Muscular System

Objective

- Understand the role of skeletal muscle in the body.
- Identify the levels of organization in a skeletal muscle.
- Describe types of skeletal fibers and their functions.
- Discuss how muscle are named.

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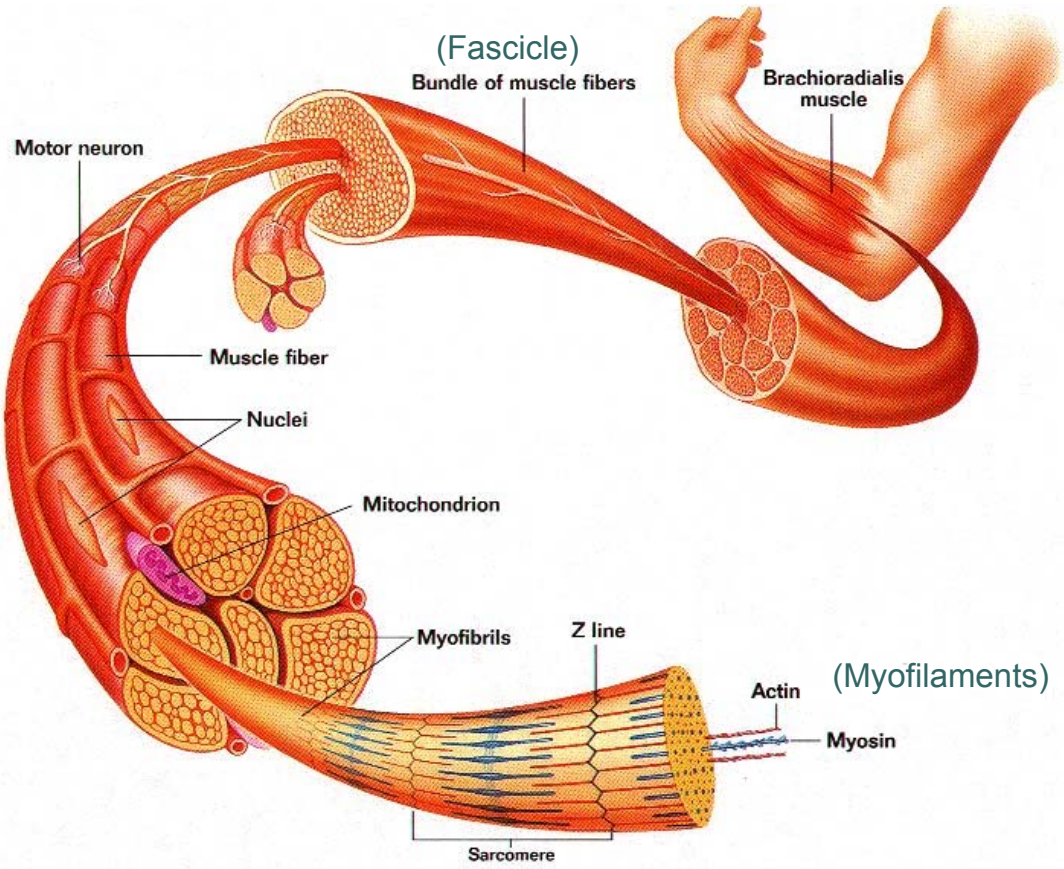
Functions of Skeletal Muscle

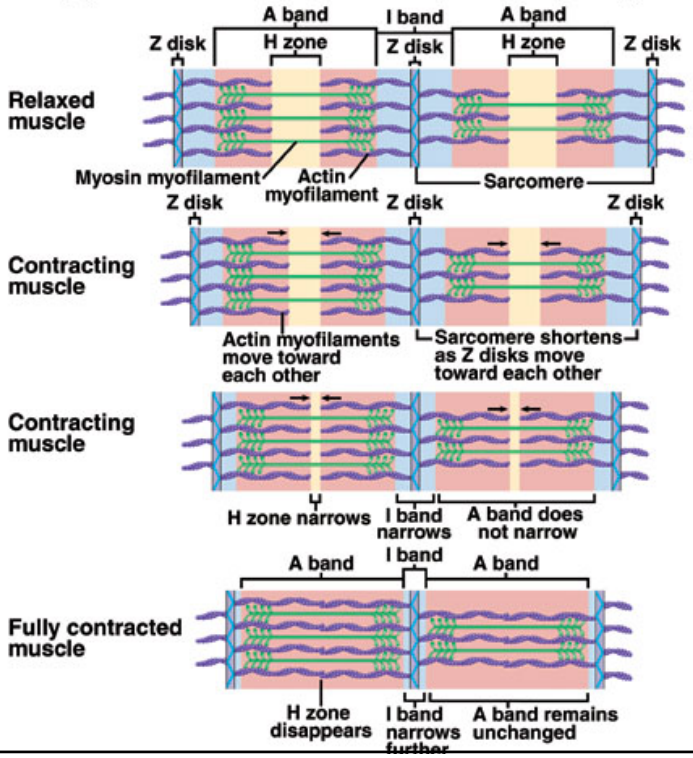
- Body movement
- Maintenance of posture
- Temperature regulation
- Storage and movement of materials
- Support

