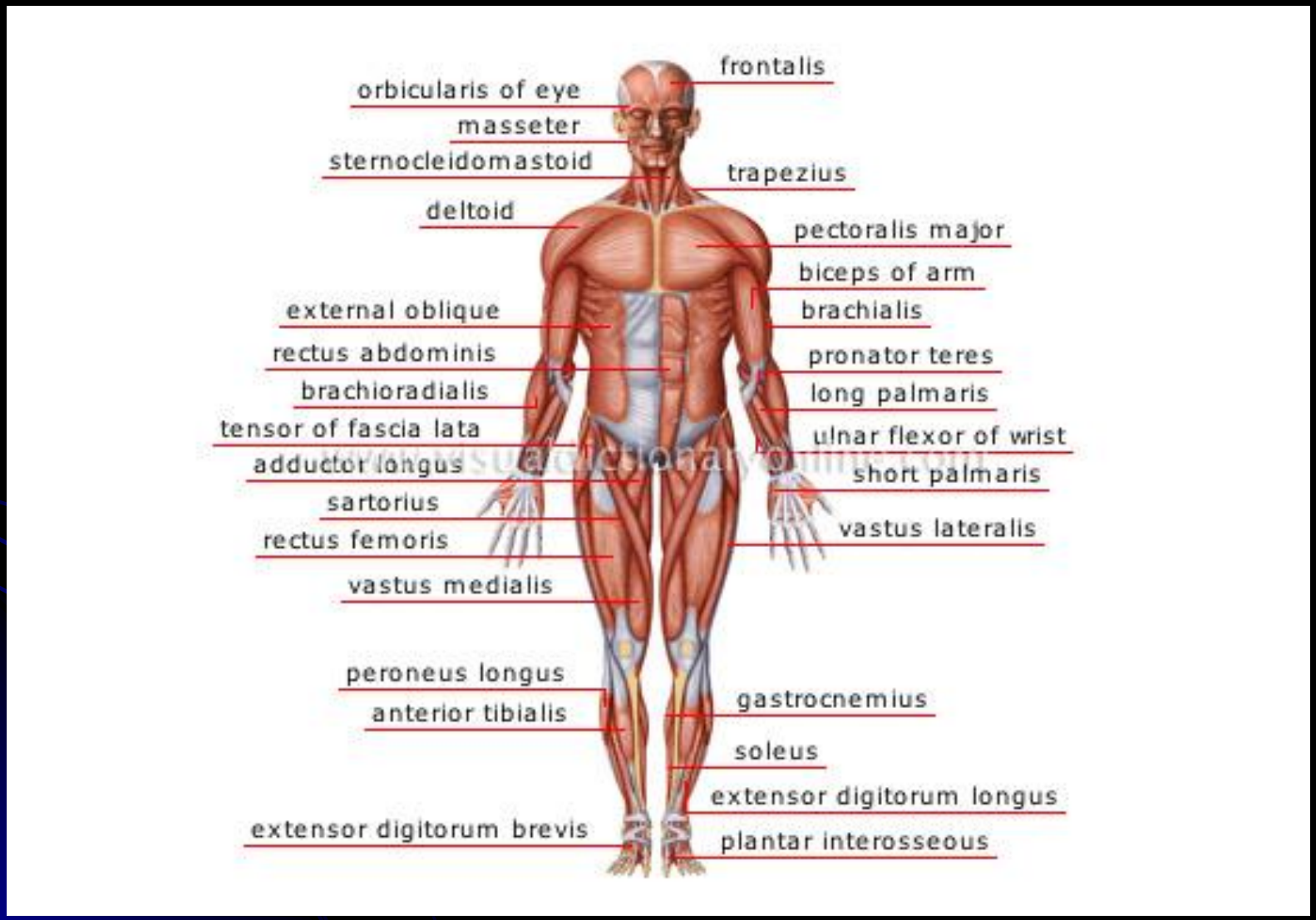
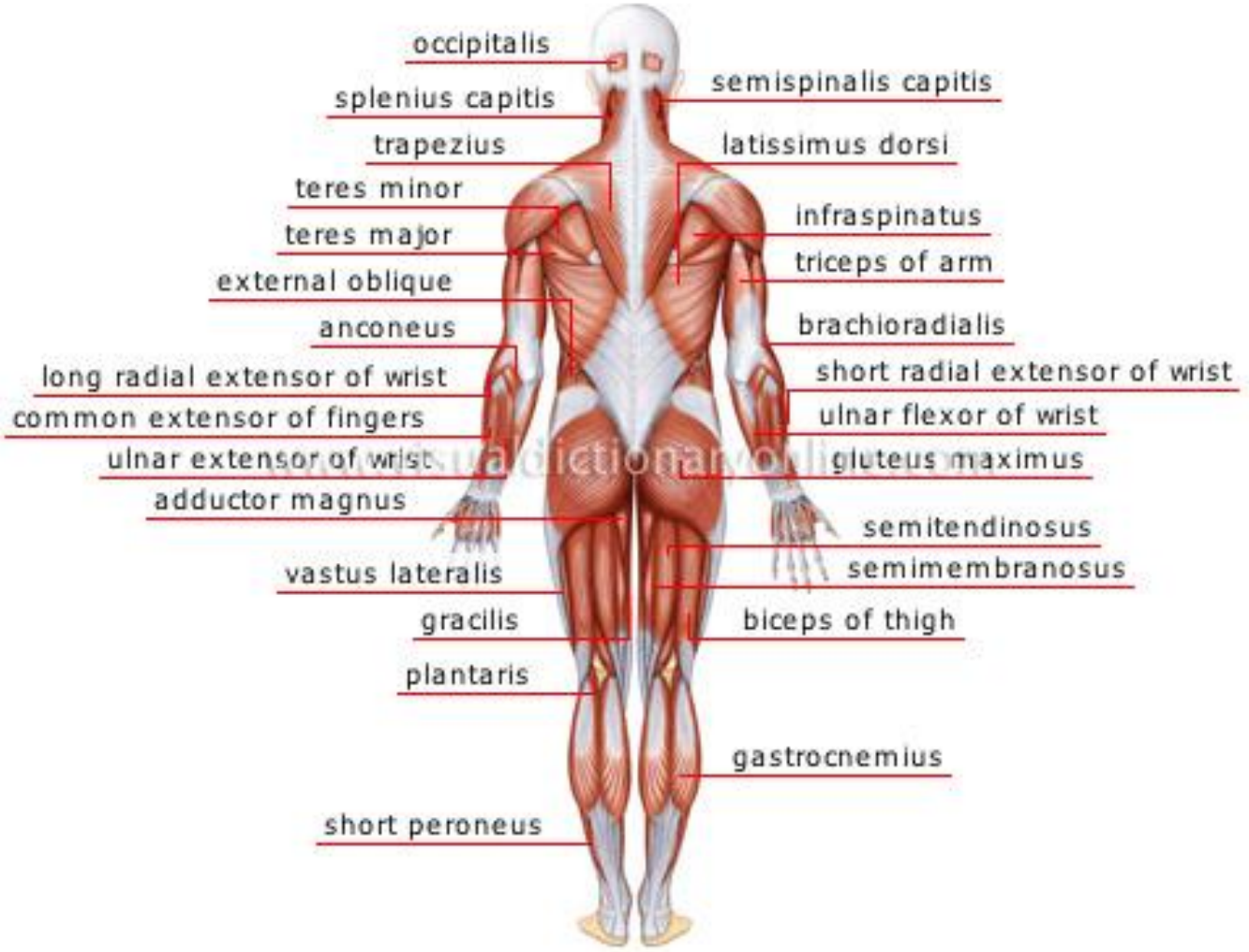
The Muscular System

Specialized tissue that enable the body and its parts to move.

