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Ch 6 The Muscular System Notes

Lisa Peck

Muscular System: consists of skeletal muscles and their connective tissue attachments

organ- skeletal muscle
consists of hundreds of muscle fibers (cells) bound tog. by connective tissue

cell- muscle fibers- elongated cells
largest (compared to smooth muscle)

primary function is contraction: ability to shorten dep. on myofilaments

muscle prefixes "myo" - muscle
"mys" - muscle
"sarco" - flesh

3 Muscle Types (p 178-181)

1. **Skeletal Muscle-** skeletal, striated, & voluntary
referred to as the human body's "muscular system"

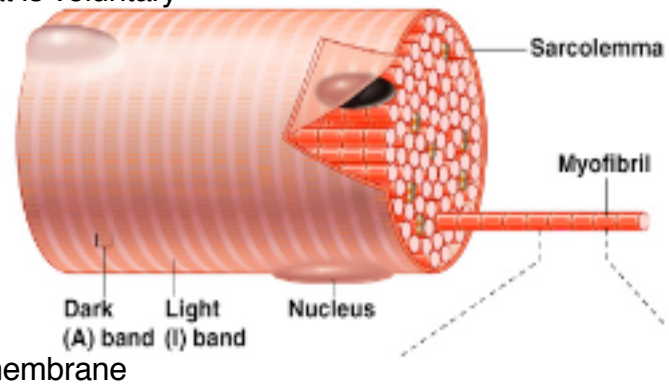
location: attach to bones or indirectly to other connective tissues or cartilage
attach via tendons or aponeuroses
exception: some facial muscles attach to soft tissues (oth. muscles or skin)

function: create movement of bones or facial skin via contractions

contraction 1. regulation: voluntary
subject to conscious control via nervous system
only muscle type that is voluntary

2. speed: rapidly w/ great force
tire easily
must rest after activity

3. no rhythmic contractions



morphology: single cell
elongated cylindrical shape

myofiber (cell):

sarcolemma- muscle cell membrane

myofibrils- contractile organelles found in cytoplasm of muscle cells
long tube-like
have light and dark bands along length
many aligned perfectly w/ in sarcolemma
giving a striated appearance to cell

multinucleated- nuclei and cytoplasm pushed to edge of sarcolemma by numerous myofibrils

sarcoplasmic reticulum- ER of cell
stores calcium (for contraction)

striated- banded appearance due to alignment of bands on myofibrils
myofibril bands created by arrangement of myofilaments within myofibril

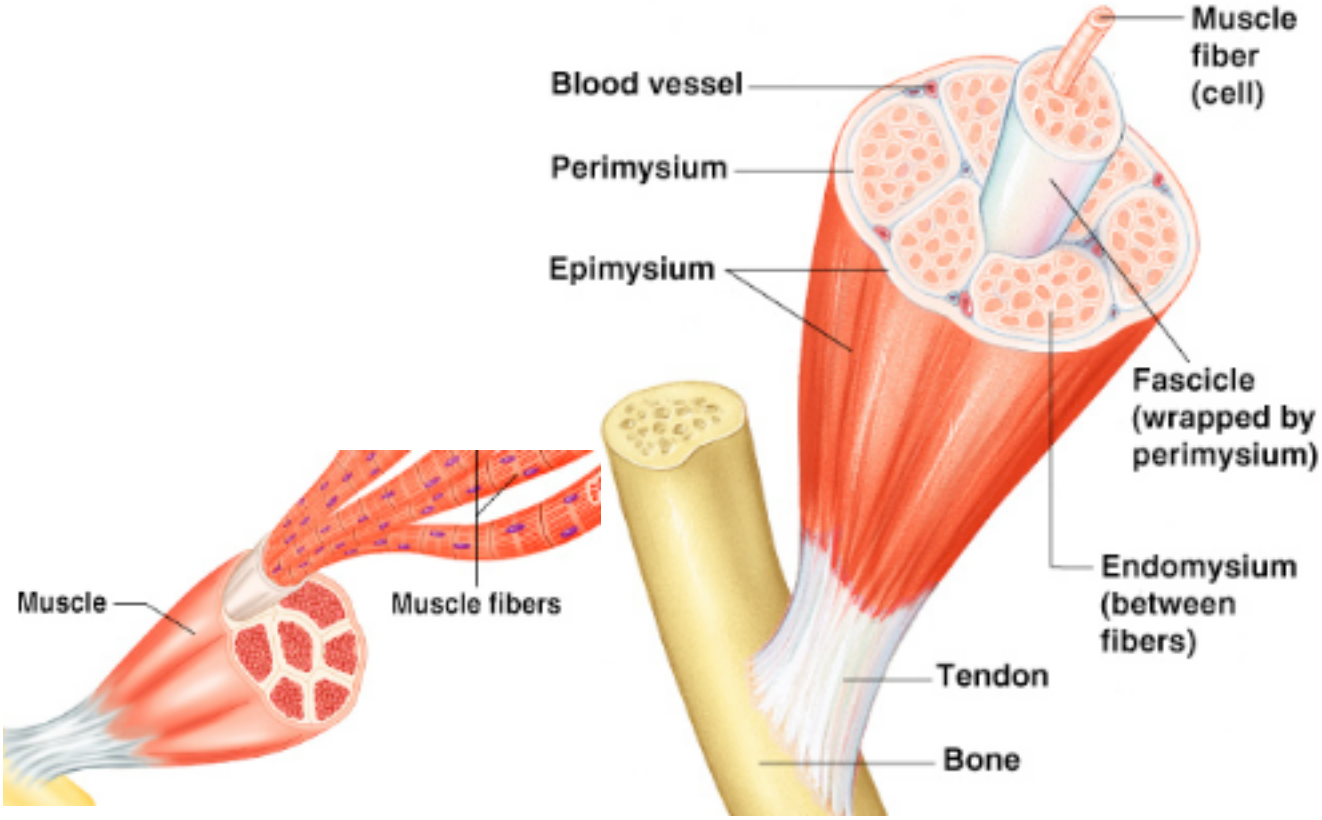
myofilaments- filaments composing the myofibrils
two types: actin & myosin

connective tissue coverings of skeletal muscle

endomysium- thin connective tissue covering muscle cell (fiber)

perimysium- coarser fibrous membrane covering bundles of muscle fibers
creating a **fascicle**- bundle of muscle fibers bound tog. by connective tissue

epimysium- tough fibrous connective tissue surrounding many fascicles
creating a skeletal muscle
outer covering of entire skeletal muscle
blend into strong, cordlike tendons or into sheetlike aponeurosis



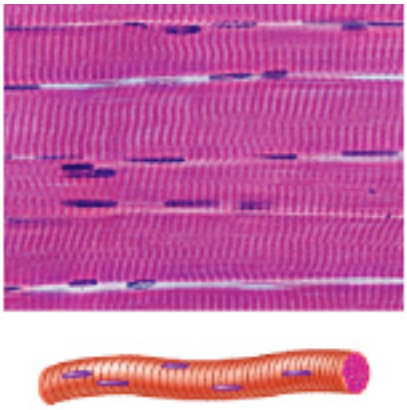
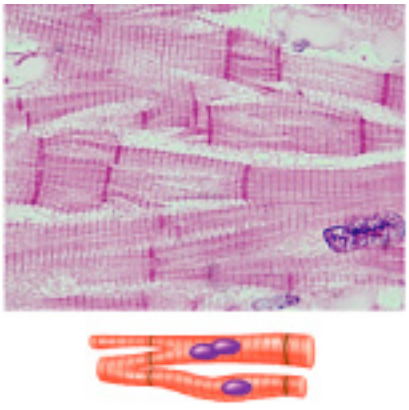
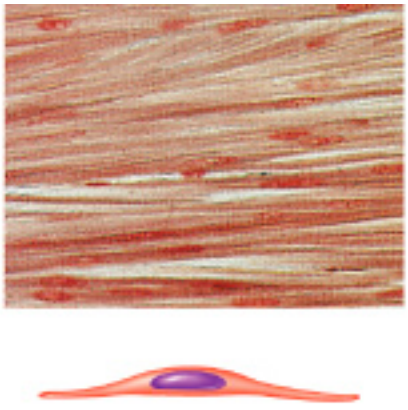
tendon- cord of dense fibrous tissue attaching a muscle to a bone

aponeuroses- fibrous or membranous sheet connecting a muscle & the part it moves

fascia- layers of fibrous tissue covering and separating muscles

tendon f'ns: 1. provide durability & conserve space
2. tough collagenic fibers, can cross rough bony projections (would tear muscle)
3. have small size, therefore more tendons than fleshy muscles can passover a joint

3 types of muscle cells:

Skeletal	Cardiac	Smooth
		
Single, very long, cylindrical, multinucleate cells with very obvious striations	Branching chains of cells; uninucleate, striations; intercalated discs	Single, fusiform, uninucleate; no striations

<u>Smooth Muscle</u>- visceral, nonstriated, & involuntary

<u>location</u>: walls of hollow visceral organs
stomach, urinary bladder, respiratory passages

<u>function</u>: create movement of substances through a tract or pathway

<u>contraction</u> 1. regulation: involuntary
control via nervous system
endocrine system (hormones)
chemicals
mechanical stretching

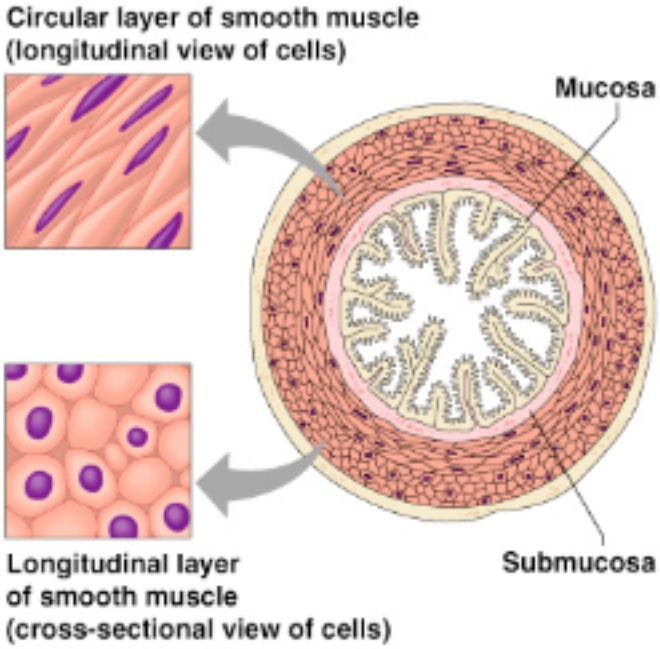
2. speed: very slow & sustained
does not tire easily

3. rhythmic contractions in some

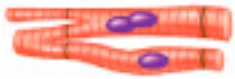
<u>morphology</u>: single cell
fusiform shape (spindle shaped)
nonstriated
uninucleated

arranged in sheets or layers
1. runs circularly
2. runs longitudinally

-layers alternatively contract & relax
-changing shape & size of organ
-moving substances through tract



Cardiac Muscle- cardiac, striated, & involuntary



location: walls of the heart

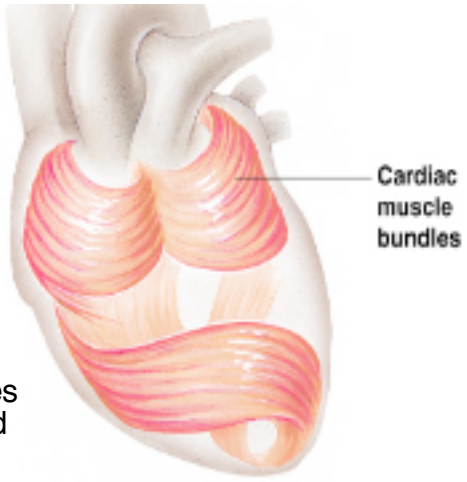
function: force movement of blood through heart chambers to arteries

contraction 1. regulation: involuntary

control via heart "pacemaker" (for rhythmic contraction)
nervous system (for increased # of contractions for short period)
endocrine system (hormones)

2. speed: slow
does not tire easily

3. rhythmic contractions



morphology: branching chains of cells
striated
uninucleated

fibers cushioned with soft connective tissue
fibers arranged in spiral or figure 8 shaped bundles
enables heart activity to be closely coordinated

branching cells joined by **intercalated discs**

Muscle Functions (pp 181-182)

