

The Muscular System

- about 1/2 of body mass
- Transforms ATP into mechanical energy.
- 3 types of muscle: 1. Skeletal 2. Cardiac 3. Smooth
- Prefixes= myo, mys, and sarco

Special Characteristics:

Excitability (responsiveness): ability to receive and respond to stimuli

stimulus usually a chemical (NT, hormone, pH)

response = AP along sarcolemma + muscle **contraction**

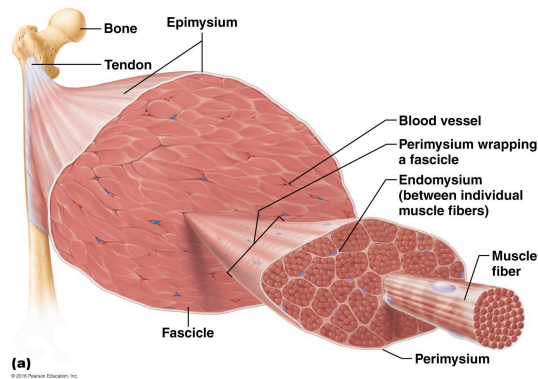
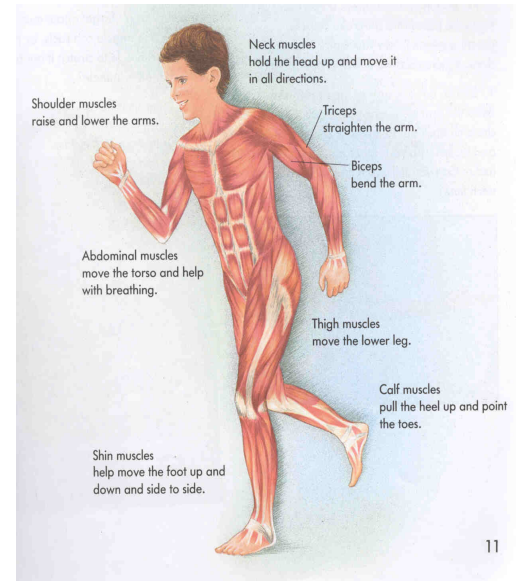
Contractility: ability to shorten forcibly when stimulated

Elasticity: ability to recoil or resume resting length after being stretched

Four Functions:

1. Produce movement
2. Maintain posture and body position
3. Stabilize joints
4. Generate heat – shivering

Every Skeletal muscle is served by one artery, one nerve, and 1+ veins



Physiology of Muscle Tissue

Recall that muscle fiber is the name of a single muscle cell

Muscle has several different levels of connective tissue wrapping

1. **Endomysium** - fine layer of areolar CT that surrounds each muscle fiber (cell)
2. **Perimysium** - dense irregular CT sheet around fascicles (groups of muscle fibers)
3. **Epimysium** - dense, irregular fibrous CT that surrounds the whole muscle
4. **Deep fascia**: still coarser layer of dense

connective tissue that binds muscles into functional groups e.g. hamstrings are separated from quadriceps by deep fascia

Attachments

Muscles span joints and attach to bones

Most are attach to bone in at least two places

Origin: The bone that is more stationary

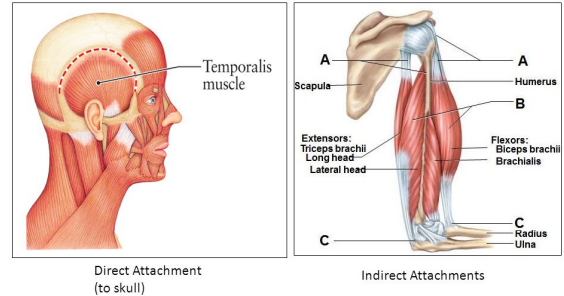
Insertion: More movable of two bones.

Because the site of insertion is more movable and the other is stable, the muscle will pull the insertion towards the origin.