Anterior View



Posterior View



TRIVIA!

- **How many muscles are there in the human body?**
  - Answer: 640 Muscles
  - The muscles make up about 40 % of the body mass.

- **What is the longest muscle in the body?**
  - Answer: *The Sartorius*
  - The **Sartorius** runs from the outside of the hip, down and across to the inside of the knee. It twists and pulls the thigh outwards.

- **What is the smallest muscle in the body?**
  - Answer: *The Stapedius*
  - The **Stapedius** is located deep in the ear. It is only 5mm long and thinner than cotton thread. It is involved in hearing.

- **What is the biggest muscle in the body?**
  - Answer: *The Gluteus Maximus*
  - The **Gluteus Maximus** is located in the buttock. It pulls the leg backwards powerfully for walking and running.

There are about 60 muscles in the face.

Smiling is easier than frowning.

It takes 20 muscles to smile and over 40 to frown.




Smile and make someone happy.

Functions of the Muscles

- Movement
- Maintenance of posture and muscle tone
- Heat production
- Protects the bones and internal organs.

Muscle Classification

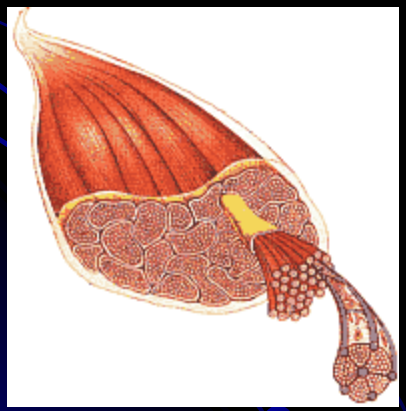
- Functionally
  - Voluntarily – can be moved at will
  - Involuntarily – can't be moved intentionally

- Structurally
  - Striated – have stripes across the fiber
  - Smooth – no striations