1. **producing movement**- result of contraction

skeletal muscles: enable quick response to changes in environment
enable expression of emotions (facial & neck muscles)

smooth muscles: force substances to move thru visceral tracts

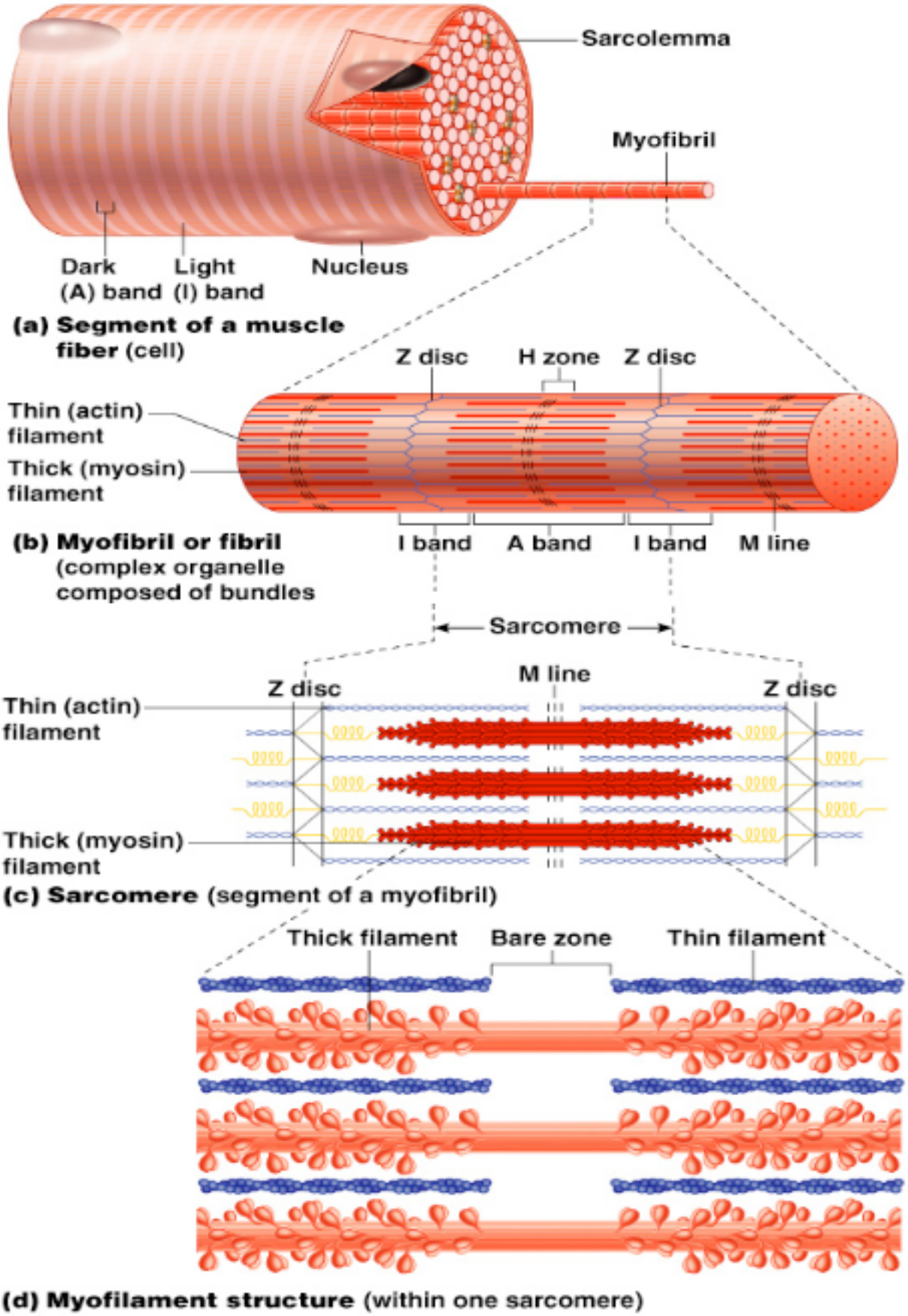
cardiac muscles: circulate blood & maintain blood pressure

2. **maintaining posture**- via skeletal muscles
overcoming gravity effects while sitting or standing

3. **stabilizing joints**- pull of skeletal muscles on bones
tendons important in reinforcing & stabilizing joints too

4. **generating heat**- by-product of muscle activity
75% of ATP energy creates heat (only 25% used to contract muscle)

Microscopic Anatomy of Skeletal Muscle (pp 182-184)



Microscopic Anatomy of Skeletal Muscle (pp 182-184) 6

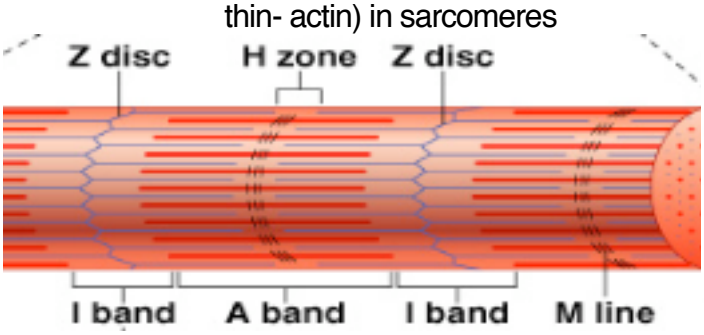
Muscle Fiber (cell) <--- bundles of **Myofibrils <---** bundles of **Myofilaments** (actin & myosin)

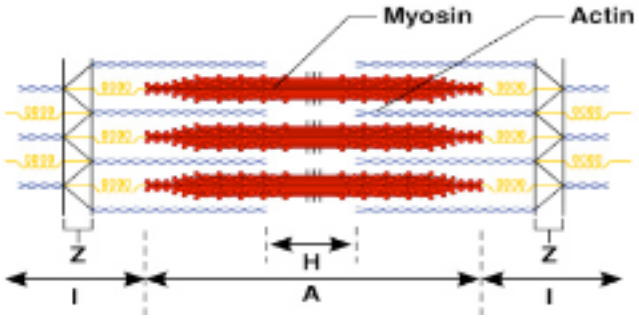
Sarcolemma- muscle cell membrane
encloses many myofibrils, many nuclei, sarcoplasmic reticulum, mitochondria etc.

Myofibrils- contractile organelles found in cytoplasm of muscle cells
long tube-like
have light and dark bands along length
-striations created by perfectly aligned myofibrils w/ in sarcolemma

consists of chains of **sarcomeres**- tiny contractile units consisting of actin & myosin

banding pattern: light & dark bands created by the arrangement of myofilaments (thick- myosin & thin- actin) in sarcomeres





Light (I) Bands- contain - only actin filaments (thin filament)
-parts of two adjacent sarcomeres

Z disk - a darker area in middle of **I band** (a midline interruption)
- connection of actin filaments (thin filaments)

Dark (A) Bands- consists of actin & myosin filaments
myosin filaments extend the entire length of A band
has a lighter central area, **H zone** (bcs no actin filaments located here)
H zone has a central line called **M line**
M line- protein rods connecting myosin filaments

Myofilaments- protein strands
2 types: **myosin filament**- thick protein filament
middle is smooth
ends contain numerous **myosin heads**

actin filament- thin protein filament
anchored to the **Z disc** in **I Band**
don't overlap ends of myosin fibers
don't extend into middle of **A band (H zone)**

Cross Bridges formed when the myosin heads link to the actin filaments (at myosin binding sites)

Sarcoplasmic Reticulum (SR)- smooth endoplasmic reticulum that surrounds every myofibril
f'n: stores calcium needed for contraction (filament sliding)

Skeletal Muscle Activity (pp 184-192)

irritability- the ability to receive and respond to a stimulus
contractility- the ability to shorten (forcibly) when an adequate stimulus is received

Stimulation and contraction of Single Skeletal Muscle Cells (pp 184-187)

one motor neuron (nerve cell) may stimulate a few muscle cells or hundreds of muscle cells

1. Nerve stimulus & the action potential

motor unit- a motor neuron and all the muscle cells it stimulates

axon- long threadlike extension of the neuron

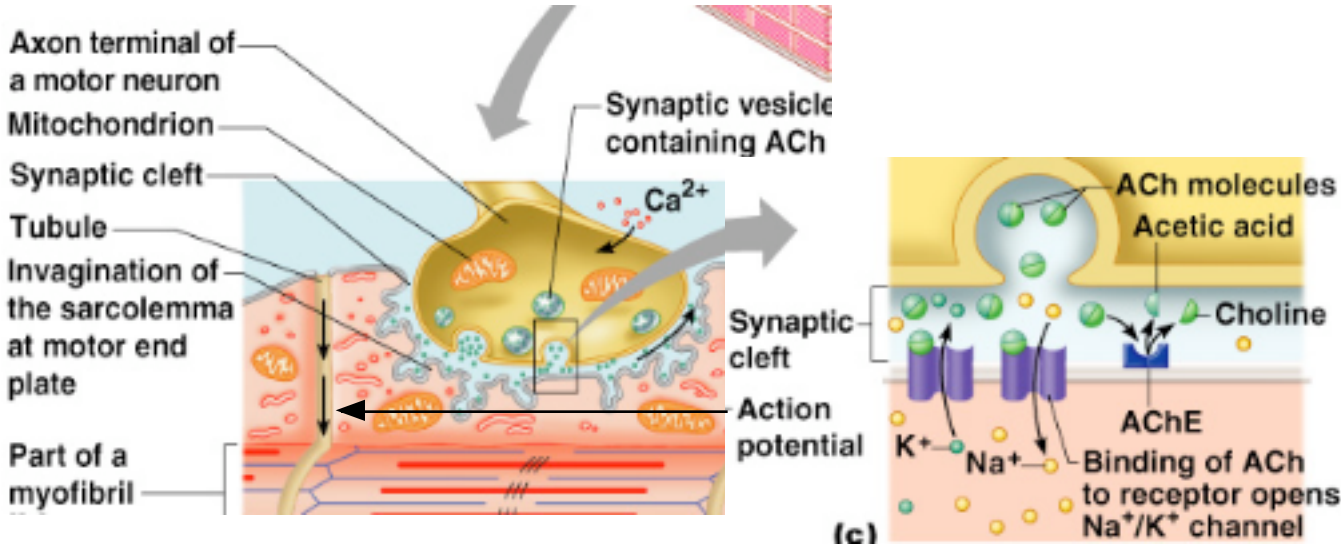
axon terminal- end of neuron that branches into numerous ends
form neuromuscular junction with muscle cell

neuromuscular junction- junction @ motor neuron's axonal ending & sarcolemma of muscle cell

synaptic cleft- gap b/ w axon terminal of motor neuron and muscle cell sarcolemma
filled w/ interstitial fluid

neurotransmitter- chemical subst. released by neuron when nerve impulse reaches axonal ends
acetylcholine in skeletal muscle

1. Acetylcholine is released into the neuromuscular junction by axonal terminal
2. Acetylcholine diffuses across the neuromuscular junction & binds to receptors on the sarcolemma
3. Depolarization occurs, and the action potential is generated (see next page)
4. Action potential, carried deep into cell, causes sarcoplasmic reticulum to release calcium ions
5. Calcium ion concentration @ myofilaments increases; myofilaments slide past one another, and muscle cell shortens
6. As calcium is actively reabsorbed into the sarcoplasmic reticulum, its concentration at the myofilaments decreases
7. The muscle cell relaxes and lengthens



Stimulation & contraction of Single Skeletal Muscle Cells

2. Mechanism of muscle contraction: the sliding filament theory

Depolarization of Muscle Cell-

nerve stimulus------> changes in sarcolemma permeability----> enables change in concentrations of sodium & potassium ions----> wh/ generates an electrical current- **action potential----->** wh/ travels over entire surface of sarcolemma----> action potential carried deep into cell----> causes sarcoplasmic reticulum to release calcium ions----> calcium ions enable myosin heads to form cross bridges with actin filaments----> initiating filament sliding

when action potential ends----> calcium ions are immediately reabsorbed into sarcoplasmic reticulum---->muscle cell relaxes back to its original length

Action Potential Generation:

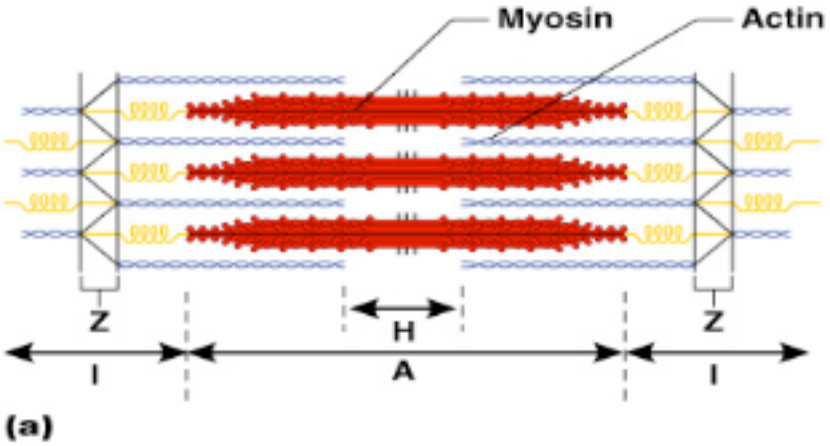
Resting: greater conc. of sodium ions outside inside is more negative than outside
greater conc. of potassium ions inside

