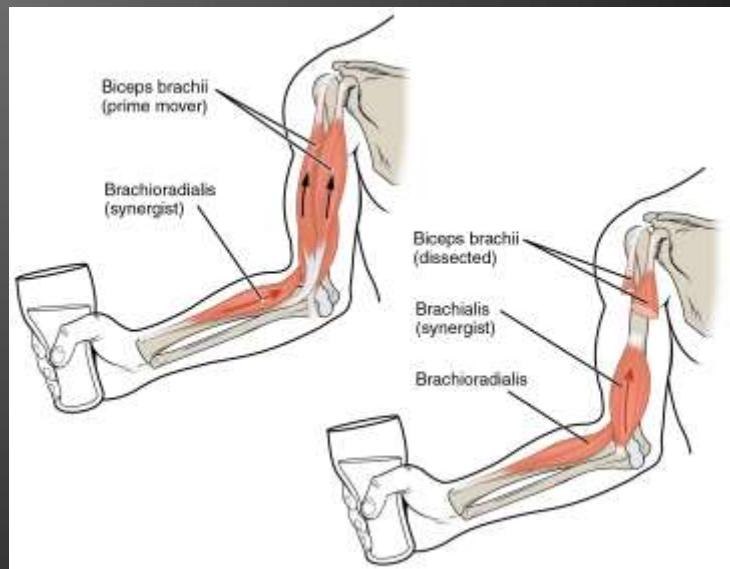
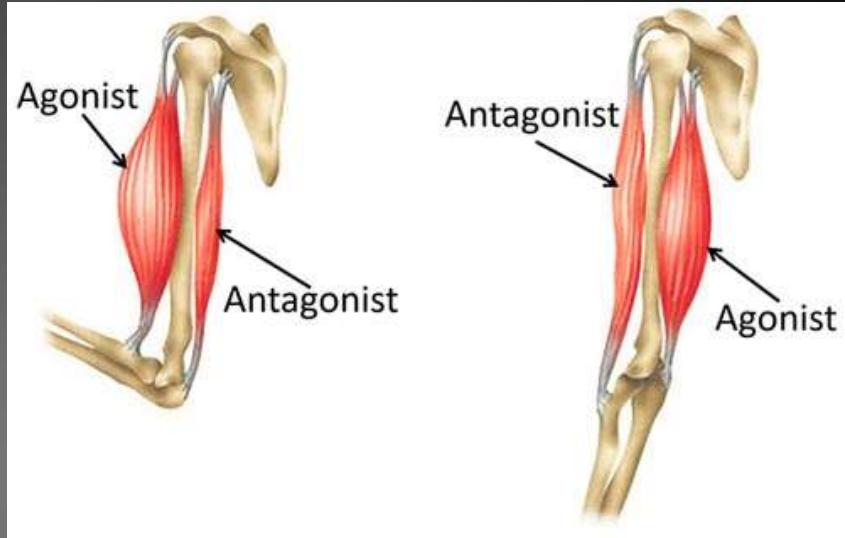
Fascicle Arrangements



- A contracting muscle shortens to about 70% of its length
- Fascicular arrangement represents a compromise between force of contraction (power) and range of motion

Coordination Within Muscle Groups

- Most movement is the result of several muscle working at the same time
- Most muscles are arranged in opposing pairs at joints
 - **prime mover or agonist** contracts to cause the desired action
 - **antagonist** stretches and yields to prime mover
 - **synergists** contract to stabilize nearby joints
 - **fixators** stabilize the origin of the prime mover



Naming the Skeletal Muscles

- Location
 - Example – the brachialis is located on the arm
- Shape
 - Example – the deltoid is triangular or rhomboid major is in the shape of a rhombus
- Relative size
 - Maximus, minimus, and longus, brevis,, and major, minor indicate size
 - Example – gluteus maximus and gluteus minimus
 - Example – pectoralis major and pectoralis minor
 - Example – extensor digitorum longus and brevis (foot)

Naming the Skeletal Muscles

- Direction of fascicles and muscle fibers
 - Name tells direction in which fibers run
 - Example – rectus abdominis and external and internal oblique muscles
- Location of attachments – name reveals point of origin and insertion
 - Example – sternocleidomastoid

Naming the Skeletal Muscles

- Number of origins – two, three, or four origins
 - Indicated by the words biceps, triceps, and quadriceps
- Action – the action is part of the muscle’s name
 - Indicates type of muscle movement
 - Flexor, extensor, adductor, or abductor
 - Extensor digitorum
 - Pronator teres

IM injection

- Intramuscular injection penetrates the skin, subcutaneous tissue and enters the muscle.
- They are given when rapid absorption is necessary, for large doses, or when a drug is irritating to subcutaneous tissue.
- Common sites of injection are the **gluteus medius, vastus lateralis, and deltoid**.
- Intramuscular injections are faster than oral medications, but slower than IV.