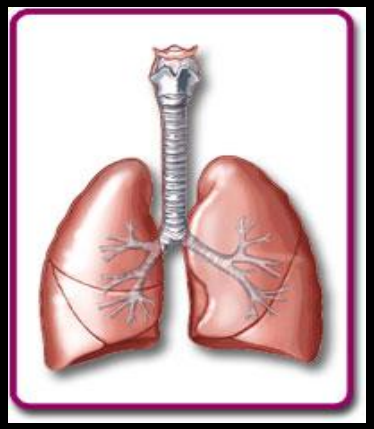
The 3 Types of Muscles

3 Types of Muscles

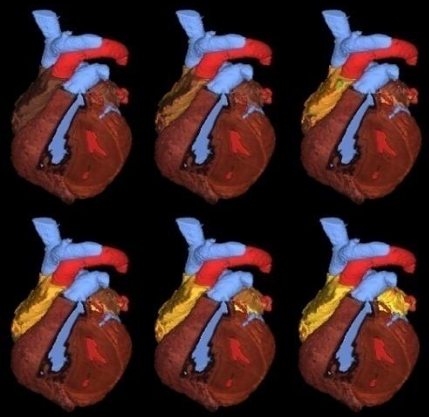
Skeletal Muscle



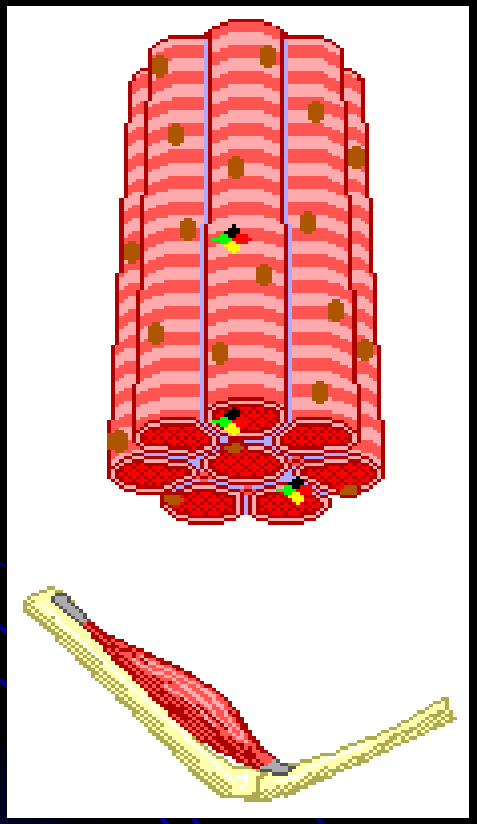
Smooth Muscle



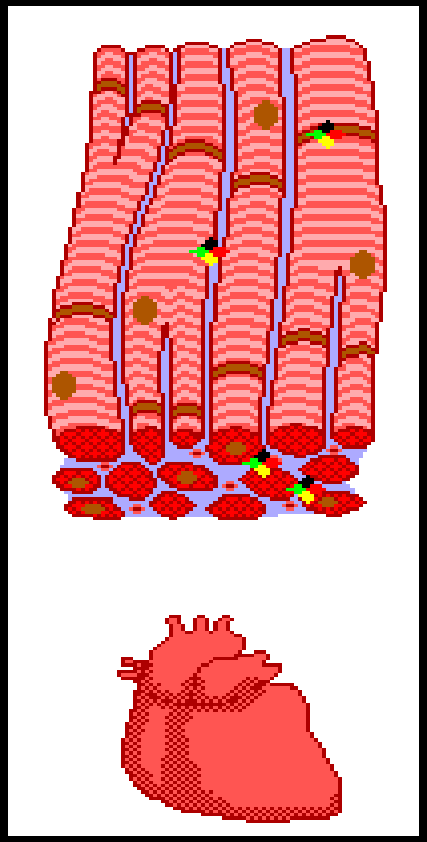
Cardiac Muscle



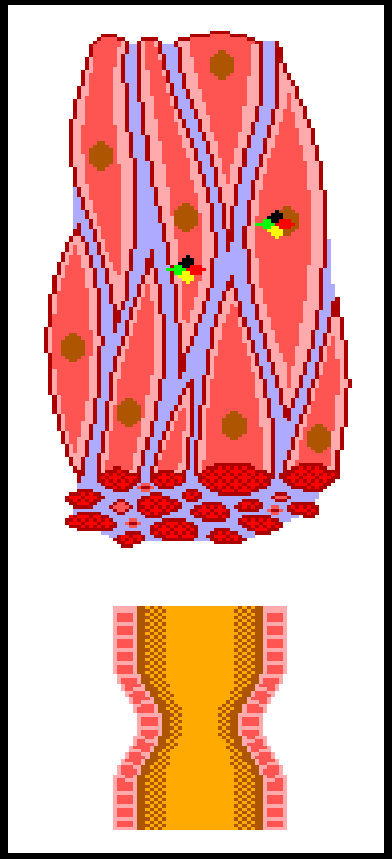
Three types of muscle



Skeletal



Cardiac



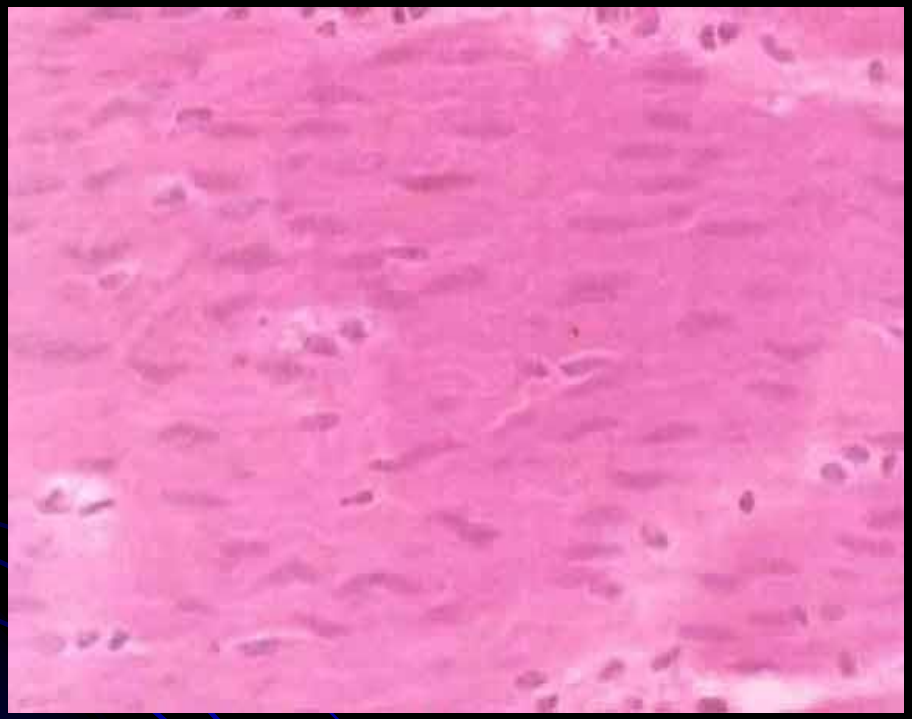
Smooth

Classification of muscle

Voluntary	Involuntary	
Skeletal	Cardiac	Smooth
Limbs	Heart	Viscera
Striated		Non-striated

Note: Control, Location and Structure

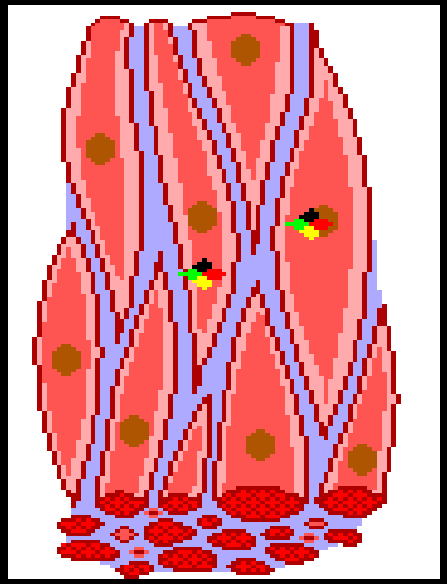
Smooth Muscle



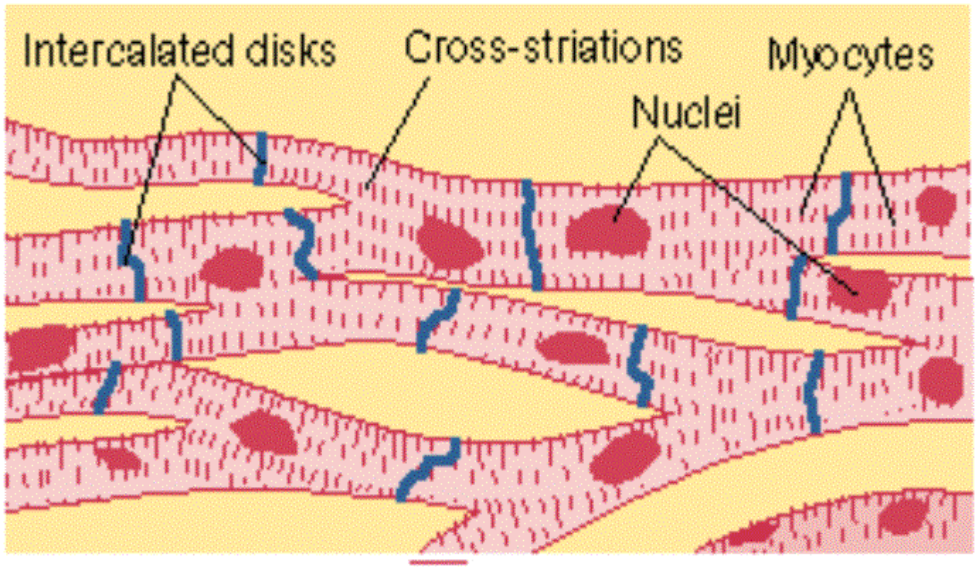
- Fibers are thin and spindle shaped.
- No striations
- Single nuclei
- Involuntary
- Contracts slowly

Smooth Muscle

- They fatigue… but very slowly
- Found in the circulatory system
  - Lining of the blood vessels
  - Helps in the circulation of the blood
- Found in the digestive system
  - Esophagus, stomach, intestine
  - Controls digestion
- Found in the respiratory system
  - Controls breathing
- Found in the urinary system
  - Urinary bladder
  - Controls urination

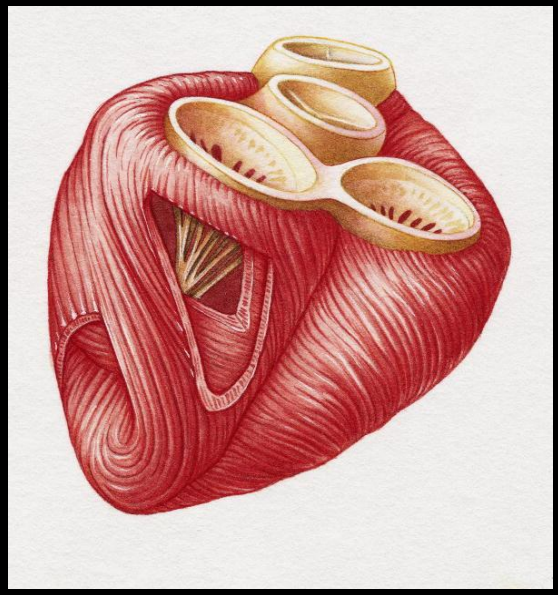


Cardiac Muscle

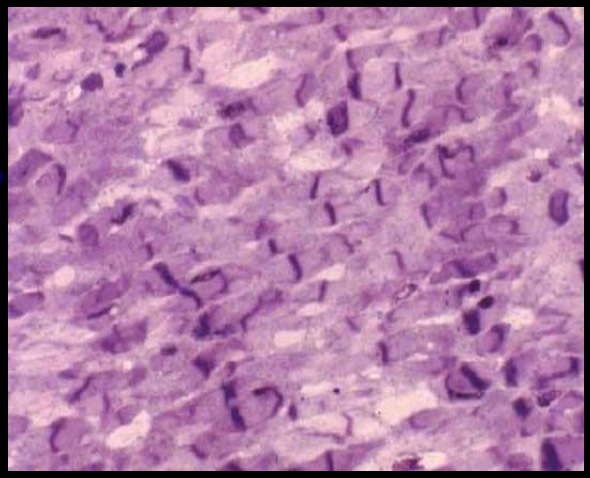


- Cells are branched and appear fused with one another
- Has striations
- Each cell has a central nuclei
- Involuntary