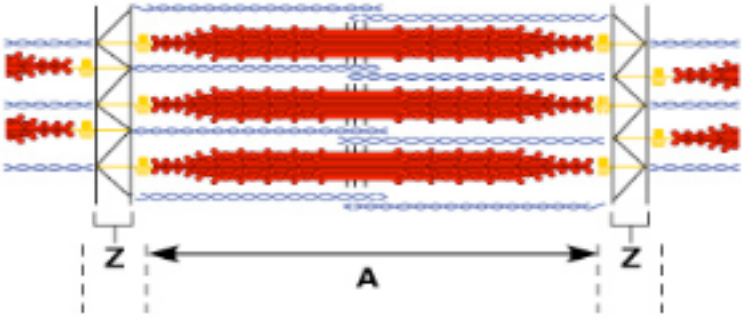
Stimulus: sarcolemma permeability changes

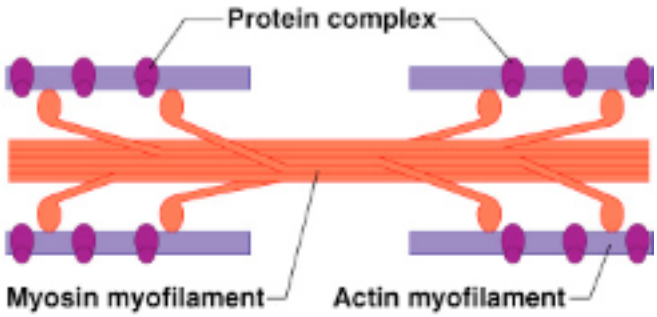
Depolarization: sodium diffuses into cell changing polarity of membrane (outside more negative)
inside more positively charged than outside----> creates electrical current

Repolarization: potassium diffuses out of cell to restore the electrical conditions of membrane

Sodium-Potassium pump- uses ATP to restore resting state conc. of sodium & potassium ions
--pumps excess sodium ions out of cell
--brings potassium ions back into cell

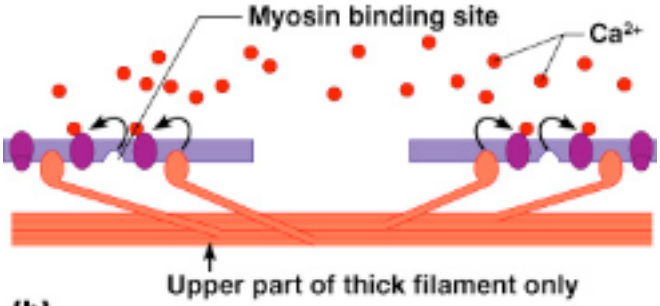






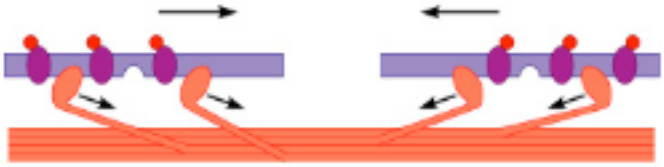
(a)

In a relaxed muscle cell, the regulatory proteins forming part of the actin myofilaments prevent myosin binding (see **a**). When an action potential sweeps along its sarcolemma and a muscle cell is excited, calcium ions (Ca^{2+}) are released from intracellular storage areas (the sacs of the sarcoplasmic reticulum).



(b)

The flood of calcium acts as the final trigger for contraction, because as calcium binds to the regulatory proteins on the actin filaments, they change both their shape and their position on the thin filaments. This action exposes myosin binding sites on the actin, to which the myosin heads can attach (see **b**), and the myosin heads immediately begin seeking out binding sites.



(c)

Free myosin has a unique property: Its heads are "cocked," much like a set mousetrap. The physical attachment of myosin to actin "springs the trap," causing the myosin heads to snap (pivot) toward the center of the sarcomere. Since the actin and myosin are still firmly bound to each other when this happens, the thin filaments are slightly pulled toward the center of the sarcomere (see **c**). ATP provides the energy needed to release and recock each myosin head so that it is ready to take another "step" and attach to a binding site farther along the thin filament. This "walking" of the myosin cross bridges or heads along the thin filaments during muscle shortening is much like a centipede's gait. Some myosin heads ("legs") are always in contact with actin ("the ground"), so that the thin filaments cannot slide backward as this cycle is repeated again and again during contraction. Notice that the myofilaments themselves do not shorten during contraction; they simply slide past each other. When the action potential ends and calcium ions are reabsorbed into the SR storage areas, the regulatory proteins resume their original shape and position, and again block myosin binding to the thin filaments. Since myosin now has nothing to attach to, the muscle cell relaxes and settles back to its original length.

B. <u>Contraction of a skeletal muscle as a whole</u> (pp 187-192)

graded responses

muscle response to increasing rapid stimulation

muscle twitches

complete tetanus- fused continuous contraction that shows no evidence of relaxation

incomplete tetanus- unfused

strong contraction: many motor units are stimulated at a rapid rate
weak but smooth muscle contraction: fewer motor units are stimulated at a rapid rate

providing energy for muscle contraction

1. direct phosphorylation of ADP by creatine phosphate(found in muscle cells lasts~20sec.)
2. aerobic respiration (makes more ATP but is slower than anaerobic respiration & needs O_2)
3. anaerobic glycolysis & lactic acid formation (makes 5% as much ATP but is faster)

Contraction of a skeletal muscle as a whole (pp 187-192) 10

muscle fatigue and oxygen debt

fatigue- when a muscle is being stimulated but is not able to contract
due to oxygen debt from prolonged muscle activity

oxygen debt: ...anaerobic respiration---> build up of lactic acid (muscle pain & poor contractions)

recovery from oxygen debt: breath rapidly and deeply

types of muscle contractions

isotonic- "same tone"
myofilaments slide past each other
muscle contracts and shortens

isometric- "same length"
myofilaments trying to slide past each other but can not slide past each other
tension in the muscle keeps increasing
"contraction without muscle shortening"

eg: pushing on a wall or immovable object

muscle tone-state of continuous partial contractions
even when muscle is relaxed...some of its fibers are contracting
result of different motor units along muscle are stimulated in a systematic way
keeps muscle firm, healthy, and ready for use
cannot be consciously controlled

Loss of muscle tone: if motor neuron is damaged (no more stimulation of muscle)
muscle becomes 1. paralyzed
2. flaccid- soft and flabby
3. atrophied- wastes away

effect of exercise on muscles

increases muscle size, strength, and endurance

aerobic exercise- (endurance)
results in 1. stronger, more flexible muscles (does not increase size)
2. muscles with greater resistance to fatigue

bcs- increased blood supply to muscle (more oxygen)
muscle cells form more mitochondria (site of respiration) & store more O_2

other benefits: 1. improves overall body metabolism
2. improves digestion & elimination
3. enhances neuromuscular coordination
4. strengthens skeleton
5. increase heart size....increase blood volume pumped
fat cleared from blood vessel walls
6. lungs become more efficient

resistant exercise- (isometric) muscles working against an immovable object (or nearly so)
key: forcing muscles to contract with as much force as possible

increase in muscle size...bcs enlargement of muscle cells...bcs increase # of filaments

Muscle Movements, Types, and Names (pp 192-200)

over 600 muscles in body

a muscle can only pull

tendons attach muscle to bone & make them work like levers
the joint acts as the fulcrum & muscles provide the force to move the lever

Five Golden Rules of Muscle Activity

1. cross at least one joint- with a few exceptions
2. bulk of muscle lies proximal to joint crossed
3. at least two attachments
origin- attachment of a muscle that remains relatively fixed during muscular contraction
insertion- the movable attachment of a muscle
as muscle contracts: the insertion area is pulled towards the origin
4. can only pull- never push
5. insertion moves toward origin during contraction

Interactions of Skeletal Muscles in the body (p 196)

most muscles act in pairs (together or against each other)

prime mover- (**agonist**) muscle whose contractions are primarily responsible for a particular movement

antagonists-muscles that act in opposition to an agonist or prime mover
never completely relaxed, its function is to provide control and damping of movement by maintaining tone against the agonist/ prime mover

when movement reverses: the names switch

example: flexing elbow: biceps brachii is the prime mover (agonist)
triceps brachii is the antagonist
extending elbow: triceps brachii is the prime mover
biceps brachii is the antagonists

synergists- muscles cooperating w/ other muscle (s) to 1. produce a desired movement
2. reduce undesired movement

synergists have the same function

this movement can be different from that performed when the muscles work independently

example: the sternocleidomastoid muscles each rotate the head ina different direction, but as synergists they flex the neck (working together)

*help stabilize joints to make a more precise movement possible

example: synergists stabilize the wrist as clench fingers so only the fingers move not the wrist

Interactions of Skeletal Muscles in the body (p 196)

fixators- muscles acting to immobilize a joint or a bone
fixes the origin of a muscle so that muscle action can be exerted at the insertion

example: fixators act as postural muscles to keep the spine erect & the leg and vertebral column extended when standing

rhomboids & levator scapulae keep the scapula from moving during actions such as lifting w/ the arms

Types of Body Movements (pp 192-196)

1. **flexion-** movement in the anterior-posterior plane (sagittal plane)
   decreases the angle or distance between two bones or parts of body
   brings 2 bones closer together
   typical in hinge & ball-and-socket joints
   eg: bending knee, elbow, or forward at the hip
   bringing head toward the chest (flexing the intervertebral jts of neck)

2. **extension**- movement in the anterior- posterior plane (sagittal plane)
   increases the angle or distance between two bones or parts of body
   reverses movement of flexion
   eg. straightening the knee or elbow

   hyperextension- increasing angle beyond 180°
   continuation of mvmt past the anatomical position
   can cause injury
   eg: tip head or torso posteriorly pointing chin to ceiling

3. **rotation-** turning the body or a limb around the longitudinal axis
   common in ball-and-socket joints
   eg. rotating the arm to screw in a light bulb
   rotating the atlas around the dens of axis (shaking head “no”)

4. **abduction**- movement away from the center of body; midline
   fanning movement of the fingers or toes (when they are spread apart)
   movement of the appendicular skeleton

5. **adduction-** movement toward the midline of the body
   opposite of abduction
   movement of the appendicular skeleton

Types of Body Movements (pp 192-196)

6. circumduction- a special type of angular motion
combination of flexion, extension, abduction, and adduction
typical of ball-and-socket joint (shoulder)
proximal end of limb is stationary and its distal end moves in a circle
limb as a whole outlines a cone

7. dorsiflexion and plantar flexion- movements of the foot
dorsiflexion- movement of ankle while elevating the sole
superior surface moves towards shin (tibia)
"digging in heels"
(corresponds to extension of the hand at the wrist)

plantar flexion- extending the ankle and elevating the heel
depressing the foot, pointing the toes
"standing on tip toes"
(corresponds to flexion of the hand at the wrist)

8. inversion and eversion- movements of the foot
inversion- turn sole medially

eversion- turn sole laterally

9. supination and pronation- movements of the radius and ulna
supination- forearm rotates laterally ...palm faces anteriorly (radius uncrossed)

pronation- forearm rotates medially ...palm faces posteriorly (radius crossed)
rotation of the distal end of the radius across the anterior surface of the ulna

10. opposition- movement of the thumb at saddle joint b/w metacarpal 1 & carpals
thumb touching the tips of the other fingers of same hand
enables thumb to grasp and hold an object

11. elevation and depression- occurs when structure moves in a superior or inferior direction
mandible is depressed when mouth is opened
mandible is elevated when mouth is closed
raising or lowering scapula ("shrugging shoulders")

12. protraction and retraction-
protraction- moving part of body anteriorly in the horizontal plane
eg: jutting face or jaw forward "hunching shoulders"

retraction- moving part of body posteriorly in horizontal plane
eg: moving jaw towards spine "squaring shoulders"