Muscle Structure

- Myofilament (myosin, actin, troponin, tropomyosin)
- Myofibril (bundle of myofilaments)
- Muscle fiber (bundle of myofibrils)
- Fascicle (bundle of muscle fibers)
- Muscle (bundle of fascicles)


(Fascicle)
Bundle of muscle fibers
Brachioradialis muscle
Motor neuron
Muscle fiber
Nuclei
Mitochondrion
Myofibrils
Z line
(Myofilaments)
Actin
Myosin
Sarcomere

Contraction of Skeletal Muscle



Types of Muscle Contraction

- **Isometric: No change in length but tension increases**
  - **Postural muscles of body**
- **Isotonic: Change in length but tension constant**
  - **Concentric: Overcomes opposing resistance and muscle shortens**
  - **Eccentric: Tension maintained but muscle lengthens**
- **Muscle tone: Constant tension by muscles for long periods of time**

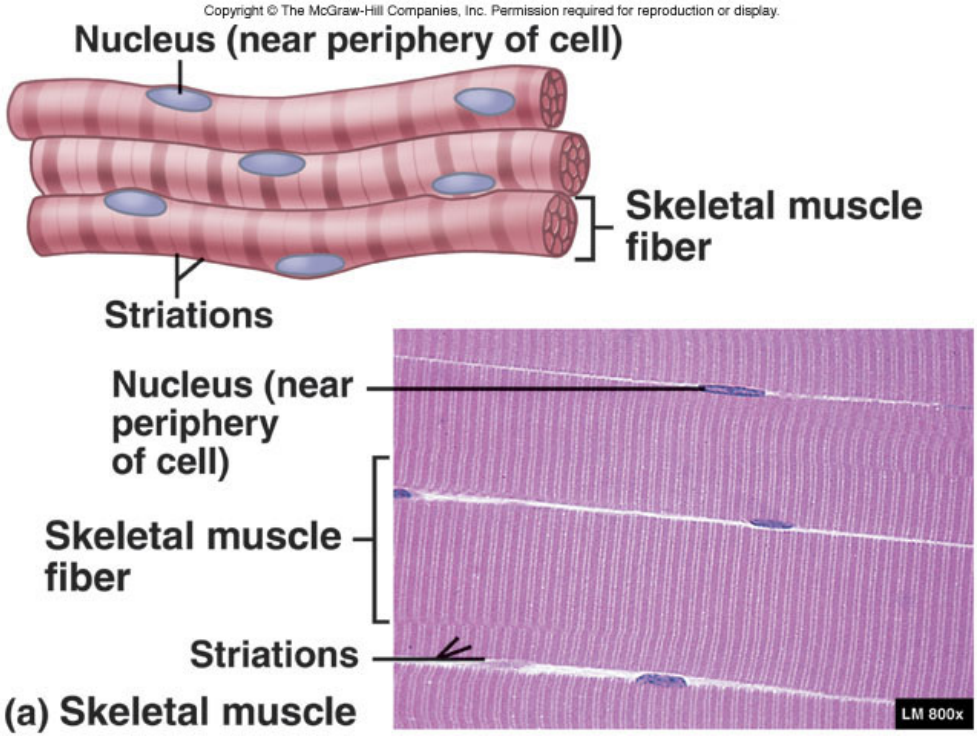
Types of Skeletal Muscle Fibers

Characteristic	Fast	Intermediate	Slow
ATP use	Quickly	Quickly	Slowly
Make ATP	Low, anaerobic	Intermediate, aerobic	High, aerobic
Capillaries	Sparse	Extensive	Extensive
Fiber Color	White (pale)	Red	Red
Fiber Velocity	Fast	Fast	Slow
Fatigue	Low	High	High
Distribution	Upper limbs	Lower Limbs	Trunk (postural)
Diameter	Largest	Intermediate	Smallest
Mitochondria	Few	Many	Many
Myoglobin	Small	Large	Large
Function	Short duration	Medium duration	Endurance

