

## Muscular System

Rita Carey-Nita

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## Types of Muscles

- Skeletal
- Smooth
- Cardiac

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## Types & Function of Muscles

- Skeletal Muscle:
  - Generally attached to bone
  - Produces movement, maintains posture & stabilizes joints
  - Produce heat therefore helps maintain body temperature
  - Muscle cells are long, cylinder shaped & **striated**
  - Controlled by choice so considered **Voluntary Muscles**

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## Muscular System

- Smooth Muscle:
  - Found in walls of the organs, breathing passages & blood vessels
  - Function automatically so are considered **involuntary muscle**
  - Not striped in appearance so are **non-striated** muscles
  - Contraction of smooth muscle enables viscera to perform

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## Muscular System

- Cardiac Muscles:
  - Found only in the heart
  - Pumps blood to body
  - Cells are long branching & fit together at junction called intercalated discs
  - Junctions create electrical impulses
  - **Striated & Involuntary muscle**

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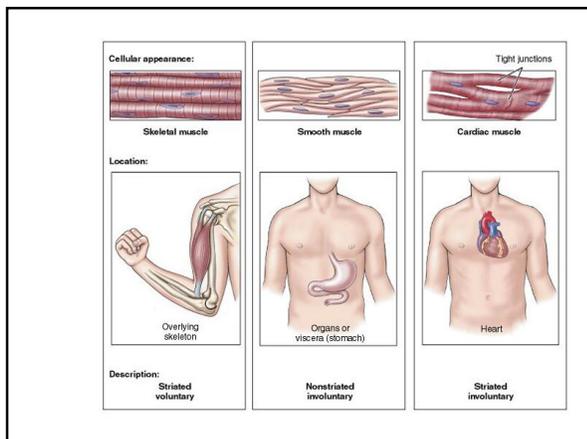
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## Muscular System

- Structure of a **Whole** Muscle:
  - each individual *muscle fiber* is surrounded by connective tissue called **endomysium**
  - when individual muscle fibers form bundles, **fascicles** are created which are surrounded by another connective tissue **perimysium**
  - These fascicles bundle together to form **fascia** that are covered by **epimysium**

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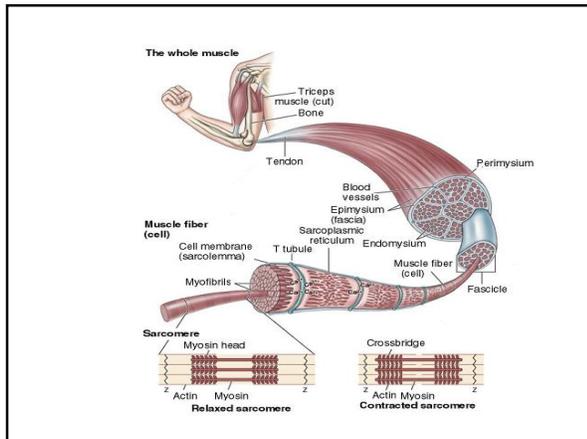
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## Muscular System

- Muscles form attachment in 3 ways:
  1. Tendons attach muscle to bone
  2. Muscles directly attach to bone
  3. Aponeurosis: flat sheet like fascia, connects muscle to muscle or muscle to bone

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## Muscular System

- Structure of a Single Muscle Fiber:
  - A muscle cell is an elongated muscle fiber that is multinucleated & surrounded by cell membrane **sarcolemma**
  - The cell membrane penetrates deep into interior of muscle fiber creating **transverse tubules**
  - Specialized endoplasmic reticulum are located within the muscle fiber called **sarcoplasmic reticulum** where  $Ca^{+}$  is stored

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## Muscular System

- Structure of Single Muscle Fiber:
  - Each fiber is composed of long cylinder structures called **myofibrils** which bundle together to form a muscle cell
  - Myofibrils are made up of contractile units called **sarcomeres**
  - Each sarcomere is formed by arrangement of two contractile proteins, **actin & myosin**
  - **Myosin heads** extend from myosin filament
  - When myosin & actin make contact a crossbridge is formed