Naming Skeletal Muscles (pp 196 and 198)

names describe a feature of muscle, often several criteria are combined into one name

direction relative to body axis of muscle fibers

anterior- front
posterior- back

inferioris- inferior
superiorus- superior

externus- superficial
internus- deep, internal

intrinsic- inside
extrinsic- outside

lateralis- lateral
medialis/medius- medial

profundus- deep
superficialis- superficial

circularis- circular

oblique- at an angle

transverse- across

rectus- straight, parallel

location of the muscle

abdominus- abdomen
anconeus- elbow
brachialis- brachium
capitis- head
carpi- wrist
cervicis- neck
nasalis- nose
coccgeus- coccyx
costalis- ribs
cutaneous- skin
femoris- femur
genio- chin
glosso/ glossal- tongue
hallucis- great toe
ilio- ilium
inguinal- groin
lumborum- lumbar region
tibialis- tibia
oculo- eye
oris- mouth
palpebrae- eyelid
pollicis- thumb
psoas- loin
radialis- radius
scapularis- scapula
temporalis- temples
cleido/ clavius- clavicle
ulnaris- ulna
uro- urinary
thoracis- thoracic region
popliteur- behind the knee

number of origins

biceps- two heads
triceps- three heads
quadriceps- four heads

body location of the muscle's origin and insertion

brachii- arm
gluteus- buttocks
infra- below
lateralis- lateral
pectoralis- chest
sub- underneath
supra- above

Naming Muscles

action of the muscle

abduction- moves away from the midline
adduction- moves closer to the midline
depressor
extension- increases the angle of a joint
flexion- decreases the angle of a joint
levatator
pronation- turns the palm of the hand down
rotation- moves bone around its longitudinal axis
supination- turns the palm of the hand up
tensor
dorsiflexion- elevates the foot
plantar flexion- lowers the foot, pointing the toes
masseter- chewing

shape, size, & color of the muscle

alba- white
brevis- short
deltoid- triangle
gracillis- slender
lata- wide
latissimus- widest
longus- long
magnus- larger
major- larger
maximus- largest
minimus- smallest
minor- smaller
orbicularis- circle
pectinate- comblike
piriformis- pear-shaped
platys- flat
pyramidal- pyramid
rhomboideus- rhomboid
serratus- serrated
splenius- bandage
teres- long & round
trapezius- trapezoid
vastus- huge or great

Arrangement of Fascicles (pp 199-200)

a fascicle is a bundle of muscle fibers enclosed by perimysium
fascicle arrangement varies...creating muscles w/ different structures and functional properties

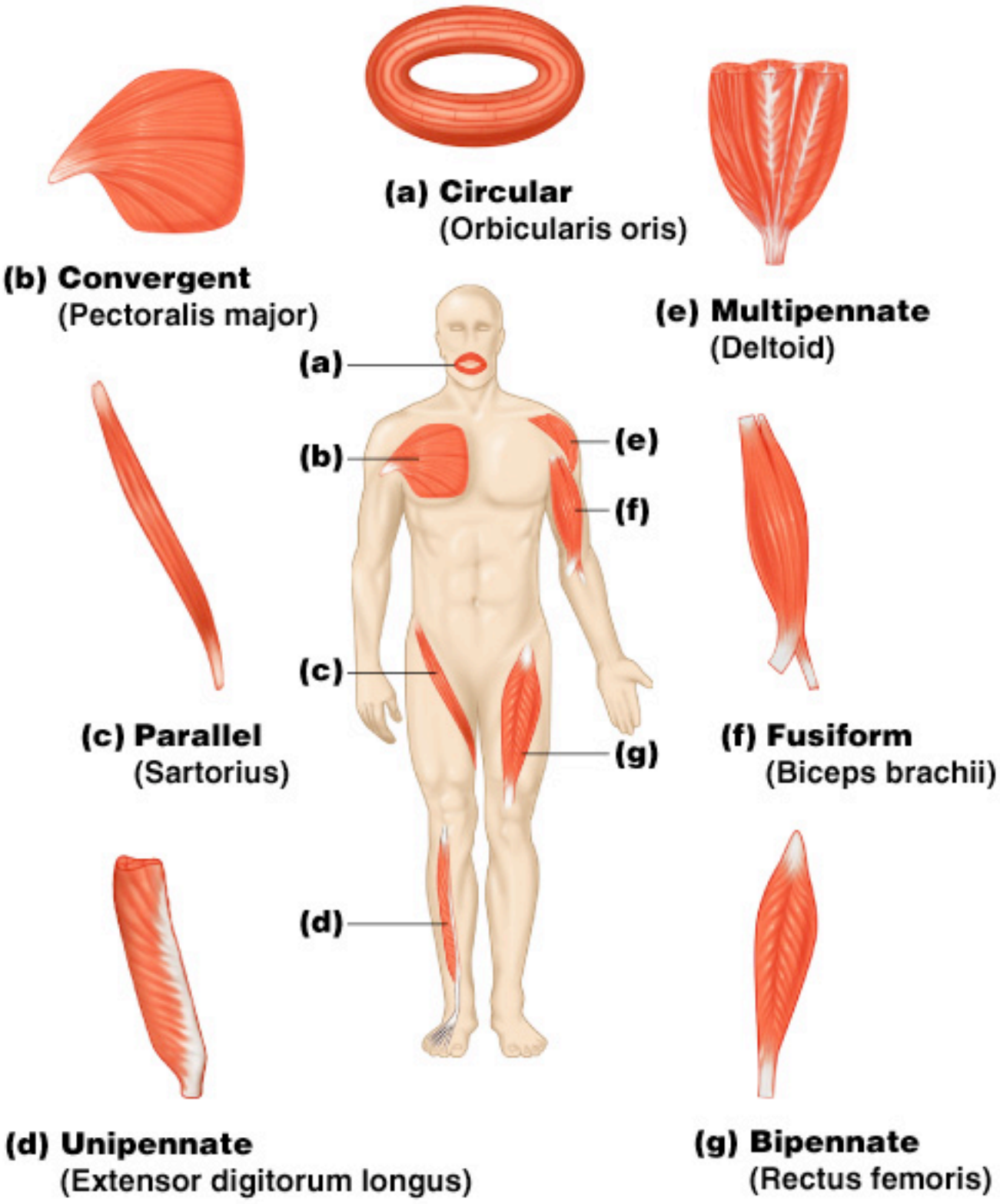
circular- fascicles arranged in concentric rings
surrounds external body openings ....closed by contracting circular muscles
"sphincters"

convergent- fascicles converge toward a single insertion tendon
muscles appears triangular or fan-shaped

parallel-fascicles run parallel to the long axis of the muscles
strap-like appearance

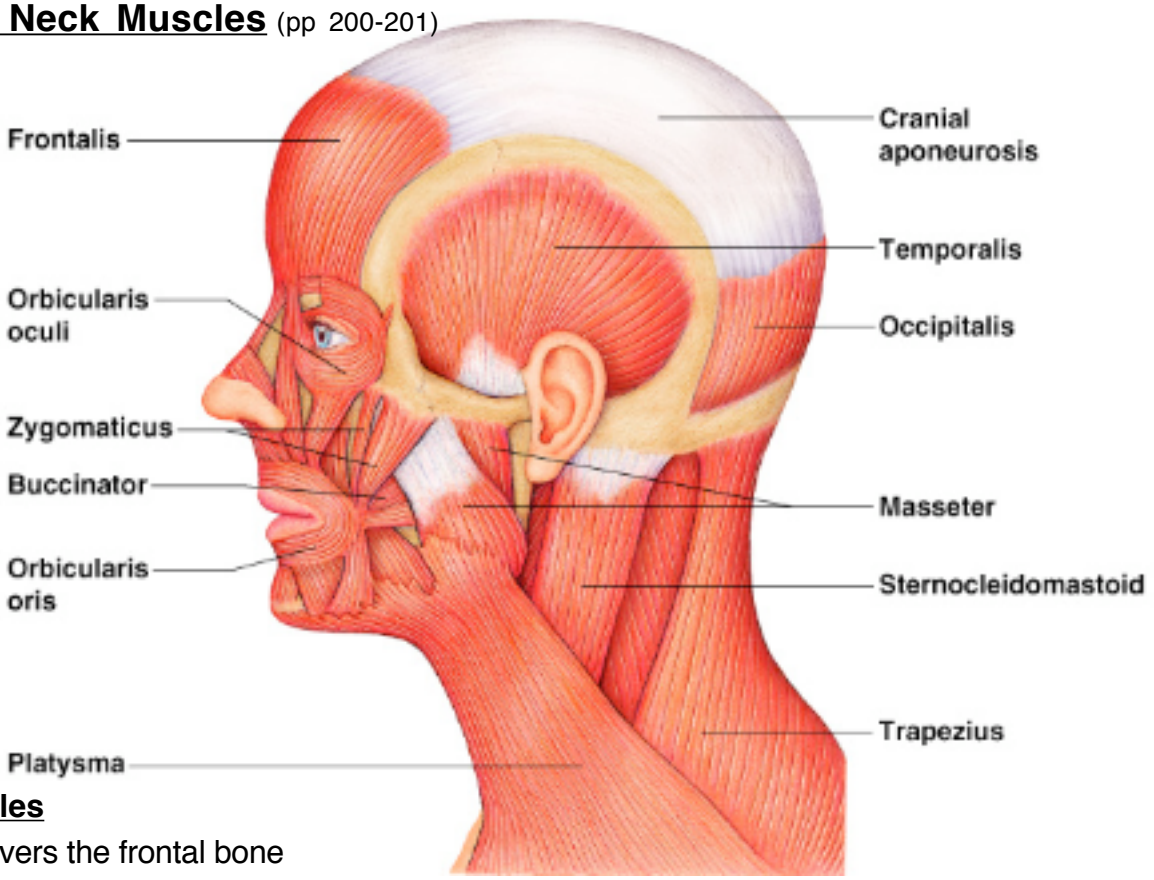
fusiform- modified parallel arrangement
spindle-shaped muscles w/ expanded midsection

pennate- feather pattern; fascicles are short & attached obliquely (on a slant) to a central tendon
unipennate- fascicles insert into only ones side of the tendon
bipennate- fascicles insert into opposite sides of the tendon
multipennate- fascicles insert into many different sides of the tendon


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

Gross Anatomy of Skeletal Muscles (pp 200-208; Fig. 6.21-6.22; Tables 6.3-6.4)

Head and Neck Muscles (pp 200-201)



Facial Muscles

Frontalis- covers the frontal bone

origin- cranial aponeurosis
insertion- skin of eyebrows
action- raises eyebrows
wrinkles forehead; forms the horizontal frown crease on the forehead

Orbicularis Oculi- fibers run in circles around eyes

origin- frontal bone & maxilla inserts to medial side of orbit (tissue around eye)
action- closes eye; squinting, blinking, & winking the eyes

Orbicularis Oris- circular muscles of lips

origin- maxilla & mandible
insertion- skin & muscle around lips
action- closes, compresses & protrudes lips "kissing muscle"

Buccinator- flattens the cheek

origin- maxillary & mandible
insertion- orbicularis oris
action- flattens & sucks in the cheek "whistling & sucking"
holds the food between the teeth during chewing

Zygomaticus- "smiling" muscle

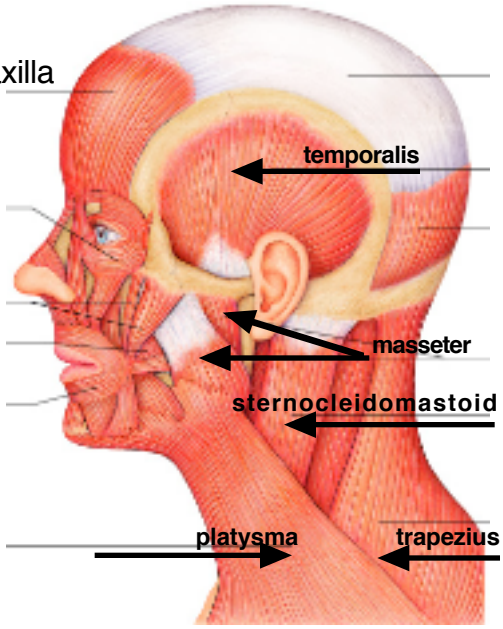
origin- zygomatic bone
insertion- skin & muscles at corner of mouth
action- raises the corners of the mouth upward

Chewing Muscles

Buccinator- holds food b/ w teeth during chewing .....considered a "chewing" & facial muscle

Masseter- prime mover of jaw closure

origin- zygomatic process of temporal bone & maxilla
insertion- mandible
action- closes jaw by elevating the mandible



Temporalis- fan shaped muscle covering temporal bone

origin- temporal lines of skull
insertion- coronoid process of mandible
action- synergist to masseter in closing the jaw

Neck Muscles: move head& shoulder girdle, small and strap-like

Platysma-single sheetlike muscle that covers ant. lat. neck

origin- cartilage of 2nd rib to acromion of scapula
insertion- mandible & skin of cheek

action- pull corners of mouth inferiorly (downward sag of mouth)
tenses skin of neck & depresses mandible

Sternocleidomastoid- paired muscles (one on each side of the neck)

"prayer muscle"
two headed (sternum & clavicle)

origin- sternum & clavicle
insertion- mastoid process of temporal bone

action- prime mover of head flexion (when the 2 pairs contract together)
single muscle contraction: head is rotated toward opposite side