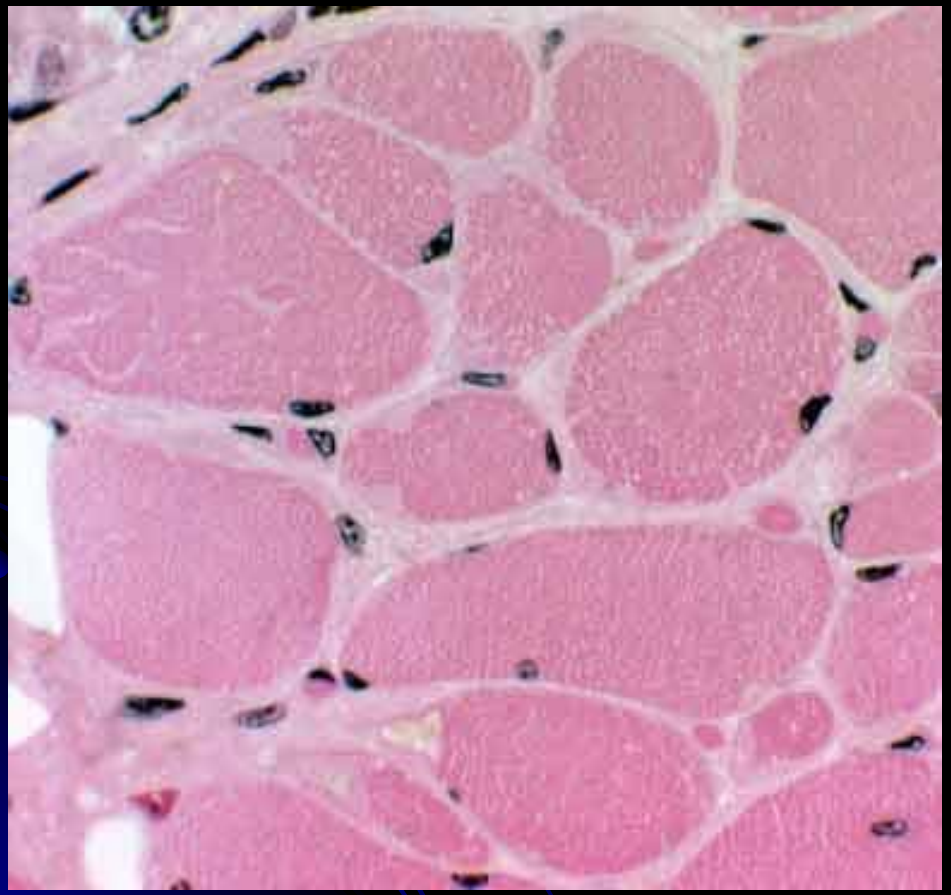
Cardiac Muscle



- Found ONLY in the heart
- Contractions of the heart muscles pump blood throughout the body and account for the heartbeat.
- Healthy cardiac muscle NEVER fatigues → or else…



Skeletal Muscle



- Fibers are long and cylindrical
- Has many nuclei
- Has striations
  - Have alternating dark and light bands
- Voluntary

Skeletal Muscle

- Attached to skeleton by tendons
- Causes movement of bones at the joints.
- And yes… they do fatigue
- Muscle fatigue activity → what substance forms causing muscle fatigue???

Functions of Skeletal Muscle

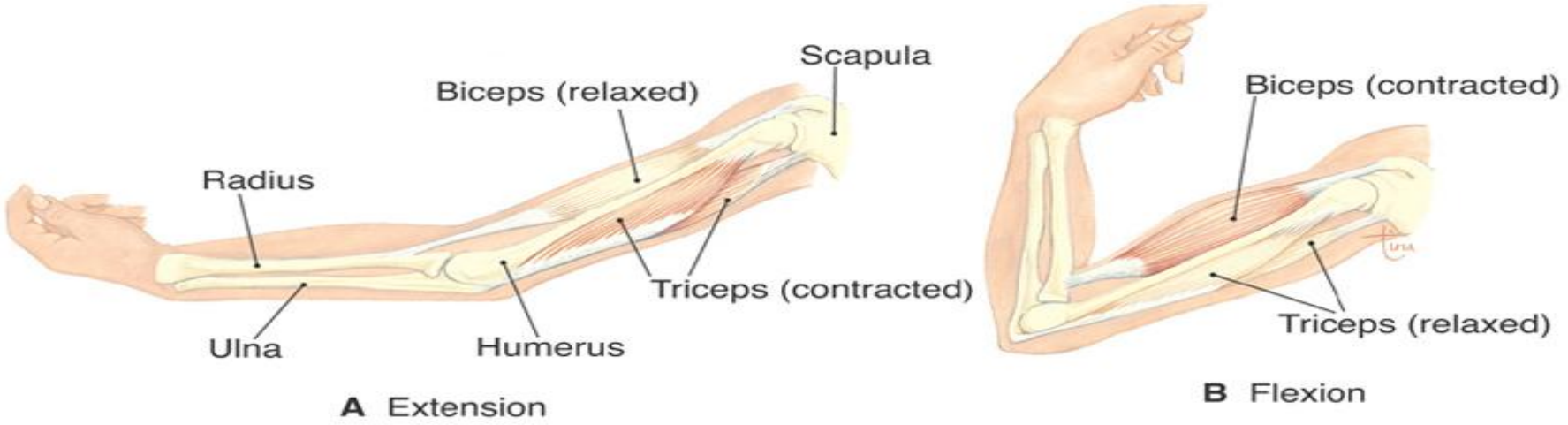
- Movement – muscle move bones by pulling not pushing.
  - Synergists – any movement is generally accomplished by more than one muscle. All of the muscles responsible for the movement are synergists.
  - The one that is most responsible for the movement is the Prime Mover (agonist).

Functions of Skeletal Muscle

- Movement
  - Antagonists – muscles and muscle groups usually work in pairs

    – example the biceps flex your arm and its partner the triceps extend your arm. The two muscles are antagonists, i.e. cause opposite actions.

    – when one contracts the other relaxes.
  - Levators – muscle that raise a body part.