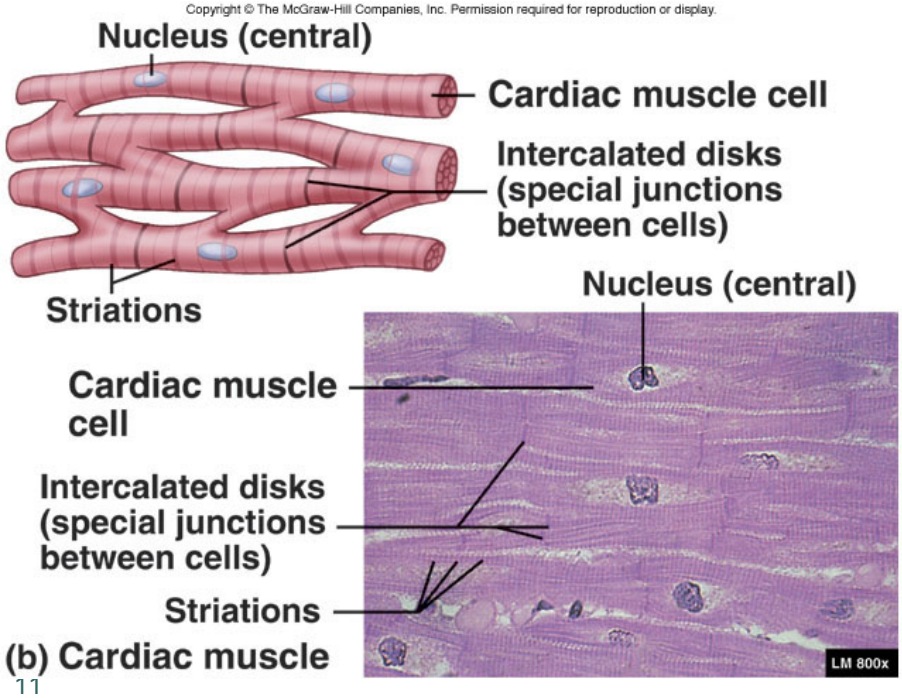
Muscle Tissue Types

- **Skeletal**
  - **Attached to bones**
  - **Nuclei multiple and peripherally located**
  - **Striated, voluntary and involuntary (reflexes)**
- **Smooth**
  - **Walls of hollow organs, blood vessels, eye, glands, skin**
  - **Single nucleus centrally located**
  - **Not striated, involuntary, gap junctions in visceral smooth**
- **Cardiac**
  - **Heart**
  - **Single nucleus centrally located**
  - **Striations, involuntary, intercalated disks**

Skeletal Muscle

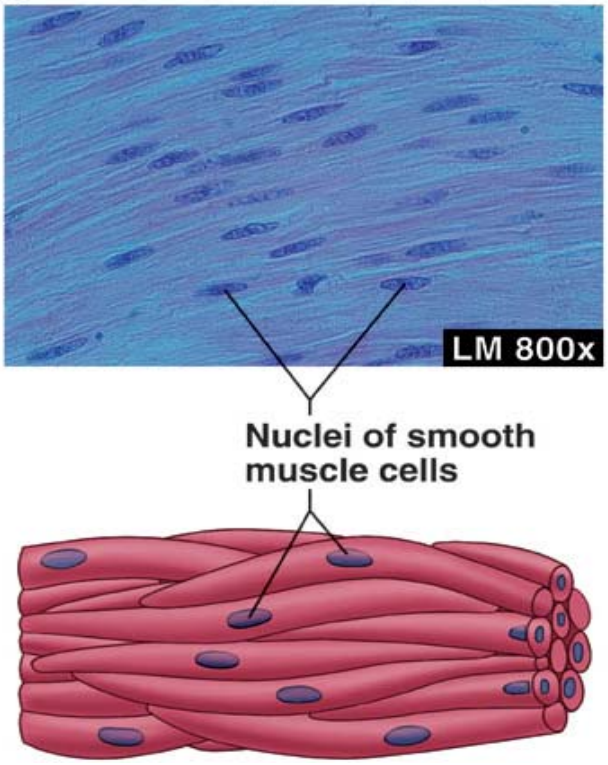


Cardiac Muscle



(b) Cardiac muscle

Smooth Muscle



Exercise & Skeletal Muscle

- Muscle Atrophy (a = without, thophe = nourishment)
  - reduction in muscle size, tone & power.
  - usually happen to individual who suffer damage to nervous system.
  - it reversible but dead or dying muscle cannot replaced.

- Muscle hyperthrophy
  - increase in muscle fiber SIZE.
  - results more mitochondria, larger glycogen reserves & increase ability to produce ATP.

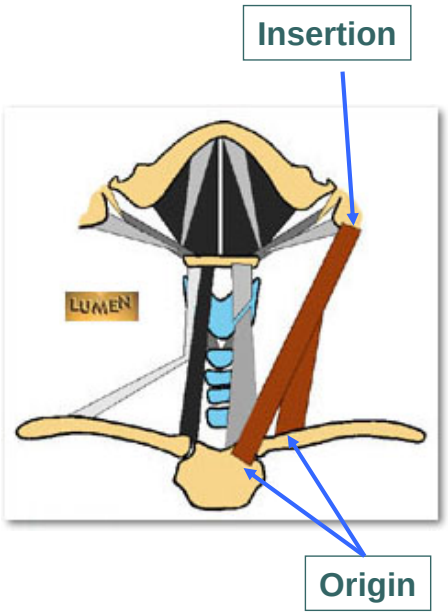
The naming of Skeletal Muscles

- Muscle attachment
- Direction of muscle fibers
- Muscle shape & size
- Specific body regions
- Number of Origins
- Muscle action