Trapezius- most superficial posterior neck muscle

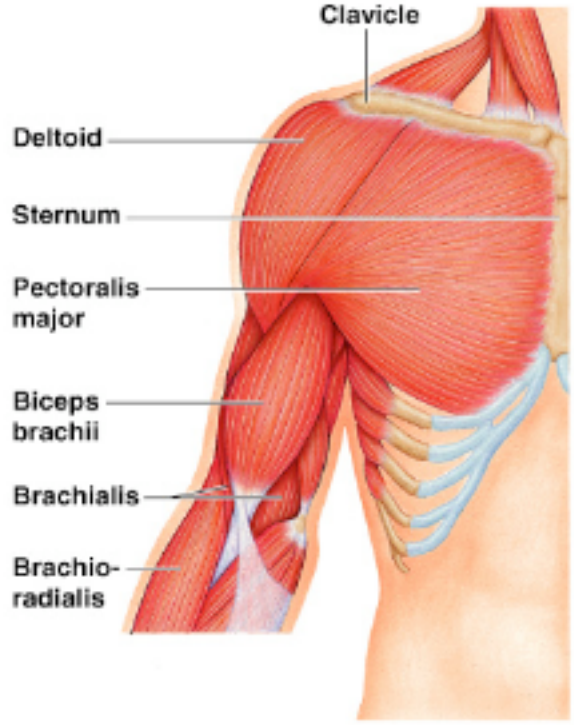
origin- occipital bone, spinous processes of cervical & throacic vertebra
insertion- acromion & spine of scapula and clavicle

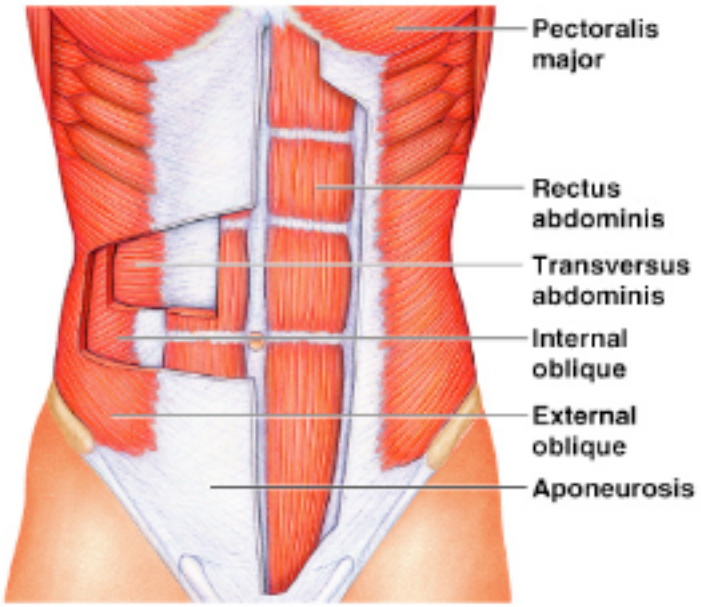
action- depends on active region and state of other muscles

*extends neck and head
antagonist of sternocleidomastoids
* may elevate, adduct, depress, or rotated scapula
* elevate clavicle
* hyperextend neck to "look at the sky"
* elevate &/ or pull back shoulder "shrugging"

Anterior Trunk Muscles (pp 201-203)

1. move the vertebral column (post. antigravity)
2. move ribs, head, and arms (anterior thorax muscles)
3. move vertebral column & form abdominal body wall muscle





Pectoralis Major- anterior large fan-shaped muscle covering the upper chest, forms ant. axilla wall

origin- sternum, clavicle, 1-6 ribs
insertion- proximal end of humerus (greater tubercle)
action- adducts, flexes & medial rotation of humerus at shoulder joint
*prime mover for shoulder flexion and adduction

Intercostal Muscles- deep muscles found between the ribs

origin- inferior border of rib & costal cartilage
insertion- superior border of rib & coastal cartilage
action- *external intercostals----elevates rib cage during inspiration
*internal intercostals-----depress rib cage during expiration

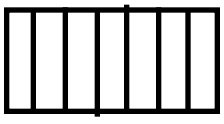
Diaphragm- "breathing muscle"

origin- sternum (xiphoid process), last 6 costal cartilages, ant. surfaces of lumbar vert.
insertion- central tendon
action- flattens to enlarge chest cavity for inhalation

Muscles of the Abdominal Girdle- reinforce body trunk (protecting abdominal viscera)

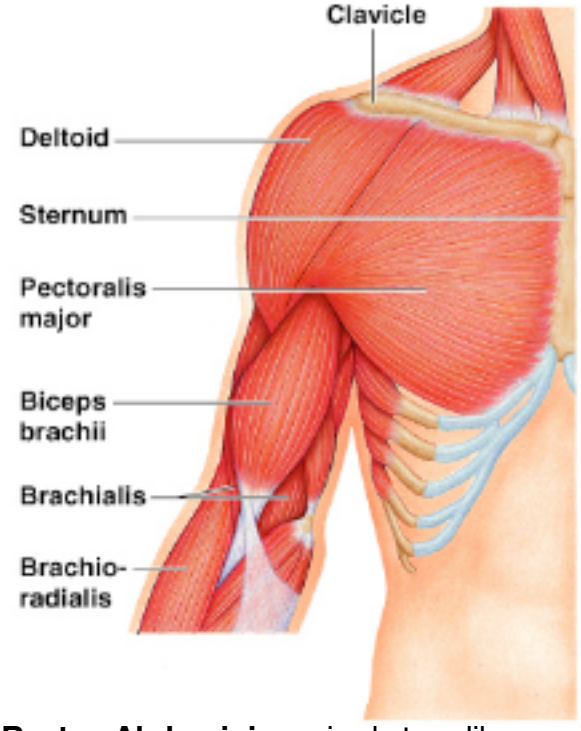
fibers of each muscle pair run in a different direction

Rectus Abdominis- paired strap-like muscles, most superficial abdominal muscle
enclosed in aponeurosis
name means "straight muscle of the abdomen"

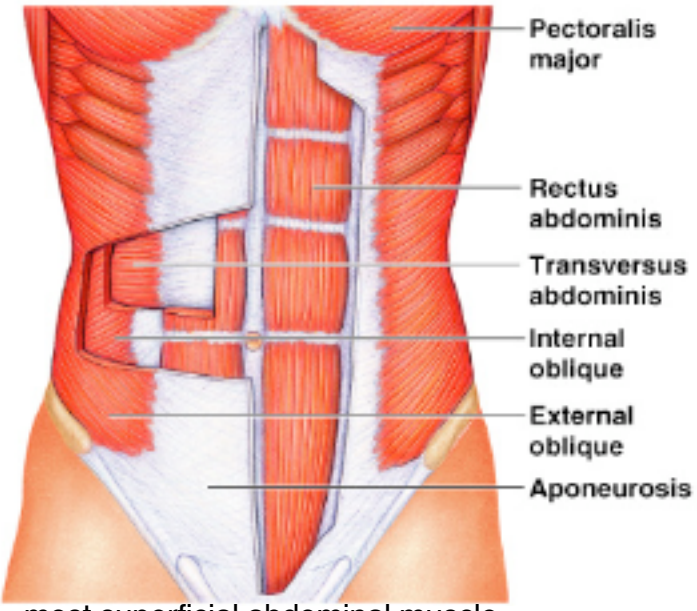


origin- pubis of coxal bone
insertion- sternum (xiphoid process) & 5th to 7th costal cartilage
action- flex vertebral column
depresses ribs for forced breathing
compress abdominal contents during defecation & childbirth

Muscles of the Abdominal Girdle (ant. trunk muscles) 20



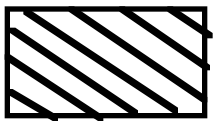
great strength: layering & fibers running in diff. directions
reinforces body trunk



Rectus Abdominis- paired strap-like muscles, most superficial abdominal muscle
enclosed in aponeurosis "straight muscle of the abdomen"

action- flex vertebral column
depresses ribs for forced breathing
compress abdominal contents (defecation & childbirth)

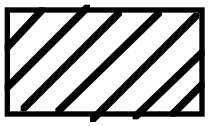
External Oblique- part of abdominal girdle
forms the external lateral walls of the abdomen
oblique.....at a slant



origin- lower 8 ribs
insertion- iliac crest of coxal bone & linea alba

action- flex vertebral column
rotate vertebral column & trunk, bending it laterally too
compresses abdomen

Internal Oblique- part of abdominal girdle
paired muscles deep to external obliques
fibers run at a right angle to external oblique



origin- iliac crest
insertion- last 3 ribs, sternum (xiphoid), & linea alba

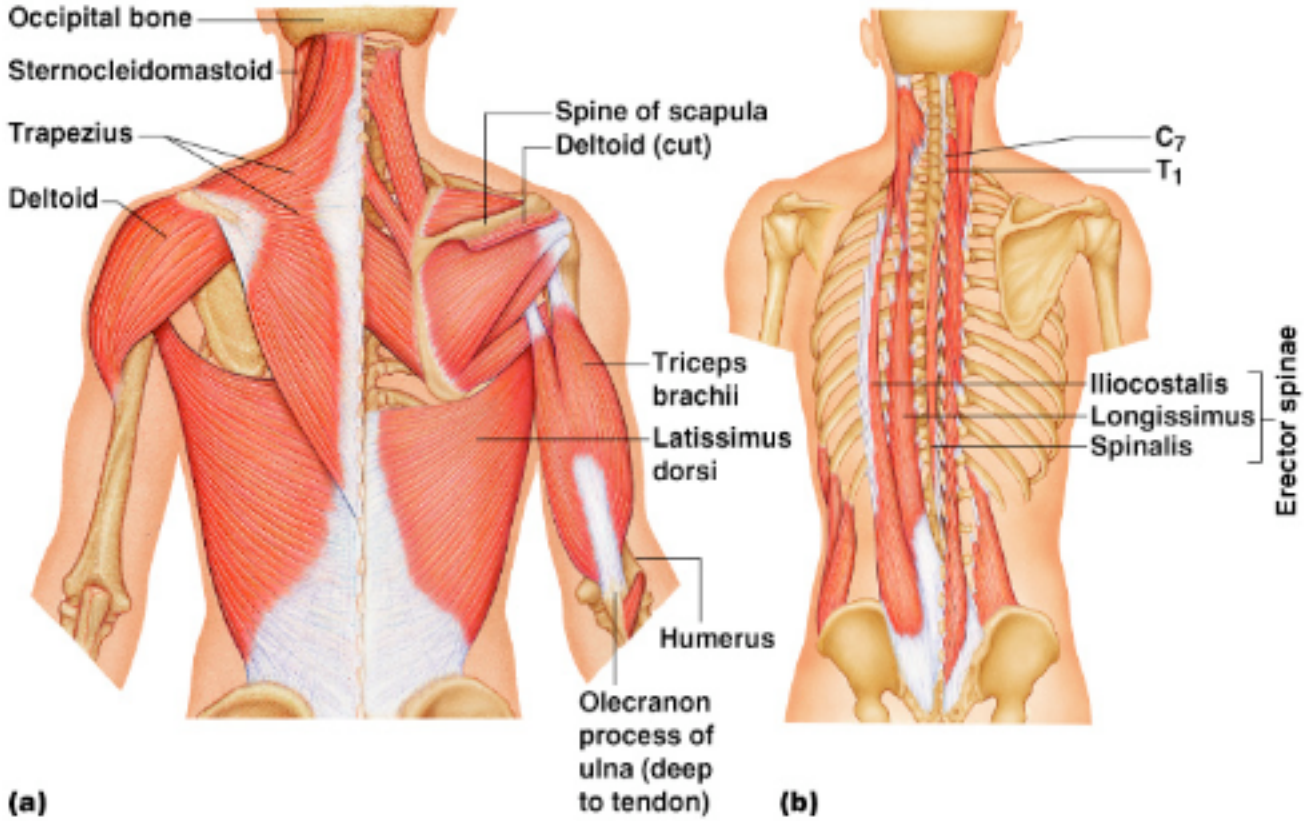
action- flex vertebral column
rotate vertebral column & trunk, bending it laterally too
compresses abdomen

Transversus Abdominis- deepest muscle of abdomen wall
fibers run horizontally across abdomen

origin- cartilage of lower ribs and iliac crest
insertion- linea alba, & pubis

action- compresses abdomen (contents)

Posterior Muscles



Trapezius- most superficial muscles of posterior neck & upper trunk

origin- occipital bone, spinous processes of cervical & throacic vertebra
insertion- acromion & spine of scapula and clavicle

action- depends on active region and state of other muscles

*extends neck and head
antagonist of sternocleidomastoids
* may elevate, adduct, depress, or rotated scapula
* elevate clavicle
* hyperextend neck to "look at the sky"
* elevate &/ or pull back shoulder "shrugging"