Copyright © 2007 F.A. Davis Company www.fadavis.com

Functions of Skeletal Muscle

- Maintenance of posture or muscle tone
  - We are able to maintain our body position because of tonic contractions in our skeletal muscles. These contractions don't produce movement yet hold our muscles in position.

- Heat production – contraction of muscles produces most of the heat required to maintain body temperature.

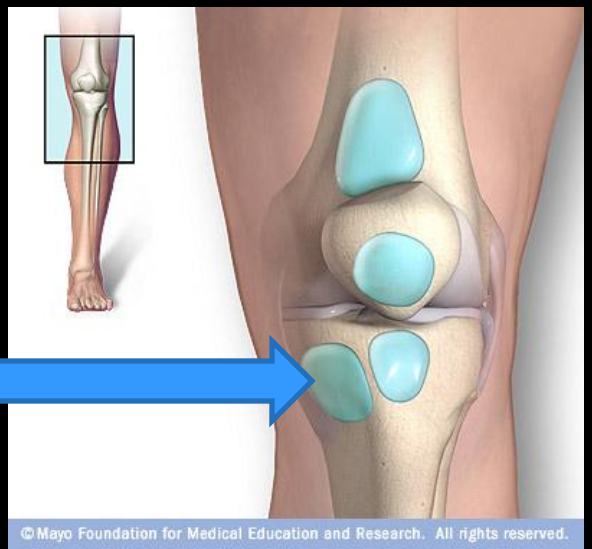
Structure of Skeletal Muscle

- Composed of striated muscle cells (=muscle fibers) and connective tissue.
  - Most muscles attach to 2 bones that have a moveable joint between them.
    - The attachment to the bone that does not move is the origin.
    - The attachment to the bone that moves is the insertion.
  - Tendons anchor muscle firmly to bones. Tendons are made of dense fibrous connective tissue.
  - Ligaments connect bone to bone at a joint.

Structure of Skeletal Muscle

- Bursae – small fluid filled sacs that lie between some tendons and the bones beneath them. They are made of connective tissue and are lined with synovial membrane that secretes synovial fluid.

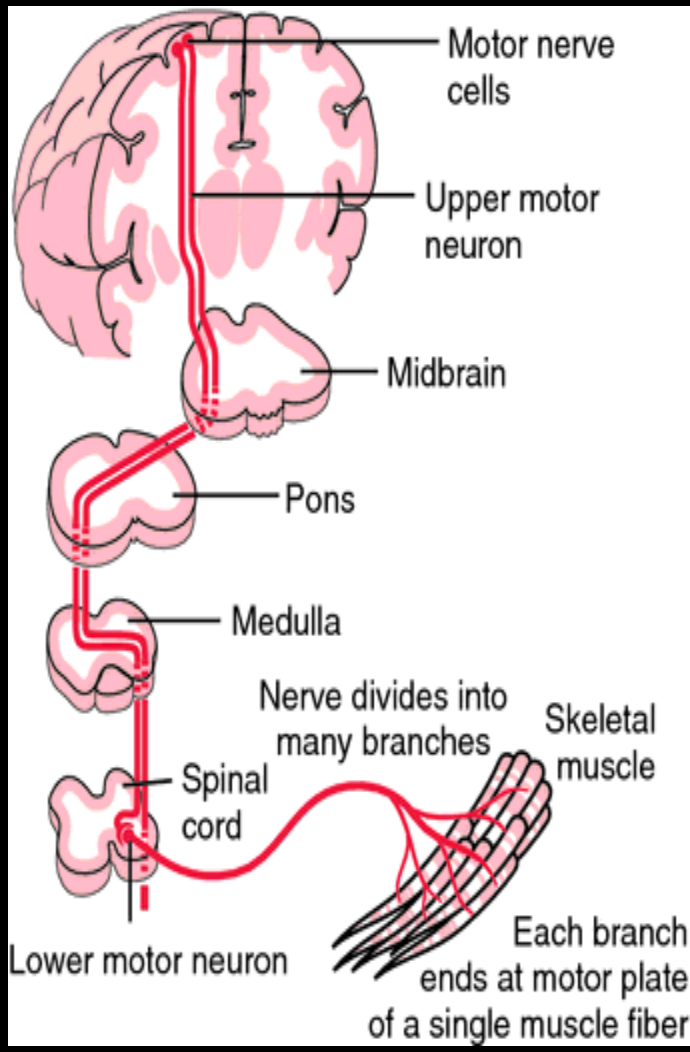
Bursae



Research *Today*

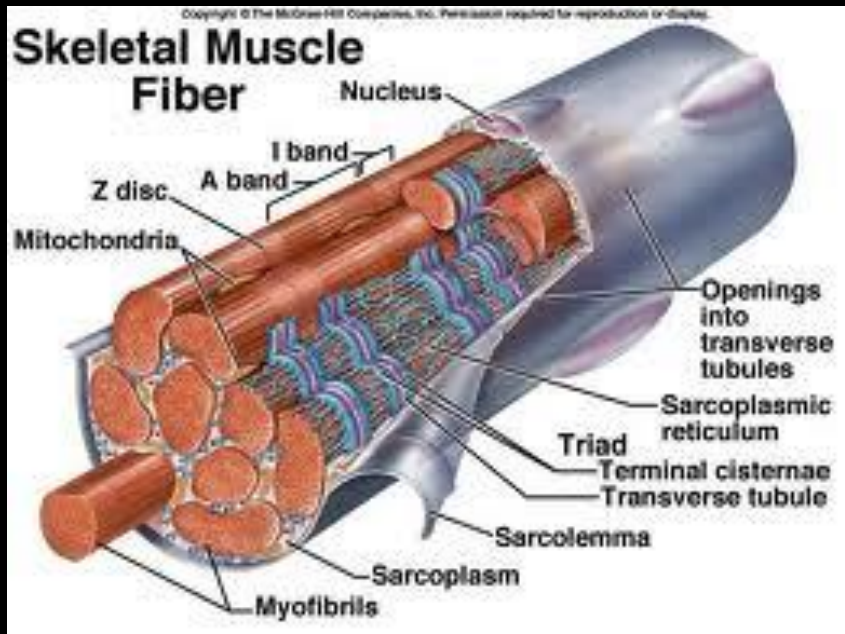
Nervous System and Muscles

- Contribution of the nervous system
  - Electrochemical impulses travel from frontal lobes - motor nerves- muscle fibers and cause them to contract.
  - Coordination = parietal lobes of the cerebrum (conscious muscle sense) and in the cerebellum (unconscious



Structure of Skeletal Muscle

- The membrane that surrounds the muscle cell is called the **sarcolemma.**
- Muscle cells are filled with 2 types of fine threadlike proteins: MYLOFILAMENTS
  - myosin (thick)
  - actin (thin).
- The myofilaments are arranged in the cells in small units called sarcomeres.



Structure of Skeletal Muscle

- Neuromuscular junction
  - Spot where the axon of a motor nerve nears the muscle fiber.
  - The axon terminal does not touch the muscle but comes close. The space between the axon and the muscle cell is called the synapse.
  - Within the terminal end of the axon are small sacs filled with a neurotransmitter called acetylcholine.