* Refer handouts

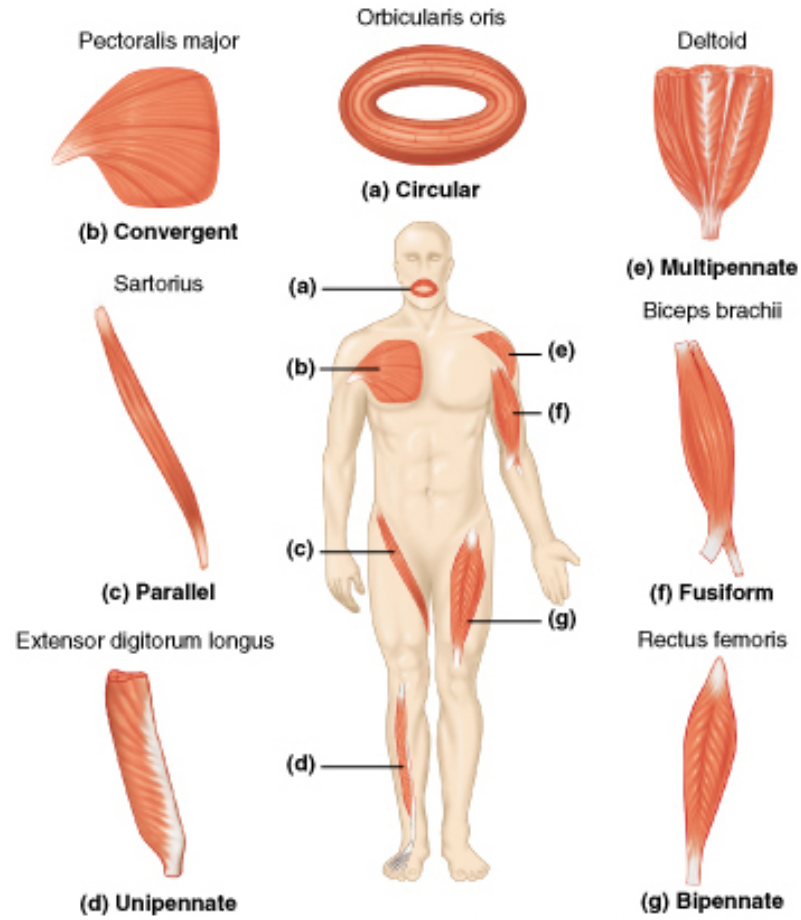
Muscle attachments

- Ends of muscle = tendon
- Origin = less movable attachment, usually proximal
- Insertion = movable attachment, usually distal
- Eg: **sternocleidomastoid**



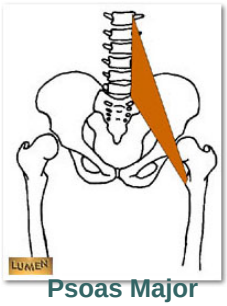
Direction of Muscle Fibers

- **parallell** (strap-like), eg: sartorius
- **fusiform** (spindle shaped), eg: biceps femoris
- **pennate** ("feather shaped"), eg: extensor digitorum longus.
- **bipennate**, eg: rectus femoris
- **multipennate**, eg: deltoid
- **convergent**, eg: pectoralis major
- **circular** (sphincters), eg: orbicularis oris

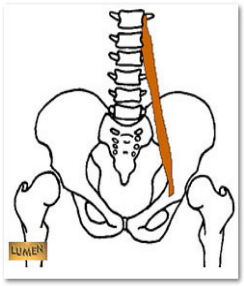

Pectoralis major
(b) Convergent
Orbicularis oris
(a) Circular
Deltoid
(e) Multipennate
Sartorius
(c) Parallel
(a)
(b)
(c)
(d)
(e)
(f)
(g)
Biceps brachii
(f) Fusiform
Extensor digitorum longus
(d) Unipennate
Rectus femoris
(g) Bipennate

Muscle Shape & Size

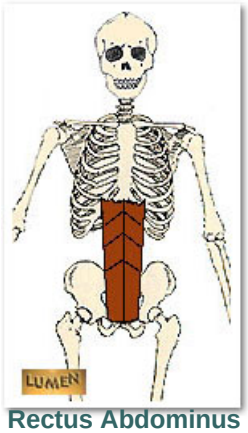
- Deltoid (triangular)
- Longus = long
- Brevis = short
- Trapezius = trapezoid
- Maximus = largest
- Minimus = smallest
- Quadratus = rectangular
- Oblique = angled
- Rectus = straight
- Major = large
- Minor = small