Latissimus Dorsi- large , flat muscle pair that covers the lower back

origin- last 6 thoracic vertebrae, all lumbar vertebrae, sacrum, iliac crest
insertion- proximal end of humerus
action- extends and adducts humerus "power stroke brings down arm"

Erector Spinae- composite muscle group spans entire length of vertebral column
consists of 3 deep muscle columns: longissimus, iliocostalis, & spinalis
origin- iliac crests, ribs 3-12, & vertebrae
insertion- ribs, thoracic and cervical vertebrae
action- extends back (powerful) prime mover of back extension
provides resistance controlling bending over at the waist

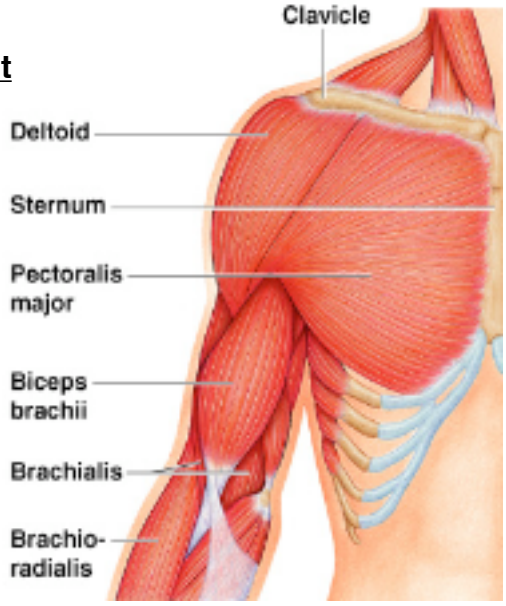
Posterior Muscles

Deltoid- fleshy, triangular-shaped muscles of shoulders
give rounded shape of shoulder....site of IM injections
origin- scapular spine & clavicle
insertion- proximal humerus (deltoid tuberosity)
action- prime movers of arm abduction "abducts humerus"
raise arm overhead
antagonist of latissimus dorsi

Muscles of the Upper Limb 3 groups:

1. **muscles of shoulder jt & humerus causing arm mvmt**

pectoralis major latissimus dorsi deltoid



2. **muscles causing movement at elbow jt**

enclose humerus & insert onto forearm bones

biceps brachii brachialis

brachioradialis triceps brachii

3. **muscles of forearm causing hand mvmt**

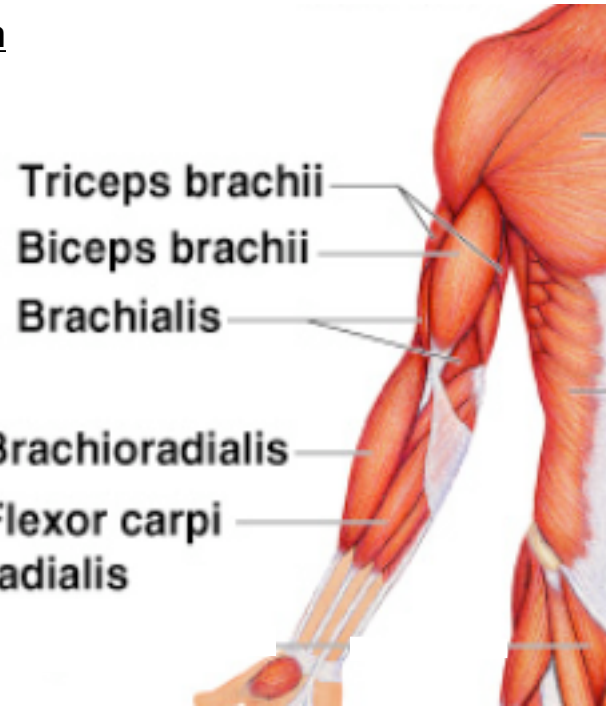
insert on hand bones causing their mvmt

numerous thin, spindle shaped muscles

Muscles of Humerus acting on Forearm

all anterior arm muscles cause elbow flexion

Elbow Flexors



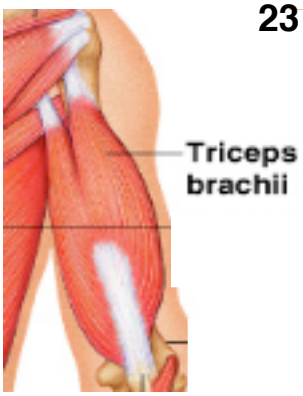
Biceps Brachii- originates by 2 heads from shoulder
origin- scapula of shoulder girdle
insertion- proximal radius
action-flexes elbow (forearm)
supinates forearm

Brachialis- lies deep to biceps
origin- distal humerus
insertion- proximal ulna
action- flexes elbow

Brachioradialis-fairly weak muscle, mostly in forearm
origin- humerus
insertion- radius (distal forearm)
action- flexes (elbow) forearm

Muscles of Humerus acting on Forearm

Elbow Extensor:



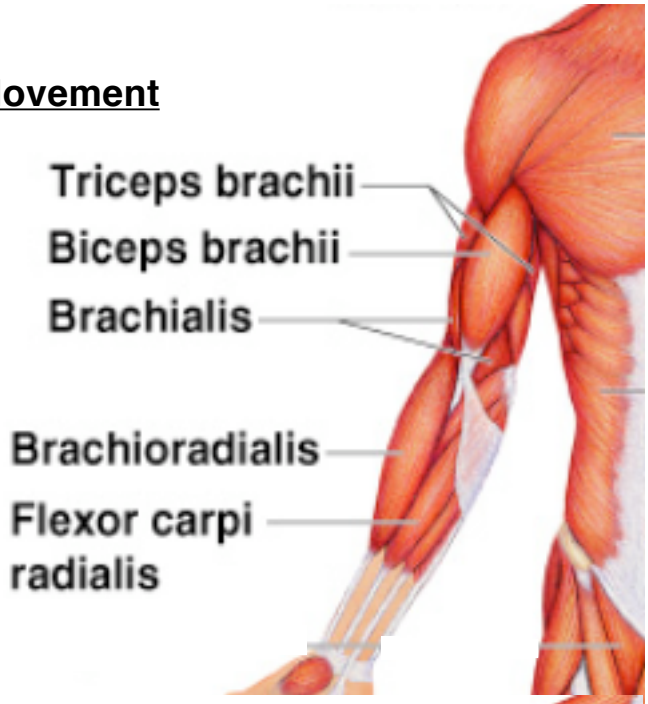
Triceps Brachii- only muscle fleshing out posterior humerus
three heads arise from shoulder girdle
extends forearm

origin- shoulder girdle (scapula) & proximal humerus
insertion- olecranon process of ulna

action- extends elbow prime mover of elbow extension
antagonist of biceps brachii

Muscles of Forearm Causing Hand Movement

insert on hand bones causing their mvmt
numerous thin, spindle shaped muscles



Wrist Flexors:

Flexor Carpi Radialis

origin- distal humerus
insertion- 2nd & 3rd metacarpals

action- flexes wrist
adducts hand

Flexor Carpi Ulnaris

origin- distal humerus & post. ulna
insertion- carpals & 5th metacarpal

action- flexes wrist
adducts hand

Wrist Extensors

Extensor Carpi Radialis

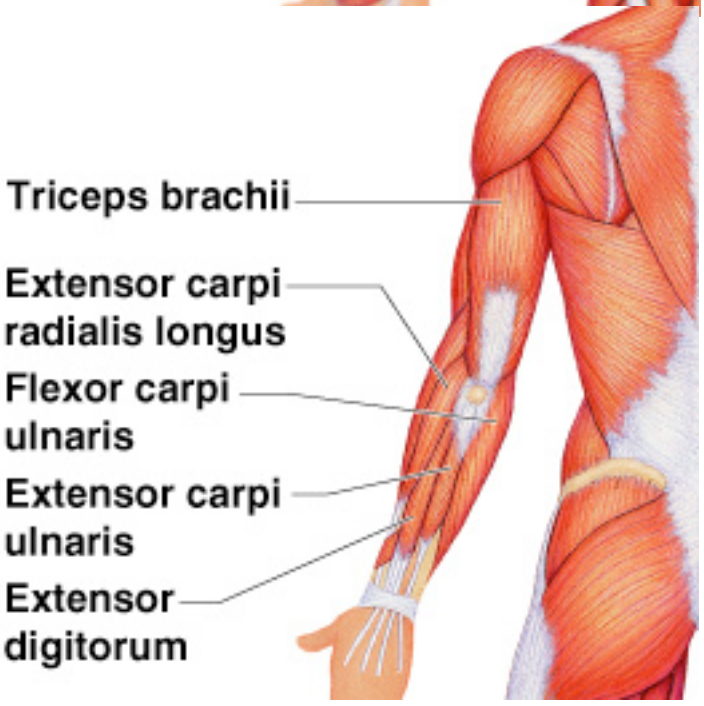
origin- humerus
insertion- 2nd & 3rd metacarpal

action- extends wrist
abducts hand

Extensor Carpi Ulnaris

origin- humerus & ulna
insertion- 5th metacarpal

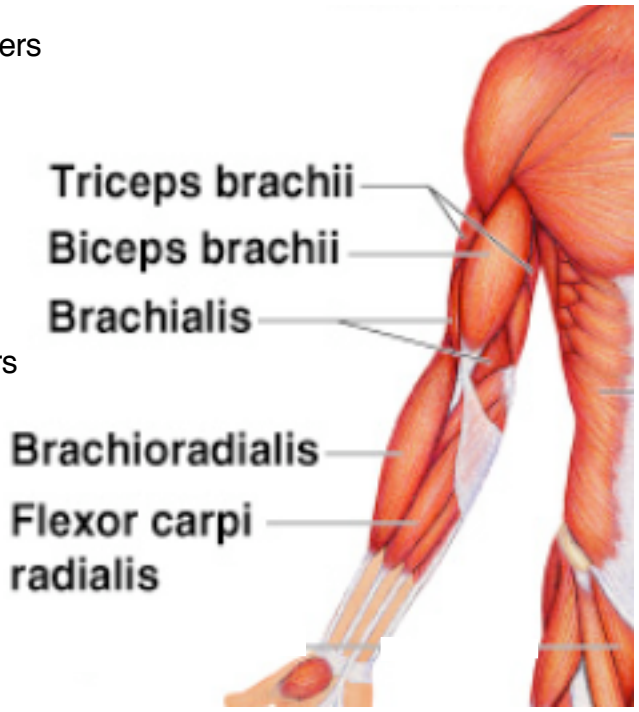
action- extends wrist
abducts hand



Muscles of Forearm causing hand movement

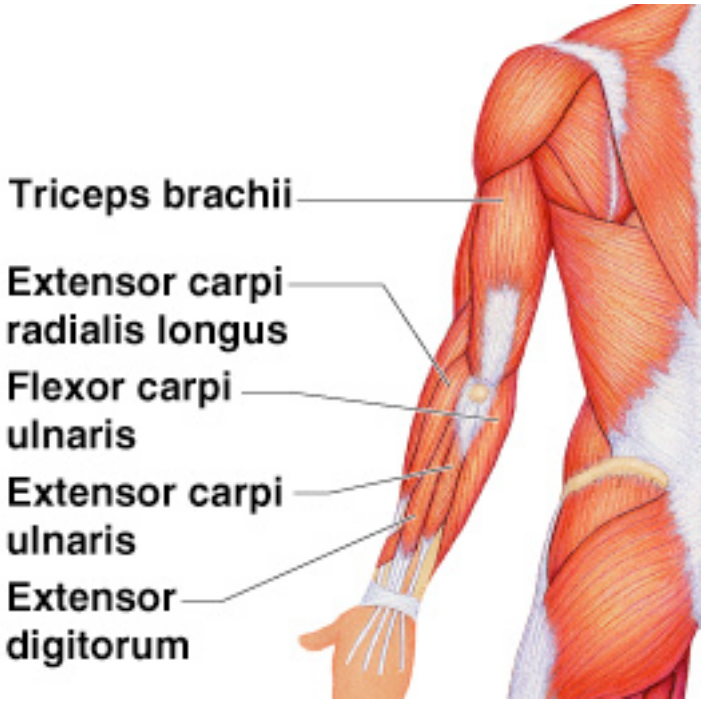
Flexor Digitorum

origin- humerus, ulan
insertion- middle phalanges of 2nd to 5th fingers
action- flexes wrist
flexes fingers