Types of attachments

Direct: epimysium fused to periosteum of bone or perichondrium of cartilage

Indirect: connective tissue wrappings extend beyond muscle as ropelike **tendon** (*rope like extension*) or sheet like **aponeurosis** (*flat, broad extension of CT*)



Functional Groups

4 different types

1. Prime Mover (agonist)

provides major force for a particular movement

e.g.: *brachialis* in elbow flexion

Prime mover and antagonist are located on opposite sides of joint across which they act

2. Antagonist

opposes or reverses a particular movement

e.g.: *triceps brachii* in elbow flexion

3. Synergists

muscles that help the prime mover by promoting the same movement

Add force to a movement; reduce undesirable or unnecessary movement

4. Fixators

Synergists that immobilize a bone or muscle's origin

e.g. muscles that immobilize the scapula during shoulder joint movements or load

Note: a single muscle can be a **agonist** for one action & an **antagonist** for another action e.g. biceps brachii & triceps brachii

Arrangement of Fascicles

Four patterns:

1. Circular

concentric rings surround external openings &

contract to close opening

(eg: *obicularis oculi*)

2. Convergent

fascicles converge towards a single tendon insertion

muscle is triangular or fan-shaped

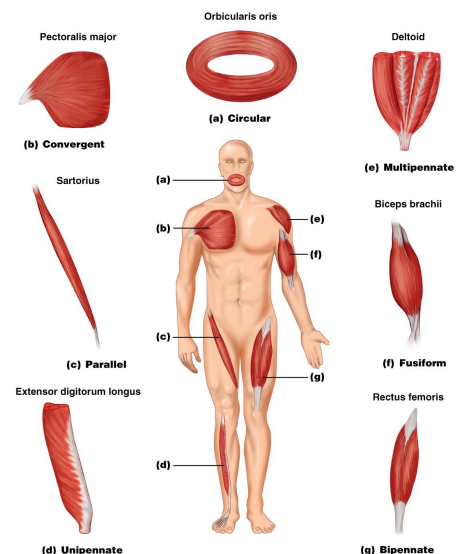
(eg: *pectoralis major*)

3. Parallel

fascicles parallel to the long axis of a strap like muscle

can be *strap like* (e.g: *sartorius*) or *fusiform* (e.g. *biceps brachii*)

4. Pennate



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short fascicles attach obliquely to a central tendon running the length of the muscle. 3 forms

unipennate = e.g. *extensor digitorum*, bipennate = e.g. *rectus femoris*,
 multipennate = e.g. *deltoid*

Rules for Naming

1. **Muscle location**—bone or body region with which muscle associated eg intercostals
2. **Muscle shape**—e.g., deltoid muscle (*deltoid* = triangle)
3. **Muscle size**—e.g., maximus (largest), minimus (smallest), longus (long)
4. **Direction of muscle fibers or fascicles**—
rectus (fibers run straight), *transversus* (fibers run at right angles)
oblique (fibers run at angles to imaginary defined axis)
5. **Number of origins**—e.g., biceps(2 origins) and triceps (3 origins)
6. **Location of attachments**—named according to point of origin and insertion (origin named first)
7. **Muscle action**—named for action they produce, e.g., flexor or extensor
8. **Several criteria can be combined**, e.g. *extensor carpi radialis longus*

Muscle Action

(a) A muscle that crosses on the anterior side of a joint produces flexion*

Example: Pectoralis major (anterior view)

* These generalities do not apply to the knee and ankle because the lower limb is rotated during development. The muscles that cross these joints posteriorly produce flexion, and those that cross anteriorly produce extension.

(c) A muscle that crosses on the lateral side of a joint produces abduction

Example: Deltoid middle fibers (anterolateral view)

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(b) A muscle that crosses on the posterior side of a joint produces extension*

Example: Latissimus dorsi (posterior view)
The latissimus dorsi is an antagonist of the pectoralis major.

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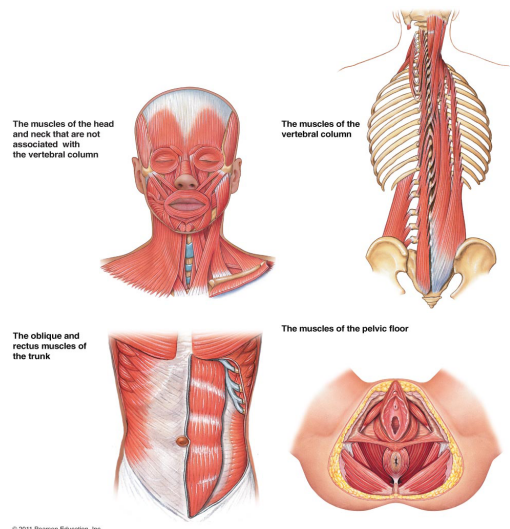
(d) A muscle that crosses on the medial side of a joint produces adduction

Example: Teres major (posterolateral view)
The teres major is an antagonist of the deltoid.