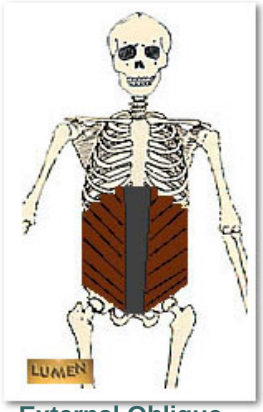
Psoas Major



Psoas Minor



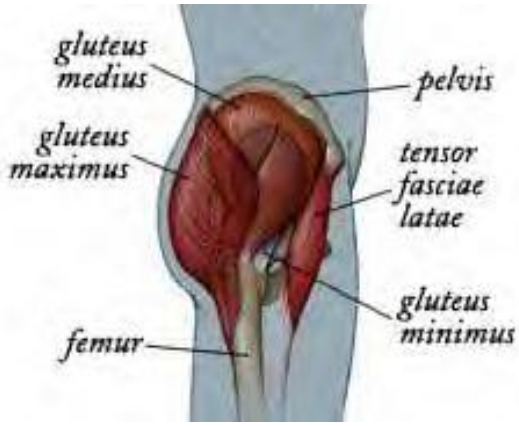
Rectus Abdominus



External Oblique

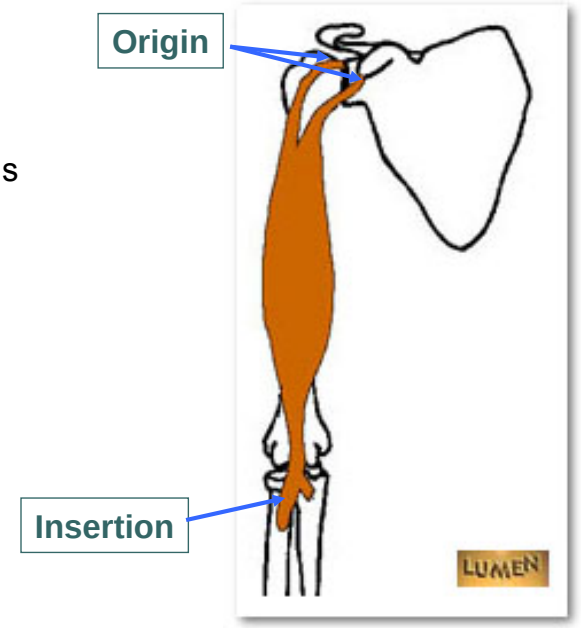
Specific Body Regions

- Frontalis: on Frontal bone
- Abdominus = abdominal
- Branchii = upper arm
- Carpi = wrist
- Gluteus = Buttocks
- Cervicis = neck



Number of Origins

- Biceps = 2 origins
- Triceps = 3 origins
- Quadriceps = 4 origins



Biseps Brachii

Muscle Actions

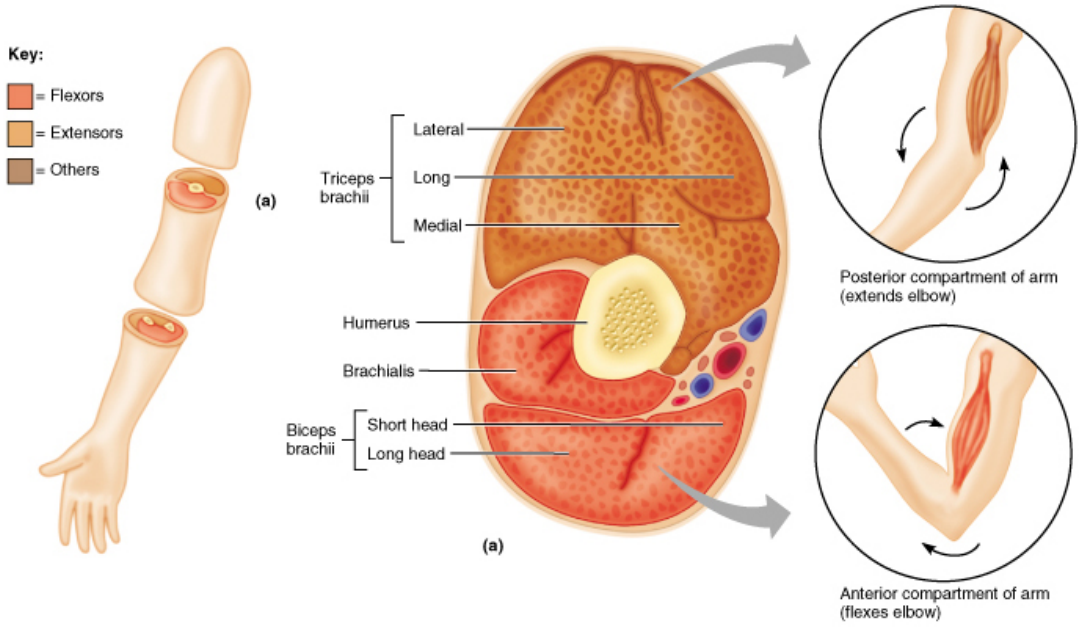
- Flexor = flexion
- Extensor = extension
- Adductor = adduction
- Abduction = abduction