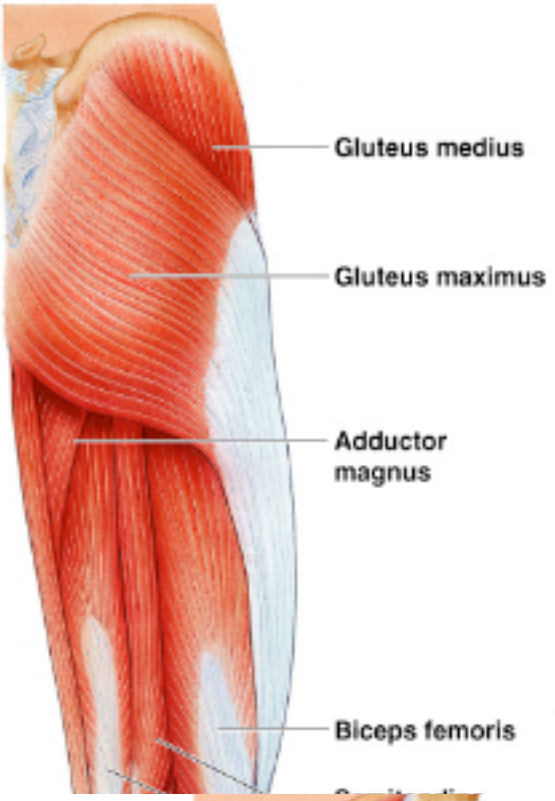
Extensor Digitorum

origin- humerus
insertion- distal phalanges of 2nd to 5th fingers
action- extend wrist
extends fingers



Muscles of the Lower Limb (pp 204-208)

largest and strongest muscles of body
pelvic girdle made of strong bones
no need for muscular stabilization like pectoral
cause movement of hip, knee, & foot
walking and balancing body



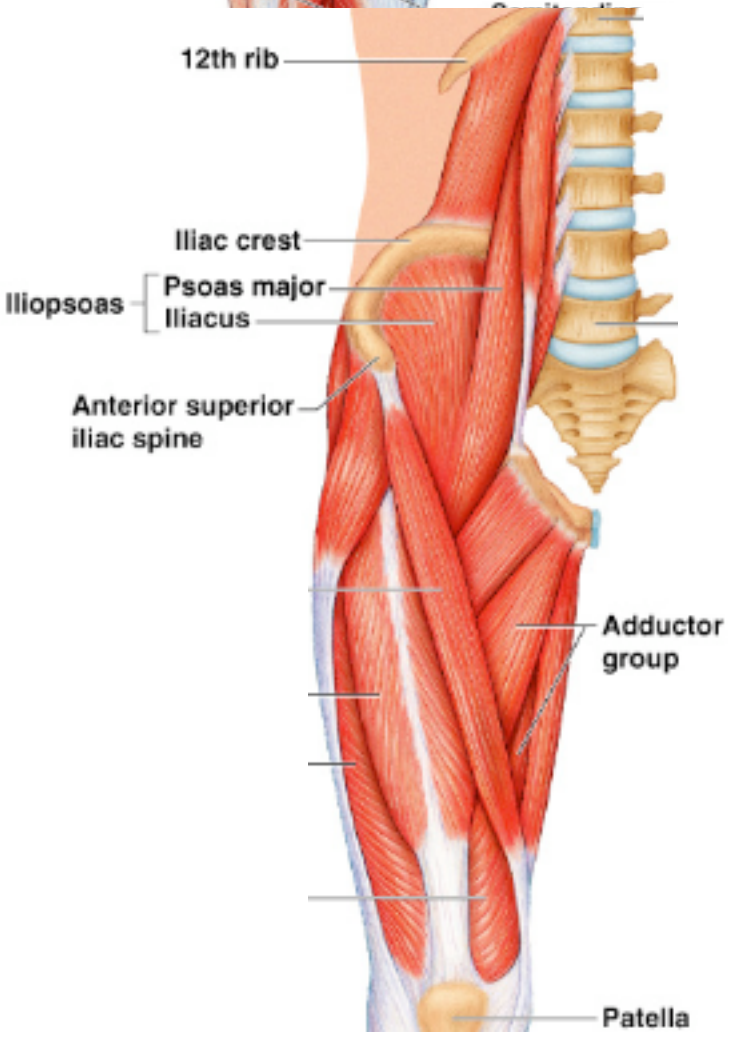
Muscles Causing Movement of Hip Joint

Gluteus Maximus- superficial muscle of hip
forms most of buttock
IM injection site

origin- sacrum and iliac
insertion- proximal femur (gluteal tuberosity)
action- lateral rotation of femur at hip jt.
powerful hip extensor
climbing stairs & jumping
increases angle/ dist. b/ w femur & hip

Gluteus Medius- runs beneath gluteus maximus
smaller hip muscle
IM injection site

origin- ilium (lateral surface)
insertion- proximal femur
(greater trochanter)
action- abducts thigh (hip abductor)
steadies pelvis during walking



Iliopsoas- fused 2 muscles
(iliacus & psoas major)
deep in pelvis

origin- ilium & lumbar vertebra
insertion- femur (lesser trochanter)
action- flexes hip
flexes lumbar spine

Adductor Group- muscles of medial thigh

origin- pelvis
insertion- proximal femur
action- adduct or press thighs together
move legs toward body midline

adductor brevis
adductor longus
adductor magnus
pectineus
gracilis

Muscles Causing Movement at Knee Joint

Hamstring group- muscle mass of post. thigh
consists of 3 muscles

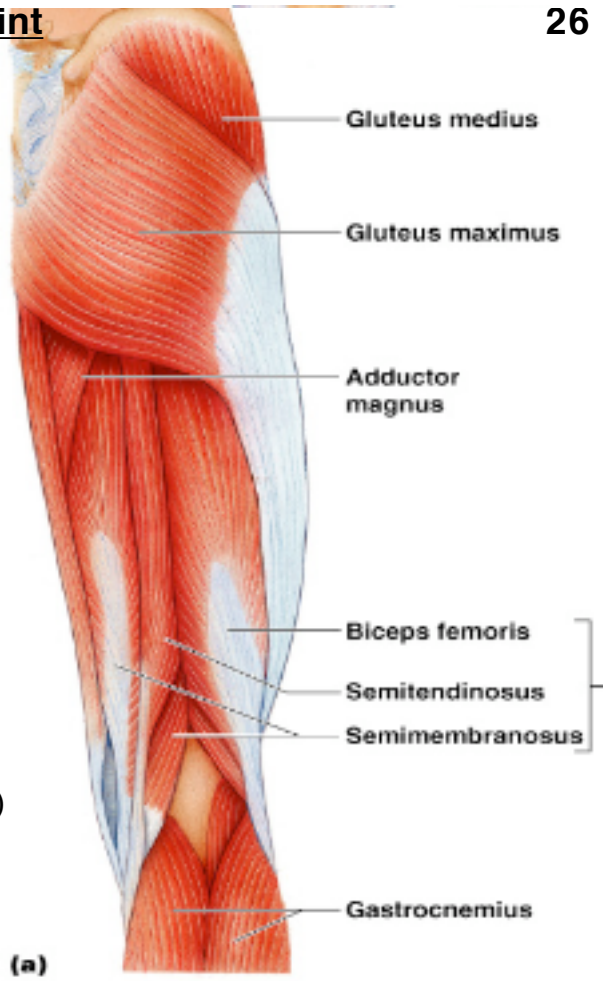
origin- ischial tuberosity
insertion- proximal tibia
head of fibula for biceps femoris

action- flexes knee (flexing lower leg)
extends hip (extends femur)
adducts hip

Biceps Femoris- flexes knee
extends & adducts hip

Semimembranosus- flexes knee
extends, adducts, rotates hip

Semitendinosus- flexes knee
extends, adducts, rotates hip



Sartorius- thin, strap-like weak thigh flexor
most superficial muscle of thigh
runs obliquely across thigh (ant to medial)

origin- ant. iliac crest
insertion- medial tibia

action- flexes knee
flexes & laterally rotates hip
synergist to crossing legs "tailor muscle"

Quadriceps Group-consists of 4 muscles
fleshy anterior thigh
*extends knee (lower leg)
flexes femur

Rectus Femoris

origin-pelvis (ilium)

insertion- tibia (tibial tuberosity
via patellar ligament)

action- extends knee
flexes hip on thigh

Vastus Muscles- 3 muscles

vastus lateralis

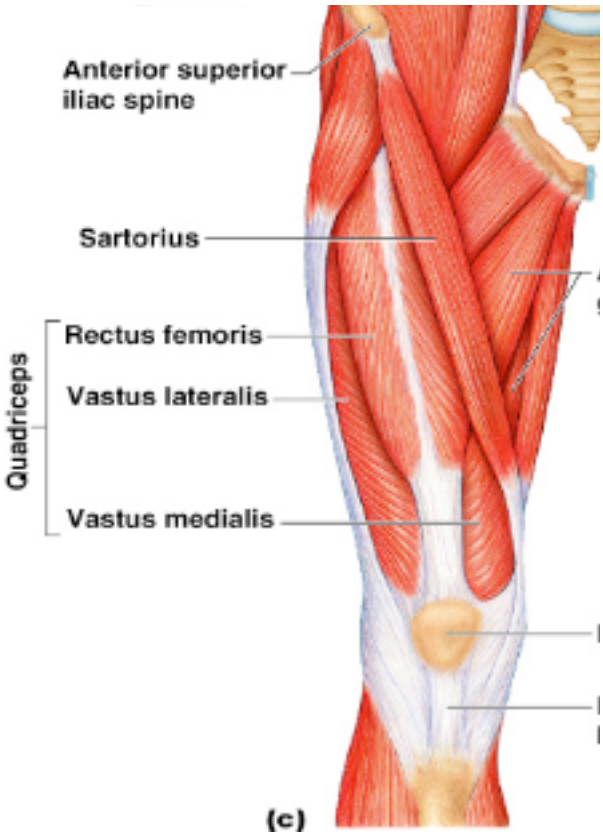
vastus medialis

vastus intermdius

origin- femur

insertion-tibia (tibial tuberosity
via patellar ligament

action- extends knee



Muscles Causing Movement at Ankle & Foot

Tibialis anterior- superficial muscle of anterior leg

origin- tibia
insertion- 1st tarsal & 1st metatarsal

action- dorsiflexes foot
inverts foot

Extensor Digitorum Longus- lateral to tibialis anterior

origin- proximal tibia & fibula
insertion- superior surfaces of phalanges, toes # 2-5

action- extends toes
dorsiflexes foot

Fibularis Muscles- 3 muscles (longus, brevis, & tertius) lateral part of leg

origin- fibula
insertion- metatarsals

action- plantar flexes foot
everts foot

Muscles Causing Movement at Ankle & Foot

Gastrocnemius- 2 headed muscle; forms posterior calf; "toe dancers muscle"

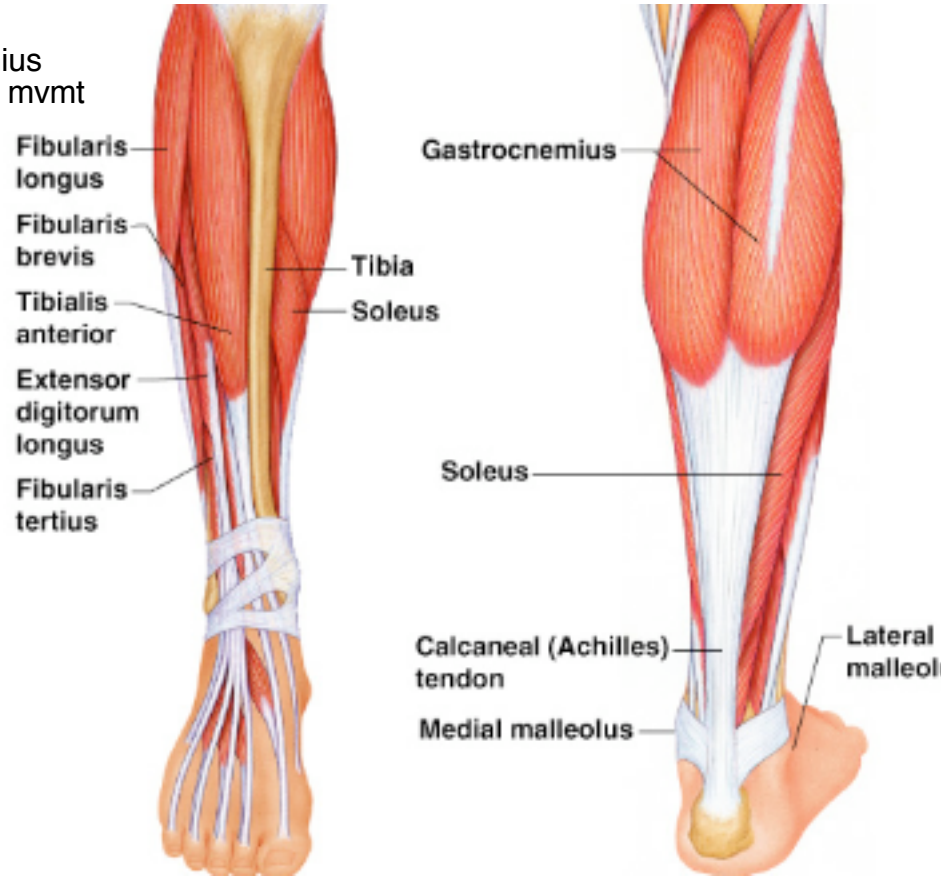
origin- distal femur (each head attaches to each side of femur)
insertion- calcaneus (heel tarsal) via Achilles tendon