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The Axial Muscles

- Stabilizes and positions the head, neck and trunk
 - Can be divided into 4 broad groups based on location and/or function
1. Pelvic floor
 2. head and neck (not vertebral column)
 3. Vertebral column
 4. Trunk



Muscles of the Head

1. Muscles of facial expression

insert into skin or other muscles, not bones
all are innervated by the *Facial nerve (CN VII)*

2. Muscles of mastication and tongue movement

1. Epicranius -

1. main muscle of scalp; bipartite muscle
 - a. *Frontal belly (Frontalis)*
Epicranial aponeurosis to skin of eyebrows
raises eyebrows, wrinkles forehead
 - b. *Occipital Belly (Occipitalis)*
Occipital and temporal bones to epicranial aponeurosis
pulls scalp posteriorly

2. Orbicularis Occuli-

1. - surrounds rim of orbit
- protects eyes from light/injury – closes the eye, blinking, squinting, also draws eyebrows inferiorly

3. Zygomaticus-

1. Zygomatic bone to corner of mouth
raises the lateral corners of the mouth (smiling muscle)

4. Orbicularis oris-

1. maxilla & mandible to muscle & skin around mouth
closes, protrudes lips; kissing & whistling

5. Buccinator-

1. mandible/maxilla to orb.oris
deep to masseter – whistling, sucking; hold food in place when chewing;
especially in nursing infants

6. Platysma-

1. fascia of chest to mandible
helps depress mandible;
tenses skin of neck (shaving muscle)

Four pairs involved in mastication

Masseter -prime movers of jaw closure

Temporalis

Grinding movements

Medial and lateral pterygoids

All innervated by mandibular division of **cranial nerve V**

Masseter

zygomatic arch & bone to angle & ramus of mandible

prime mover of jaw closure

Temporalis

temporal fossa to coronoid process of mandible

elevates and retracts mandible (closes jaw)

maintains closed jaw at rest

Medial and lateral pterygoid

Pterygoid process of sphenoid to mandible

additional jaw movements (e.g. side-to-side grinding movements)

Tongue

- Three muscles anchor and move tongue
- All innervated by **cranial nerve XII** - hypoglossal nerve

1. Styloglossus

- styloid process of temporal bone to inferolateral tongue
- retracts & elevates tongue