Adductor Magnus

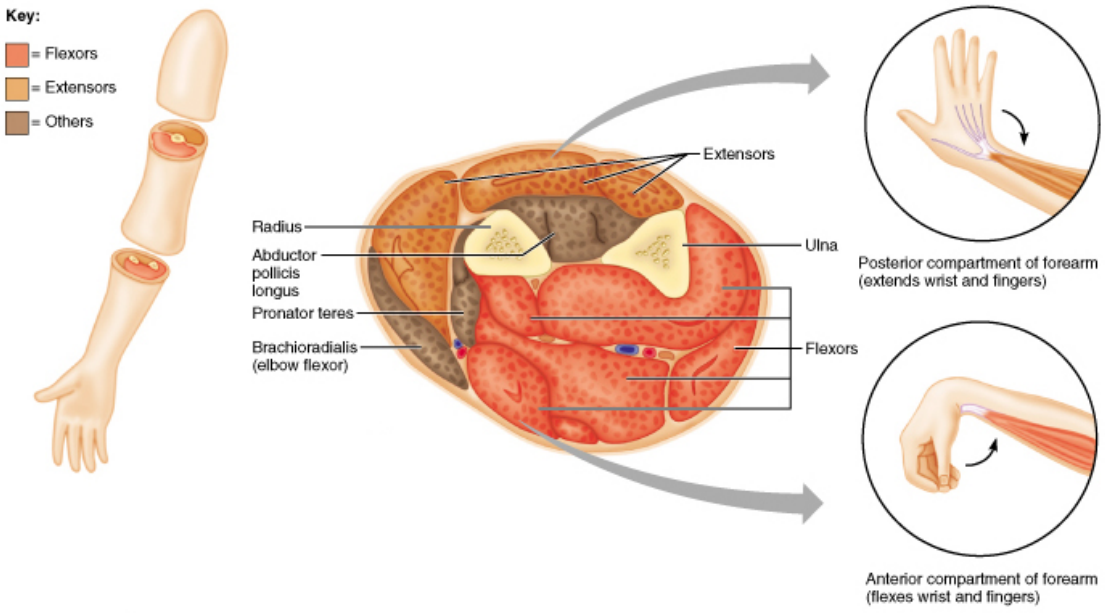
Interactions of Skeletal Muscles in the Body

- **Prime Mover (=agonist):** the principle muscle that causes a movement
  - ex: biceps brachii, flexion of forearm
- **Antagonist:** the principle muscle that causes the opposite movement
  - ex: triceps brachii, extension of forearm
- **Synergists:** muscles that assist the prime mover
  - ex: extensor carpi (wrist) muscles are synergists for the flexor digitorum muscles when you clench your fist
- **Fixators:** synergists that stabilize the origin of a prime over
  - ex: several back muscles that stabilize scapula when the deltoid flexes the arm