STOP

Muscle Contraction

- Sequence
  - Electrical impulse travels down a motor neuron. When it reaches the end, acetylcholine (chemical) is released into the synapse.
  - Acetylcholine bind to special receptors on the muscle cell and causes an electrical impulse to spread over the cell.
  - The sarcomeres shorten and the muscle cell contracts.

LETS GO TO THE VIDEO

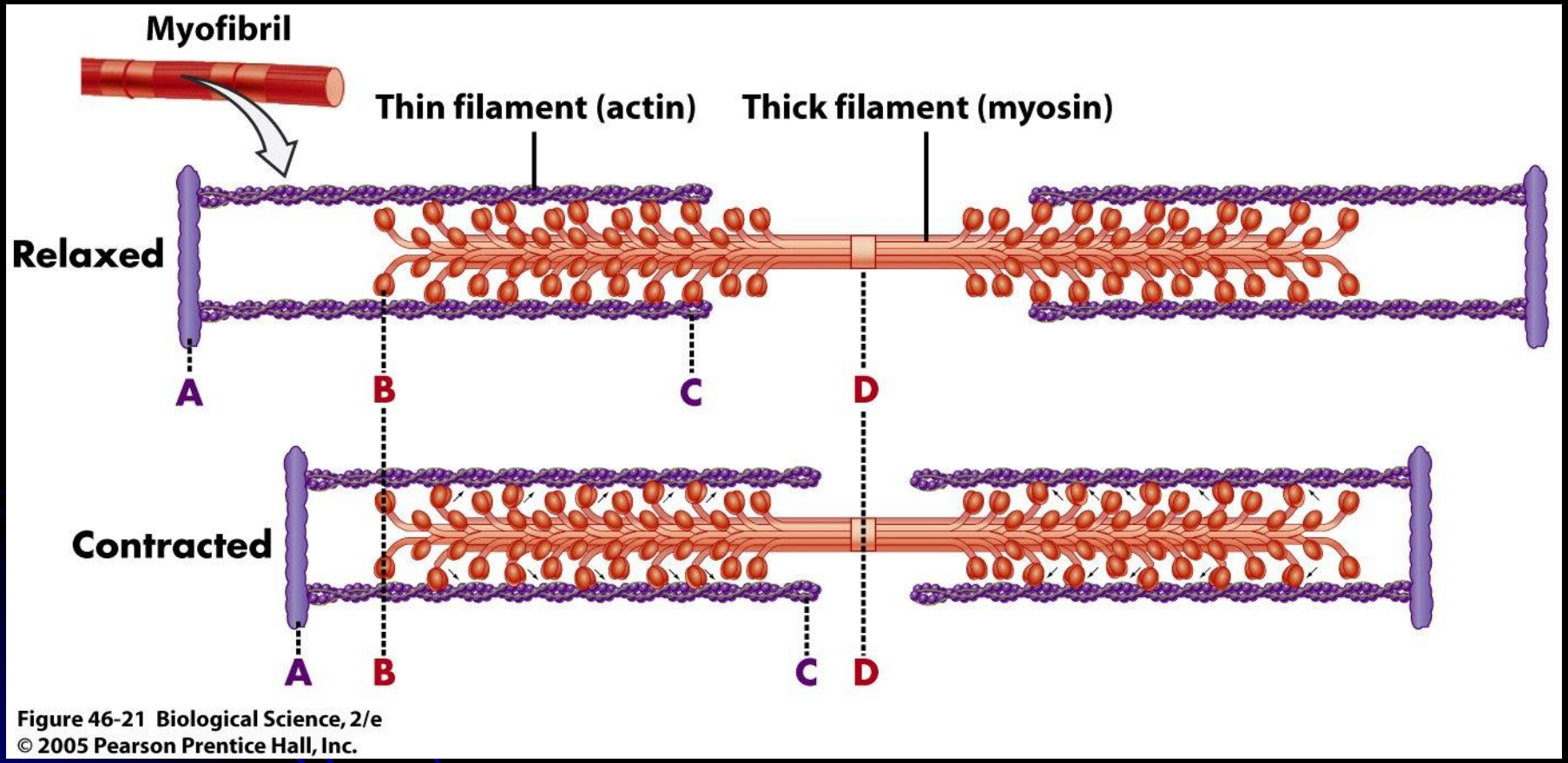
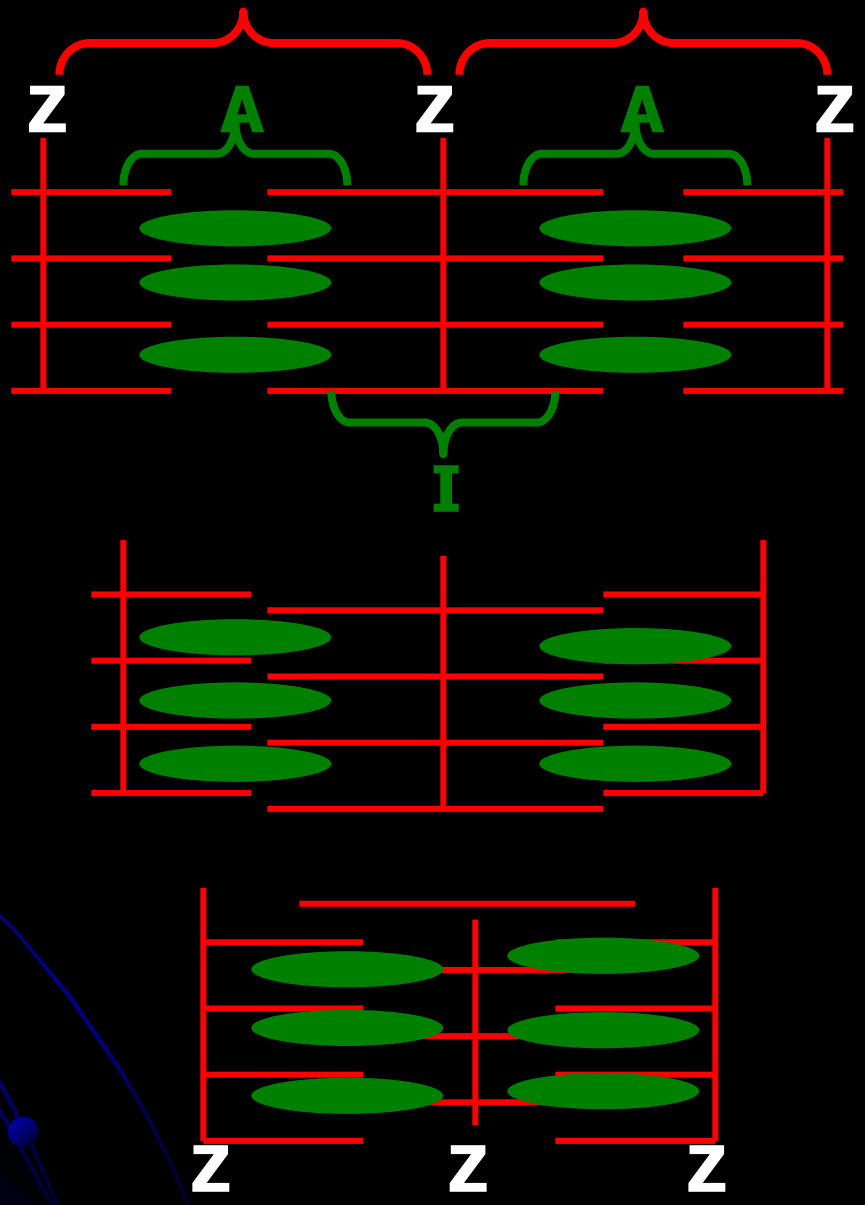