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## Muscular System

- Muscle Contraction:
  - When actin & myosin filaments slide past each other, the sarcomeres shorten causing the muscle to shorten
  - Sarcomere shorten because myosin heads make contact with actin forming temporary connections called crossbridges
  - Myosin heads rotate pulling the actin toward the center of the sarcomere
  - Relaxation occurs when crossbridges are broken & actin & myosin return to normal position

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## Muscular System

- Contraction & Relaxation
  - Adenosine triphosphate & calcium play key role
  - ATP helps myosin heads form & break crossbridges with actin
  - Calcium is stored in sarcoplasmic reticulum & is needed for ATP to function
  - When muscle is stimulated, calcium is released from SR causing ATP, actin & myosin to interact creating muscle contraction
  - When calcium is pumped back in SR, away from actin, myosin & ATP crossbridges break & muscles relax

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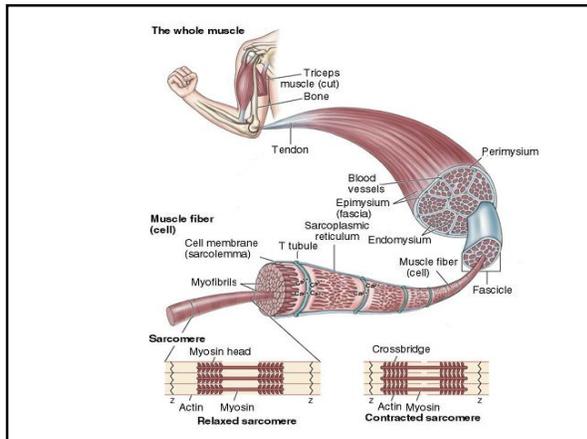
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## Muscular System

- Skeletal Muscles & Nerves
  - Skeletal muscles only contract when stimulated by a motor nerve
  - This motor nerve causes a release of neurotransmitter acetylcholine from the nerve into the neuromuscular junction
  - The neurotransmitter then binds with the muscle membrane, travels along & triggers the release of calcium from sarcoplasmic reticulum which comes in contact with actin, myosin & ATP causing muscle contraction

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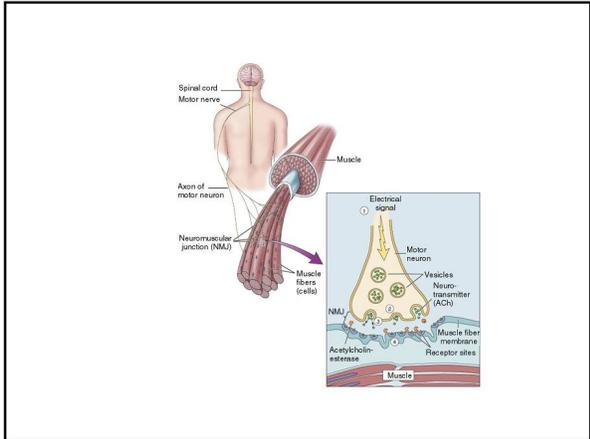
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### Types of Muscle Contraction

- Single muscle fibers contract in all or nothing manner; never partially.
- All whole muscle is capable of contracting partially, either weakly or very strong depending on need.
- Contracting of whole muscle may require several hundred fibers to several thousand.
- Recruitment is the process of using more muscle fibers for greater muscle force.