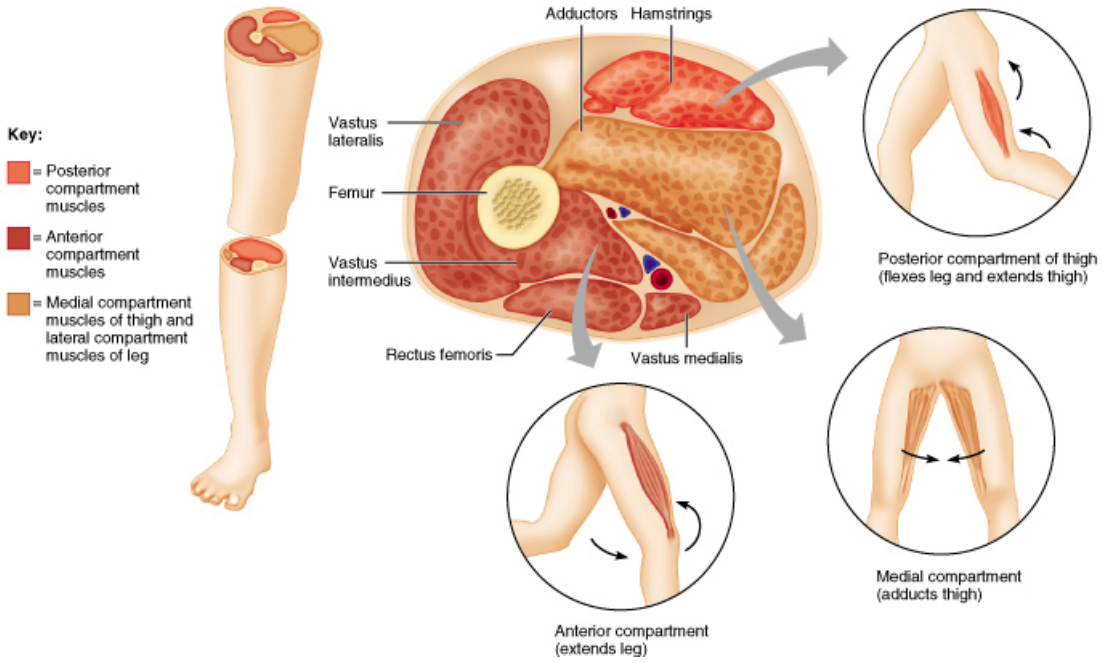
Actions at Arm



Actions at Hand



Actions at Hip



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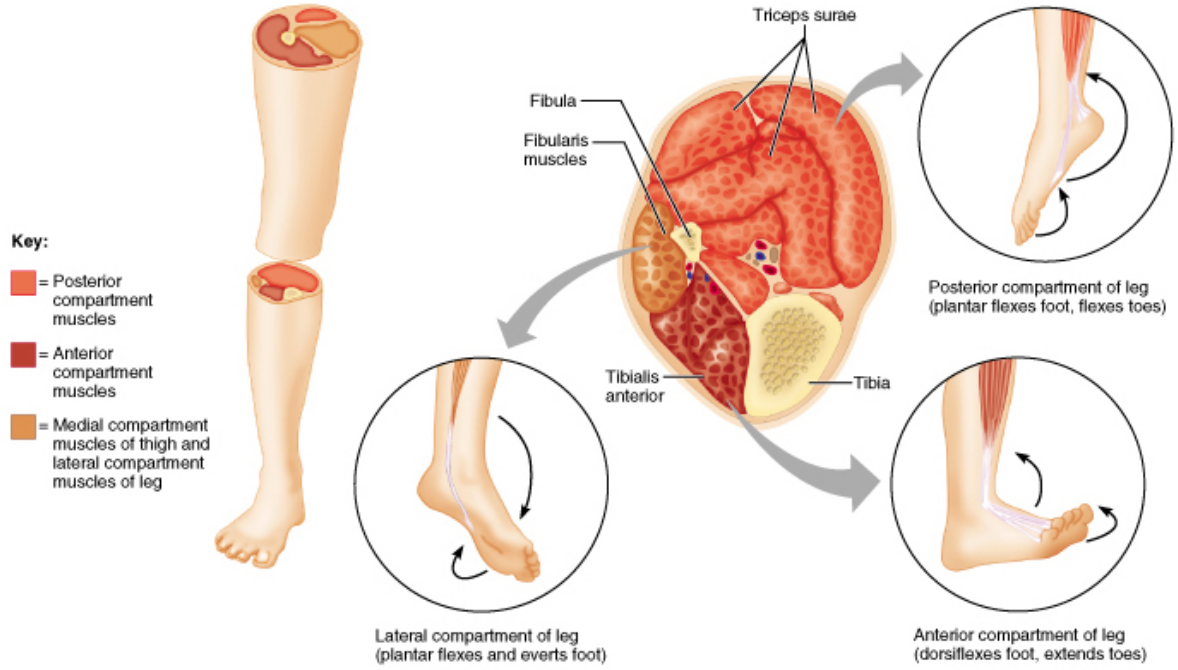
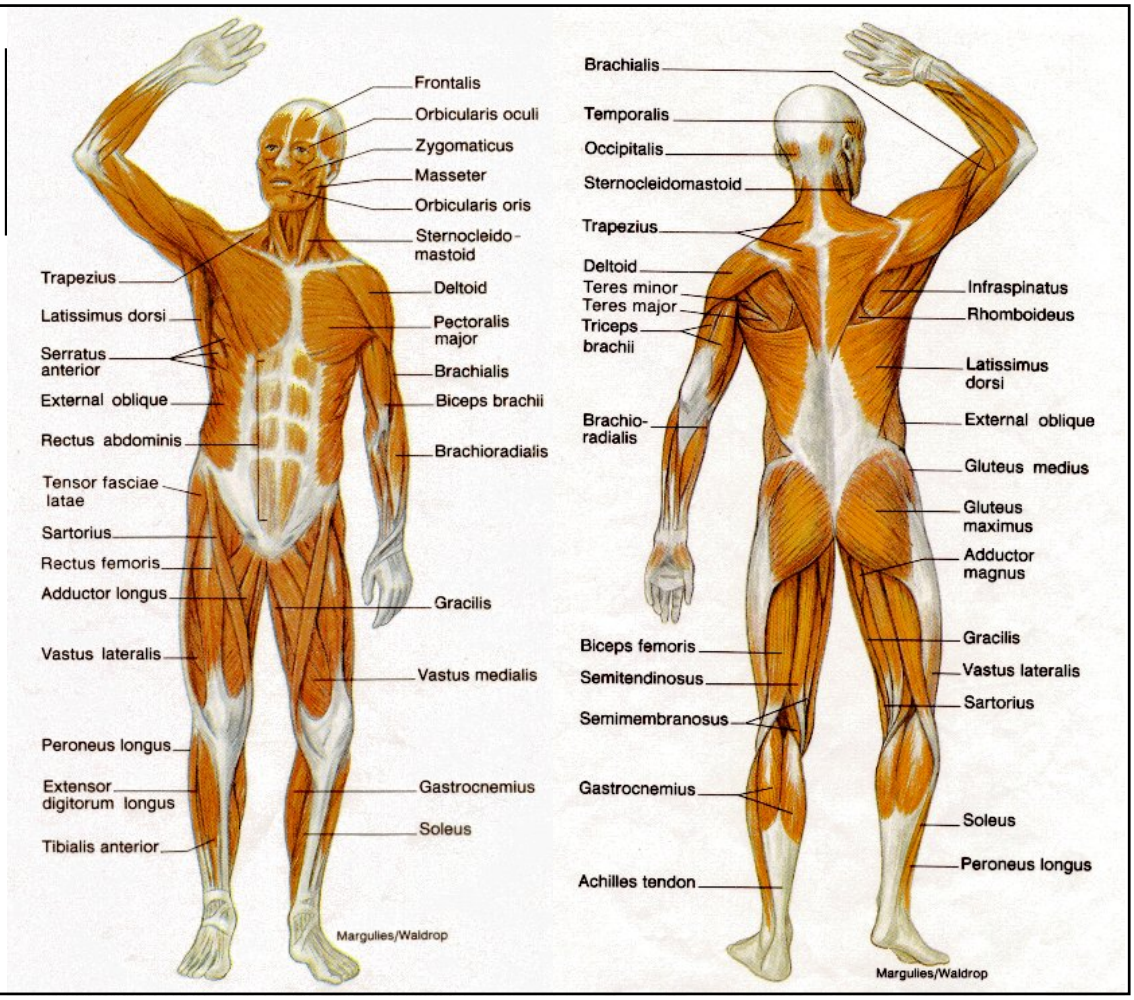
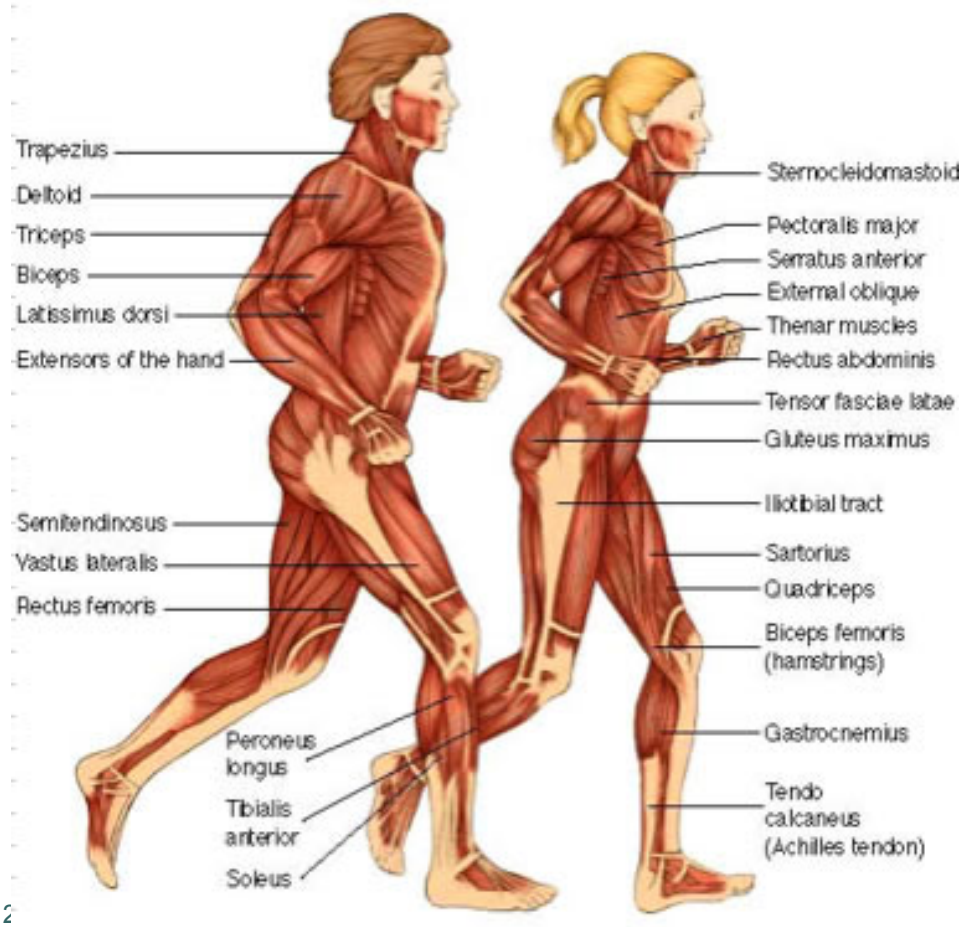
Actions at Foot