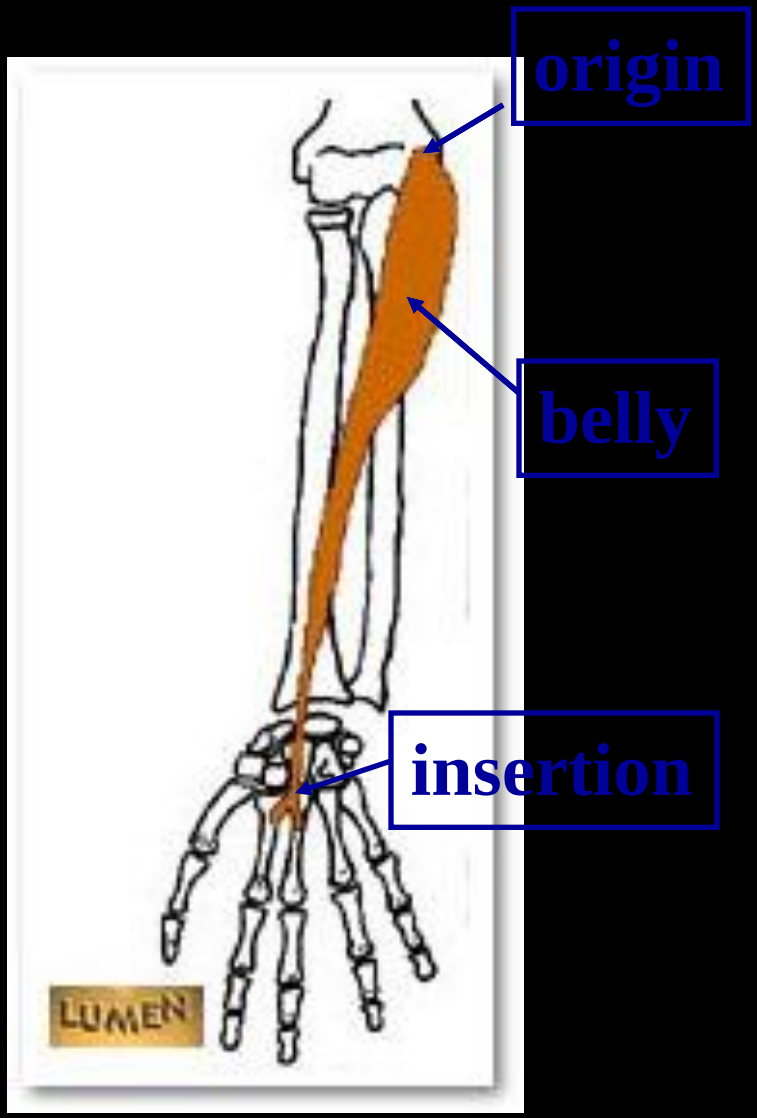
Figure 46-21 Biological Science, 2/e
© 2005 Pearson Prentice Hall, Inc.

Sarcomere



Movement of Muscles

- **Origin:** the attachment of the muscle to the bone that remains stationary
- **Insertion:** the attachment of the muscle to the bone that moves
- **Belly:** the fleshy part of the muscle between the tendons of origin and/or insertion

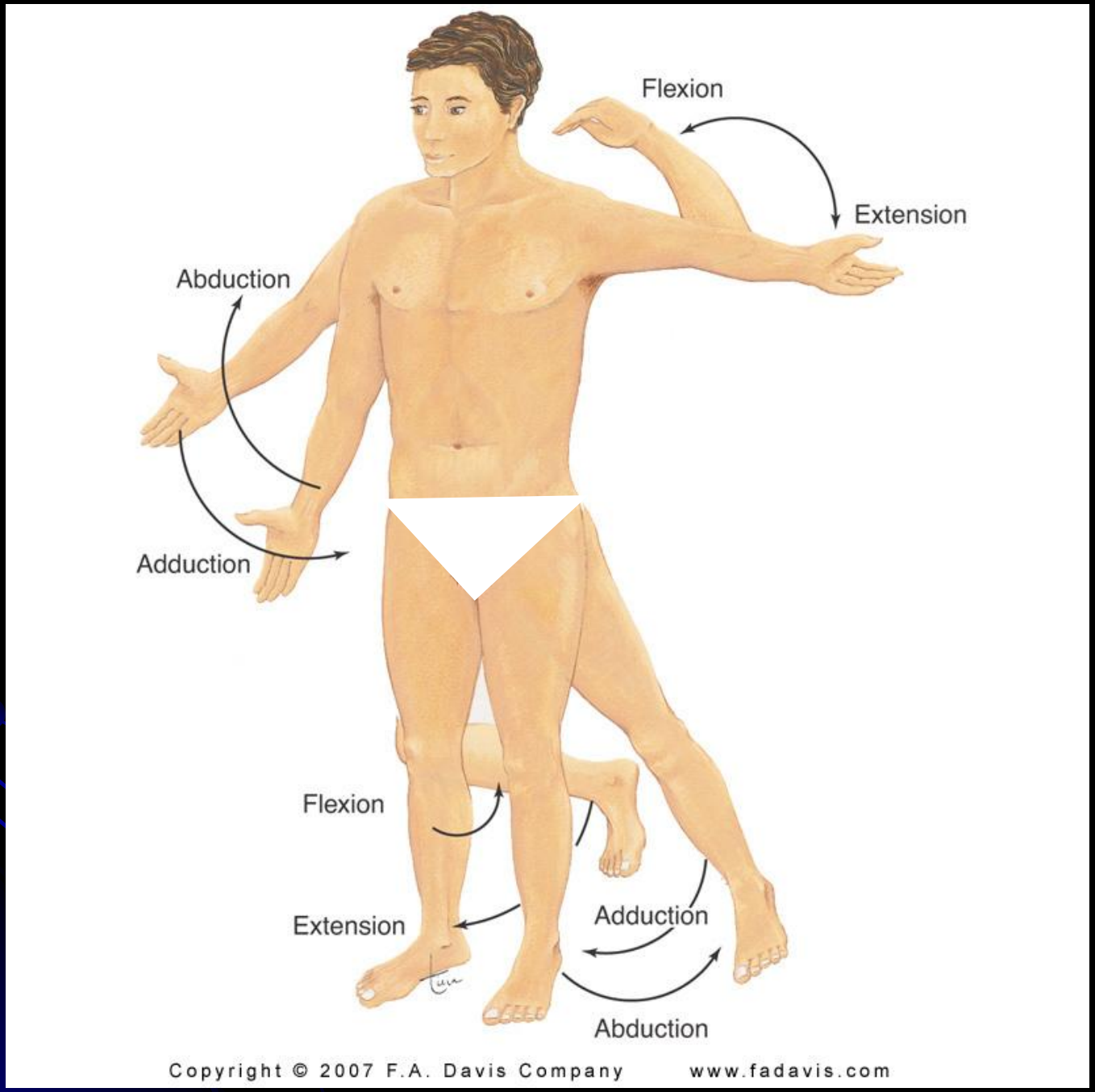


Movement of skeletal muscle

- These muscles move when the brain sends messages to the muscle
- Always work in pairs
- 2 movements of skeletal muscle
  - Contraction (shorten)
  - Extension (lengthen)