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### Muscular System

- Types of muscle contraction:
  - Twitch: single stimulus delivered to muscle, muscle contracts & then fully relaxes
  - Tetanus: muscle is stimulated repeatedly without giving the muscle time to relax with sustained muscle contraction
- Muscle tonus: normal continuous state of partial muscle contraction

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## Muscular System

- ATP is required for contraction
- ATP is replaced in three ways:
  1. Aerobic metabolism: glycogen, glucose & fats are broken down for energy
  2. Anaerobic metabolism: not a complete breakdown of fuels without O<sub>2</sub> lactic acid is produced
  3. Metabolism of creatine phosphate

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## Muscular System

- Terms related to muscle movement:
  - Origin: where muscle attaches to stationary bone
  - Insertion: where muscle attaches to movable bone
  - Prime mover: the chief muscle responsible for most movement of the muscle group
  - Synergist: helper muscles of prime mover
  - Antagonist: muscles that oppose the action of another muscle
  - Hypertrophy: increase in muscle size
  - Atrophy: decrease in muscle size
  - Contracture: abnormal formation of fibrous tissue

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## Muscular System

- Naming skeletal Muscles according to the following characteristics:
  - Size
  - Shape
  - Direction of fibers
  - Location
  - Number of origins
  - Origin & Insertion
  - Muscle Action

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## Muscular system

- Size:
  - vastus: huge
  - maximus: large
  - langus: long
  - minimus: small
  - brevis: short
- Shape:
  - deltoid: triangular
  - latissimus: wide
  - teres: round

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## Muscular System

- Location:
  - pectoralis: chest
  - gluteus: buttock
  - brachii: arm
  - supra: above
  - infra: below
  - lateralis: lateral
  - sub: underneath

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## Muscular System

- Number of Origins:
  - Biceps (2)
  - Triceps (3)
  - Quadriceps (4)
- Origin & Insertion:
  - Strenocleidomastoid
- Direction of fibers:
  - Oblique: diagonal
  - Rectus: straight
  - Transverse: across
- Muscle Action

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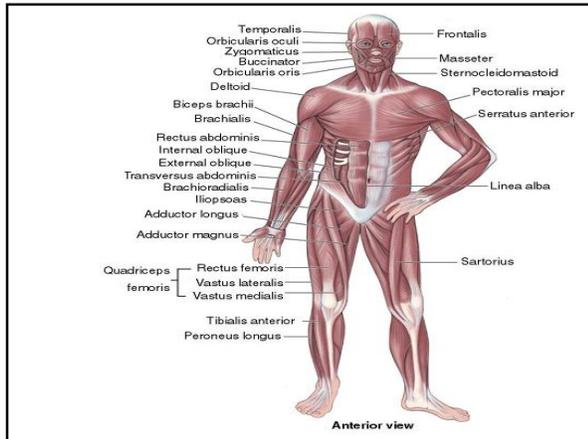
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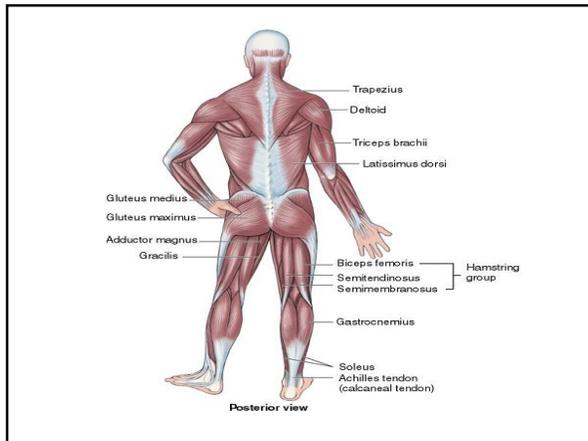
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## Muscular System

- Major Muscles:
- Facial:
  - Frontalis: covers frontal bone; contraction raises eyebrows
  - Orbicularis oculi: sphincter muscle that encircles the eye; contraction closes eye, assists with winking, blinking & squinting
  - Orbicularis oris: sphincter muscle that encircles the mouth; contraction assists in closing the mouth, forming words & pursing lips

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## Muscular System

- Facial Muscles:
  - Buccinator: muscle that inserts into the orbicularis oris & flattens the cheek when contracted; helps position food between teeth for chewing
  - Zygomaticus: extends from the corners of the mouth to the cheekbone; smiling muscle