action- plantar flexes foot (points toe)
flexes knee

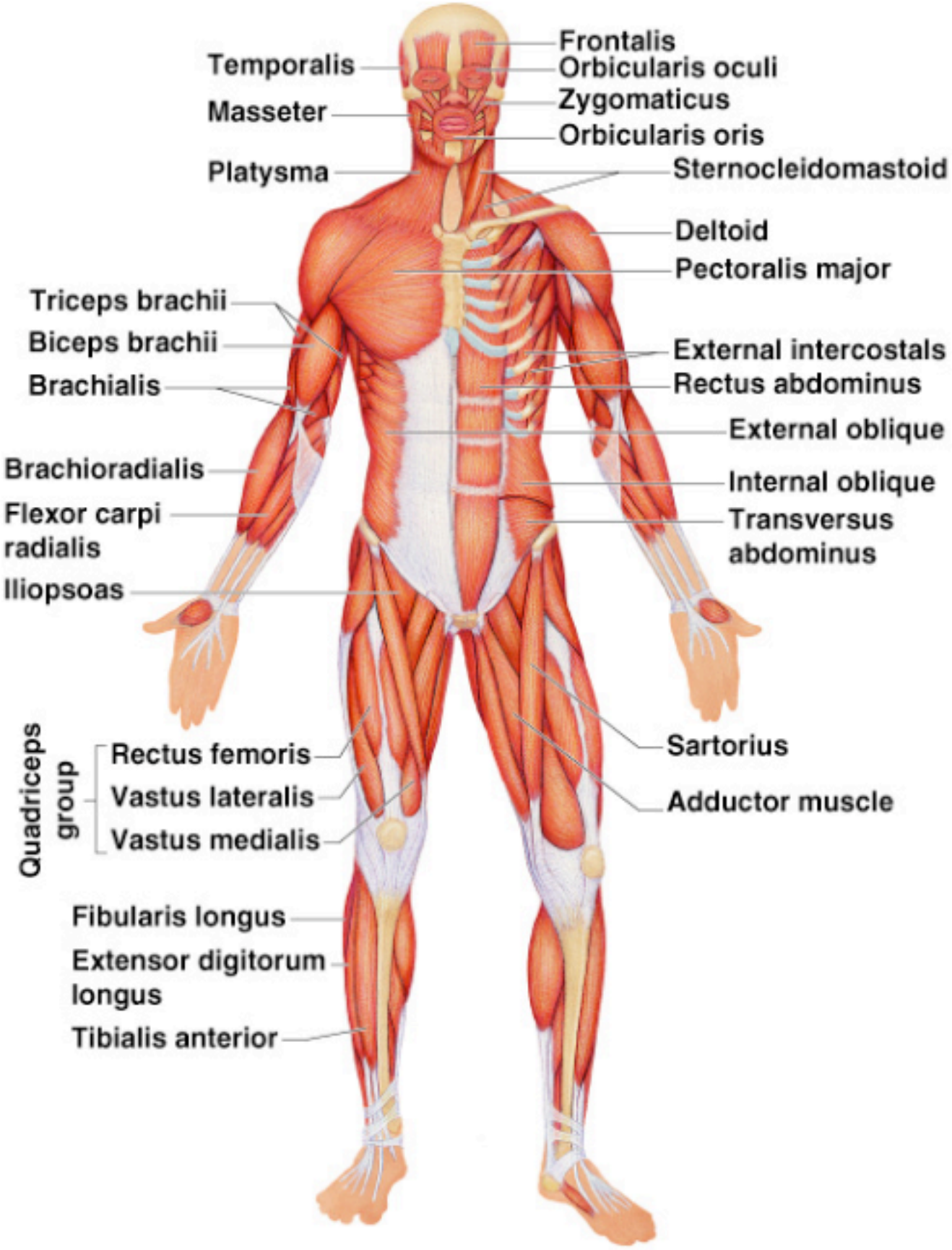
Soleus- deep to gastrocnemius
does not effect knee mvmt
no femur insertion

origin- tibia & fibula
insertion- calcaneus

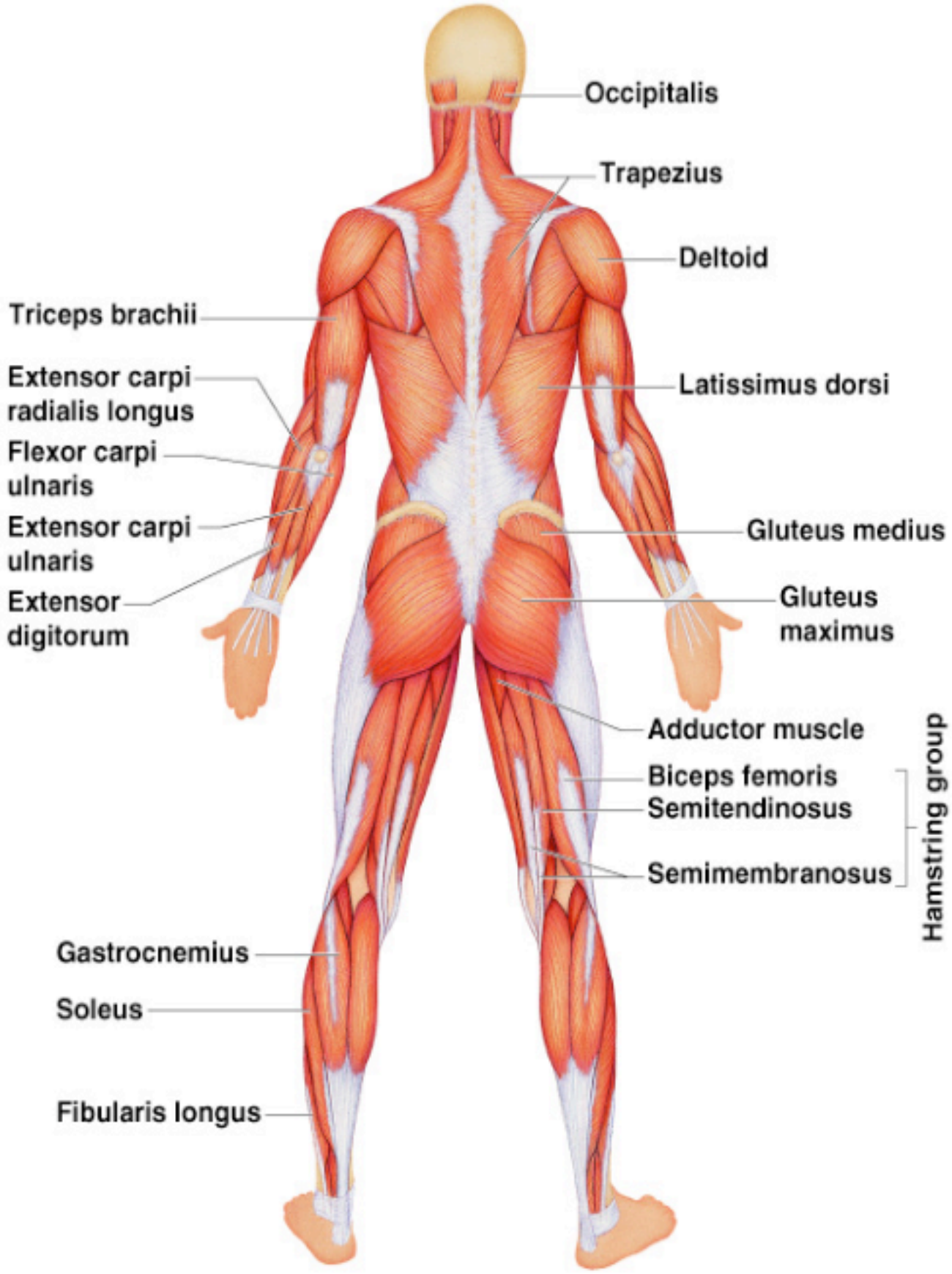
action- plantar flexes foot



Anterior superficial Muscles



Posterior Superficial Muscles



Developmental Aspects of the Muscular System (p 214) 30

Embryonic Development

1. Maturation of Muscle Control

cephalic to caudal direction

proximal to distal direction- gross motor skills first
fine motor skills last

2. Aging Effects

hypertrophy- increase in connective tissue

atrophy- decrease in muscle tissue

muscles become stringier, more sinewy

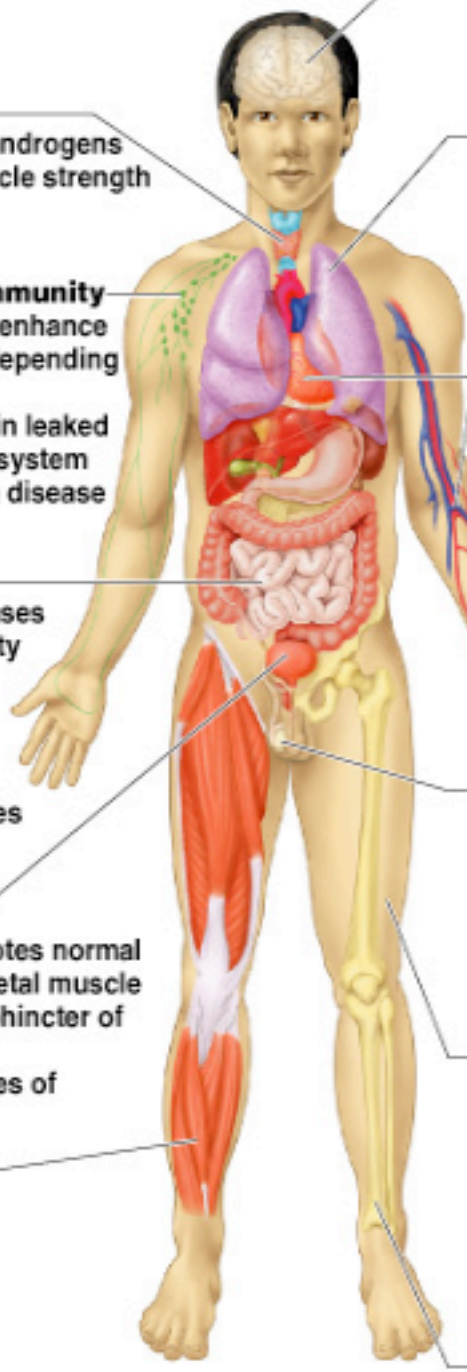
decrease muscle strength

Homeostatic Imbalances

1. Muscular Dystrophy

2. Myasthenia Gravis

Homeostatic Relationships Between the Muscular System and Other Body systems



Nervous System
- Facial muscle activity allows emotions to be expressed
- Nervous system stimulates and regulates muscle activity

Endocrine System
- Growth hormone and androgens influence skeletal muscle strength and mass

Respiratory System
- Muscular exercise increases respiratory capacity
- Respiratory system provides oxygen and disposes of carbon dioxide

Lymphatic System/Immunity
- Physical exercise may enhance or depress immunity depending on its intensity
- Lymphatic vessels drain leaked tissue fluids; immune system protects muscles from disease

Cardiovascular System
- Skeletal muscle activity increases efficiency of cardiovascular functioning; helps prevent atherosclerosis and causes cardiac hypertrophy
- Cardiovascular system delivers oxygen and nutrients to muscles; carries away wastes

Digestive System
- Physical activity increases gastrointestinal mobility when at rest
- Digestive system provides nutrients needed for muscle health; liver metabolizes lactic acid

Reproductive System
- Skeletal muscle helps support pelvic organs (e.g., uterus in females); assists erection of penis and clitoris
- Testicular androgen promotes increased skeletal muscle size

Urinary System
- Physical activity promotes normal voiding behavior; skeletal muscle forms the voluntary sphincter of the urethra
- Urinary system disposes of nitrogenous wastes

Integumentary System
- Muscular exercise enhances circulation to skin and improves skin health; exercise also increases body heat, which the skin helps dissipate
- Skin protects the muscles by external enclosure

Muscular System

Skeletal System
- Skeletal muscle activity maintains bone health and strength
- Bones provide levers for muscle activity