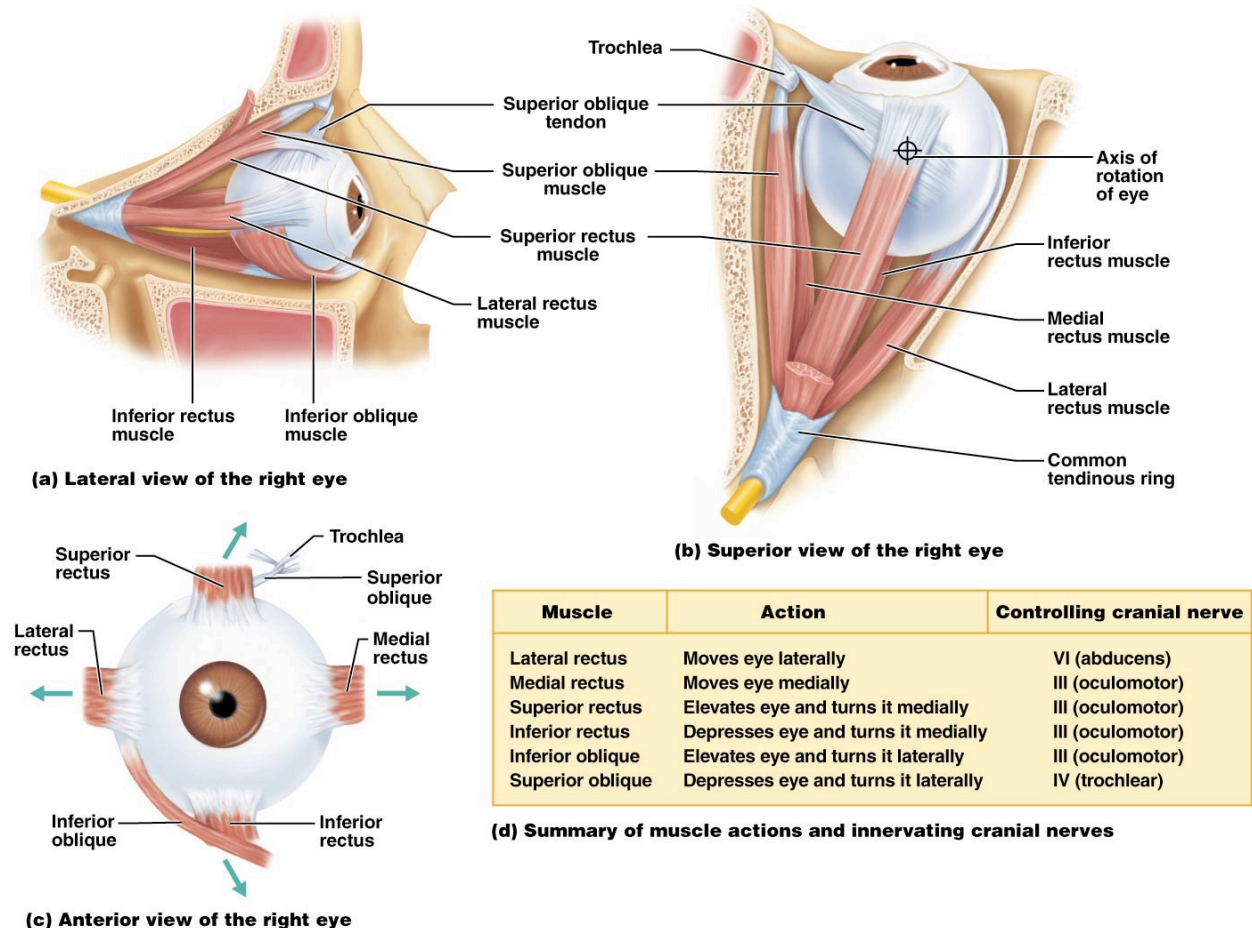
2. Genioglossus

- mandible to inferior tongue & hyoid bone
- prime mover of tongue protrusion
- anchors tongue to prevent obstruction of respiration

3. Hypoglossus

- hyoid bone to inferolateral tongue
- depresses tongue, especially lateral margins

The Eye



Head, Neck, and Trunk Movement

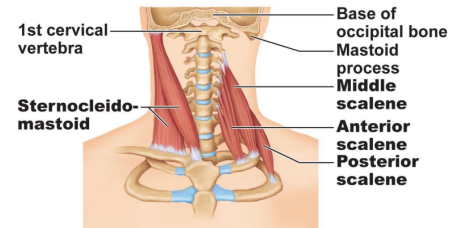
Head movement:

1. Sternocleidomastoid

1. manubrium/clavicle to mastoid process of temporal bone
 - Headed; deep to the platysma
 - prime mover (both muscles) of head flexion (lift head when lying on back)
 - individual muscle action for head rotation to side, head tilt

2. Scalenes

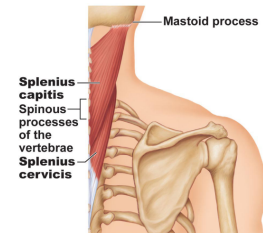
1. cervical vertebrae to 1st 2 ribs
2. More laterally and deep to platysma & SCM
 - elevates first 2 ribs
 - flexes & rotates neck
 - aids in inspiration



(a) Anterior

3. Splenius:

2. spinous process of vertebrae to mastoid process of temporal bone & occipital bone
 - head extension (both sides)
 - rotation, tilts head (one sided)



(b) Posterior

Vertebral Column:

- *Deep/ intrinsic back muscles*
 - trunk movements and back posture
 - form a broad, thick column extending from sacrum to skull

1. Erector spinae (sacrospinalis) group

- prime movers of back extension and lateral bending
- Resistance to bending forward & extensor for returning to erect position
 - Iliocostalis
 - Longissimus
 - Spinalis

Semispinalis & quadratus lumborum synergists in extension and rotation