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## Muscular System

- Chewing Muscles:
  - Masseter: extends from zygomatic process of temporal bone to mandible; contraction closes jaw; synergistically works with temporalis muscle
  - Temporalis: fan-shaped muscle extending from the flat portion of the temporal bone to the mandible; works synergistically with other chewing muscles

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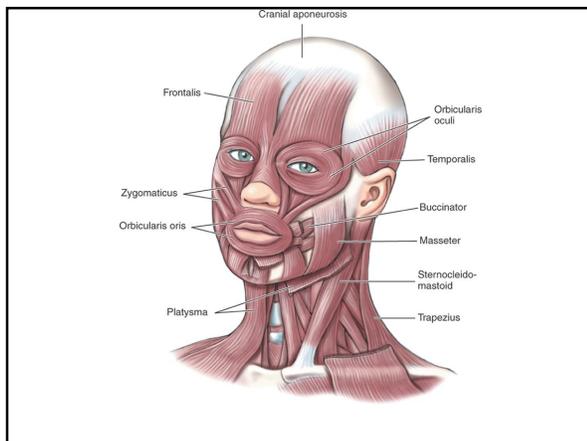
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## Muscular System

- Muscles of Neck:
  - Sternocleidomastoid (2): Muscle extends from sternum & clavicle to the mastoid process of temporal bone; contraction of one causes head to rotate; contraction of both causes flexion of the head (bows to pray)
  - Trapezius: attaches to the base of the occipital bone, shoulder & upper vertebral column; contraction extends head (face to sky)
  - These two muscles work antagonistically to one another

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## Muscular System

- Muscles of Trunk:
  - Intercostal muscles: located between ribs; raise & lower rib cage during breathing
  - Diaphragm: dome-shaped muscle that separates the thoracic cavity from the abdominal cavity; chief muscle of inhalation

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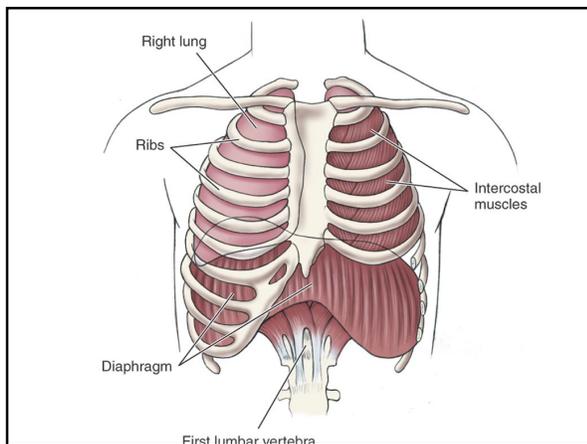
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## Muscular System

- Muscles of Abdomen:
  - Rectus abdominus: runs up & down; longitudinally from sternum to pubic bone; contraction flexes or bends vertebral column
  - External Oblique: make up lateral walls of abdomen; run slanted

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## Muscular System

- Muscles of the abdomen:
  - Internal oblique: part of the lateral walls of the abdomen; add strength of external oblique by creating a criss-cross pattern
  - Transverse abdominus: form the innermost layer of abdominal muscles; run horizontally across abdomen
  - Abdominal muscles are covered with fascia that forms a large aponeurosis. White line in center of these aponeuroses is linea alba & extends from sternum to pubic bone

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## Muscular System

- Muscles of the Vertebral Column: group of muscles attached to vertebrae; assist with movement of vertebral column
- Muscles of the Pelvic Floor: two flat muscle sheets & surrounding fascia; support pelvic viscera & assist with urinary & bowel elimination

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## Muscular System

- **Muscles of Shoulder & Upper Arm**

- Trapezius: attaches to thoracic vertebrae & scapula; contraction shrugs shoulders & moves head
- Serratus anterior: located on sides of the chest & extends from the ribs to the scapula where it attaches; contraction lowers shoulders & moves upper arms forward
- Deltoid: rounded portion of shoulder; extends from the clavicle & scapula to humerus; contraction abducts the arm, raising it to a horizontal position