Frontalis
Orbicularis oculi
Zygomaticus
Masseter
Orbicularis oris
Sternocleido-mastoid
Trapezius
Deltoid
Latissimus dorsi
Pectoralis major
Serratus anterior
Brachialis
External oblique
Biceps brachii
Rectus abdominis
Brachioradialis
Tensor fasciae latae
Sartorius
Rectus femoris
Adductor longus
Gracilis
Vastus lateralis
Vastus medialis
Peroneus longus
Extensor digitorum longus
Gastrocnemius
Soleus
Tibialis anterior
Margulies/Waldrop
Brachialis
Temporalis
Occipitalis
Sternocleidomastoid
Trapezius
Deltoid
Teres minor
Teres major
Triceps brachii
Infraspinatus
Rhomboideus
Latissimus dorsi
Brachio-radialis
External oblique
Gluteus medius
Gluteus maximus
Adductor magnus
Biceps femoris
Gracilis
Semitendinosus
Vastus lateralis
Semimembranosus
Sartorius
Gastrocnemius
Soleus
Achilles tendon
Peroneus longus
Margulies/Waldrop


Trapezius
Deltoid
Triceps
Biceps
Latissimus dorsi
Extensors of the hand
Semitendinosus
Vastus lateralis
Rectus femoris
Peroneus longus
Tibialis anterior
Soleus
Sternocleidomastoid
Pectoralis major
Serratus anterior
External oblique
Thenar muscles
Rectus abdominis
Tensor fasciae latae
Gluteus maximus
Iliotibial tract
Sartorius
Quadriceps
Biceps femoris (hamstrings)
Gastrocnemius
Tendo calcaneus (Achilles tendon)