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## Muscular System

- **Muscles of shoulder & Upper Arm**

- Pectoralis major: large broad muscle that forms anterior chest wall; connects with humerus & clavicle; contraction moves upper arm across front of chest
- Latissimus dorsi: large broad muscle located in the middle & lower back region; extends from back to humerus; contraction lowers shoulders & brings arms back as in rowing
- Rotator cuff muscles: group of 4 muscles that attach the humerus to scapula; form cuff over proximal humerus; helps rotate arm at shoulder

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## Muscular System

- **Muscles that move Lower Arm**

- Triceps brachii: lies at posterior surface of the humerus; contraction extends forearm
- Biceps brachii: located on the anterior surface of the humerus; contraction extends the forearm; works synergistically with brachialis & brachioradialis

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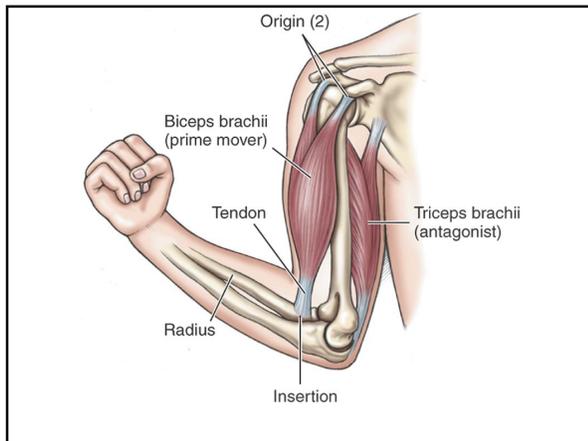
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### Muscular System

- Muscles that move the Hands & Fingers
  - Flexors & extensors are 20 muscles move hand & fingers; allow delicate movements
  - Flexors are located anteriorly
  - Extensors are located posteriorly
  - Flexors are slightly stronger which attributes to the slight flexed position of the hand at rest

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### Muscular System

- Muscles that move the Thigh, Leg & Foot
  - Gluteal Muscles: located on posterior surface of body & include:
    - Gluteus maximus: largest muscle of body & forms buttocks; muscle we sit on
    - Gluteus medius
    - Gluteus minimus
  - The gluteal muscles abduct the thigh; raise thigh sideways to a horizontal position

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## Muscular System

- **Muscles that move the Thigh**

- Iliopsoas: anterior surface of groin; contraction flexes the thigh; antagonist to the gluteus maximus
- Adductor muscles: located on medial surface of the thigh; adduct the thighs pressing them together & include:
  - Adductor longus
  - Adductor brevis
  - Adductor magnus
  - Adductor gracilis

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## Muscular System

- **Muscles that move the Leg**

- Quadriceps Femoris: group of four muscles located on anterior & lateral surface of the thigh; insert into tibial tuberosity by patellar tendon; contraction extends or straightens the leg at the knee; kicking a football
- 4 muscles that make Quadriceps Femoris:
  - Vastus lateralis
  - Vastus intermedius
  - Vastus medialis
  - Rectus femoris

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## Muscular System

- **Muscles that move the Leg**

- Sartorius: longest muscle in the body; strap-like muscle located on the anterior surface thigh; passes over quadriceps in an oblique direction; allows legs to rotate; cross legs
- Hamstrings: group of muscles located on posterior surface of thigh; extend from ischium to tibia; contraction flex leg at knee
- Includes:
  - biceps femoris
  - Semimembranosus
  - semitendinosus

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## Muscular System

- **Muscles that Move the Foot**

- Tibialis anterior: located on anterior surface; contraction causes dorsiflexion
- Peroneus longus: muscles on lateral surface; contraction causes eversion; supports arch of foot; assist plantar flexion
- Gastrocnemius & Soleus: major muscles of the posterior leg that form calf; attach to the calcaneus by calcaneal tendon or Achilles tendon; contraction causes plantar flexion; tiptoe

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