Categories of skeletal muscle actions

Categories	Actions
Extensor	Increases the angle at a joint
Flexor	Decreases the angle at a joint
Abductor	Moves limb away from midline of body
Adductor	Moves limb toward midline of body
Levator	Moves insertion upward
Depressor	Moves insertion downward
Rotator	Rotates a bone along its axis
Sphincter	Constricts an opening


Flexion
Extension
Abduction
Adduction
Flexion
Extension
Adduction
Abduction
Copyright © 2007 F.A. Davis Company
www.fadavis.com

Practice these Movements

1. **Bend arm**
   - **biceps → contract**
   - **triceps → extend**
2. **Straighten arm**
   - **biceps → extend**
   - **triceps → contract**
3. **Bend knee**
   - **quadriceps → extend**
   - **hamstrings → contract**

More Movements

4. Straighten knee
   - quadriceps → contract
   - hamstrings → extend
5. Crunches
   - abdomen → contract
   - back muscles → extend
6. Point toes
   - calf muscle → contract
   - shin muscle → extend

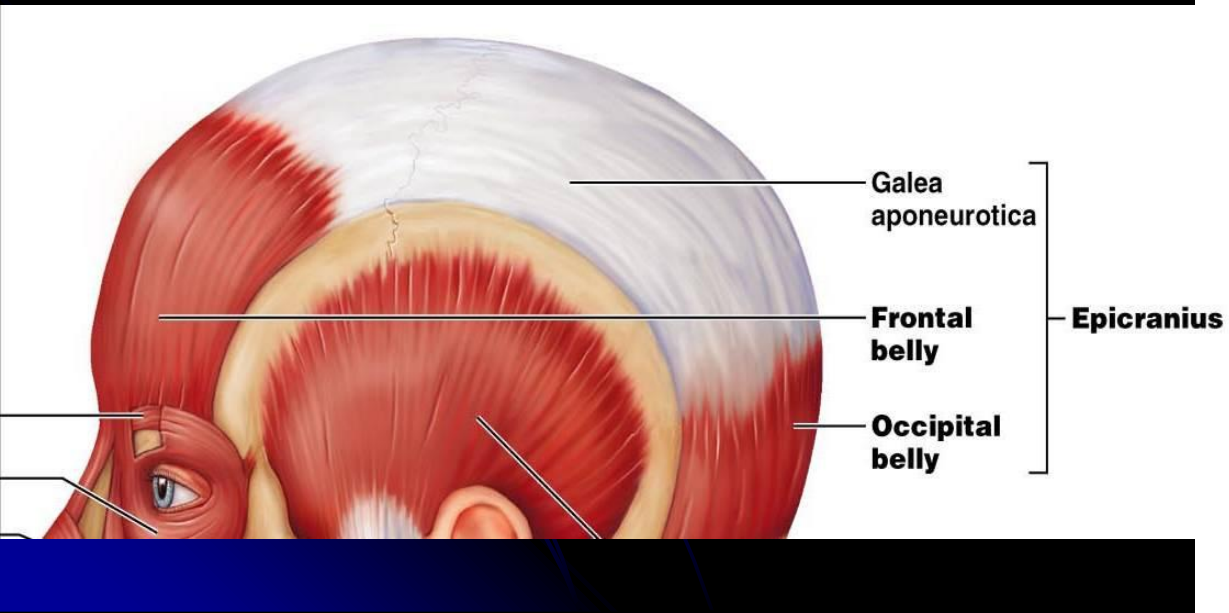
Naming Skeletal Muscles

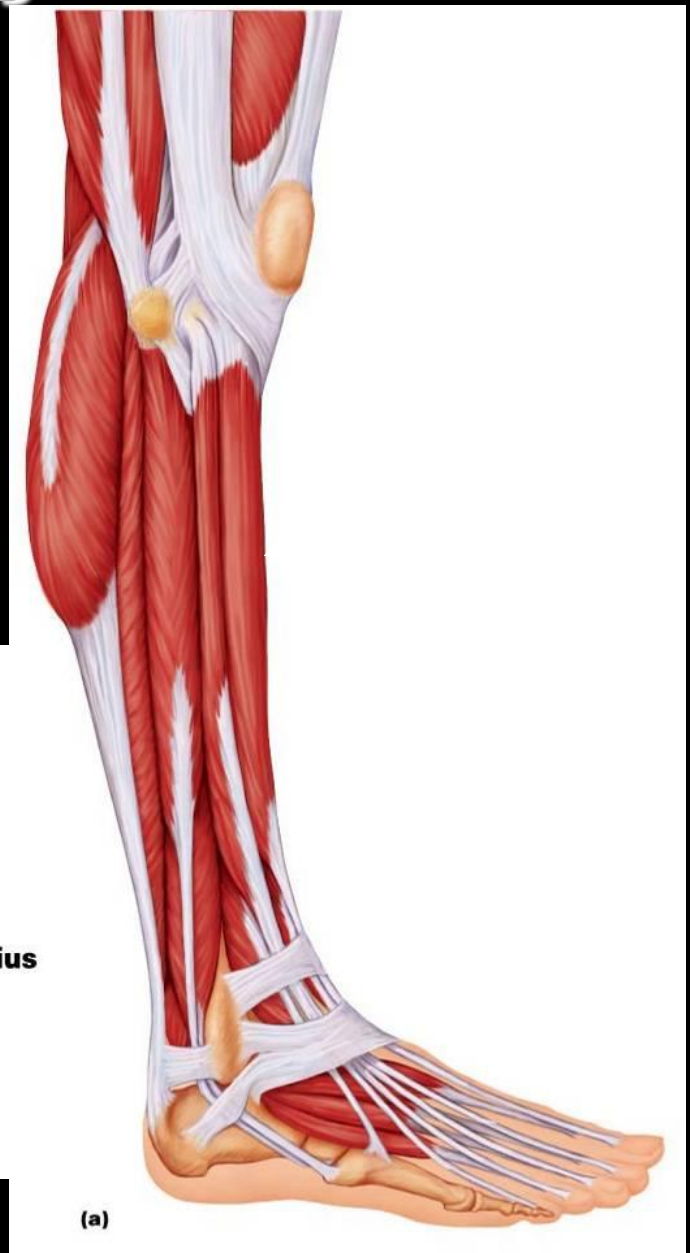
- Location of the muscle
- Shape of the muscle
- Relative Size of the muscle
- Direction/Orientation of the muscle fibers/cells
- Number of Origins
- Location of the Attachments
- Action of the muscle


STOP

Muscles Named by Location

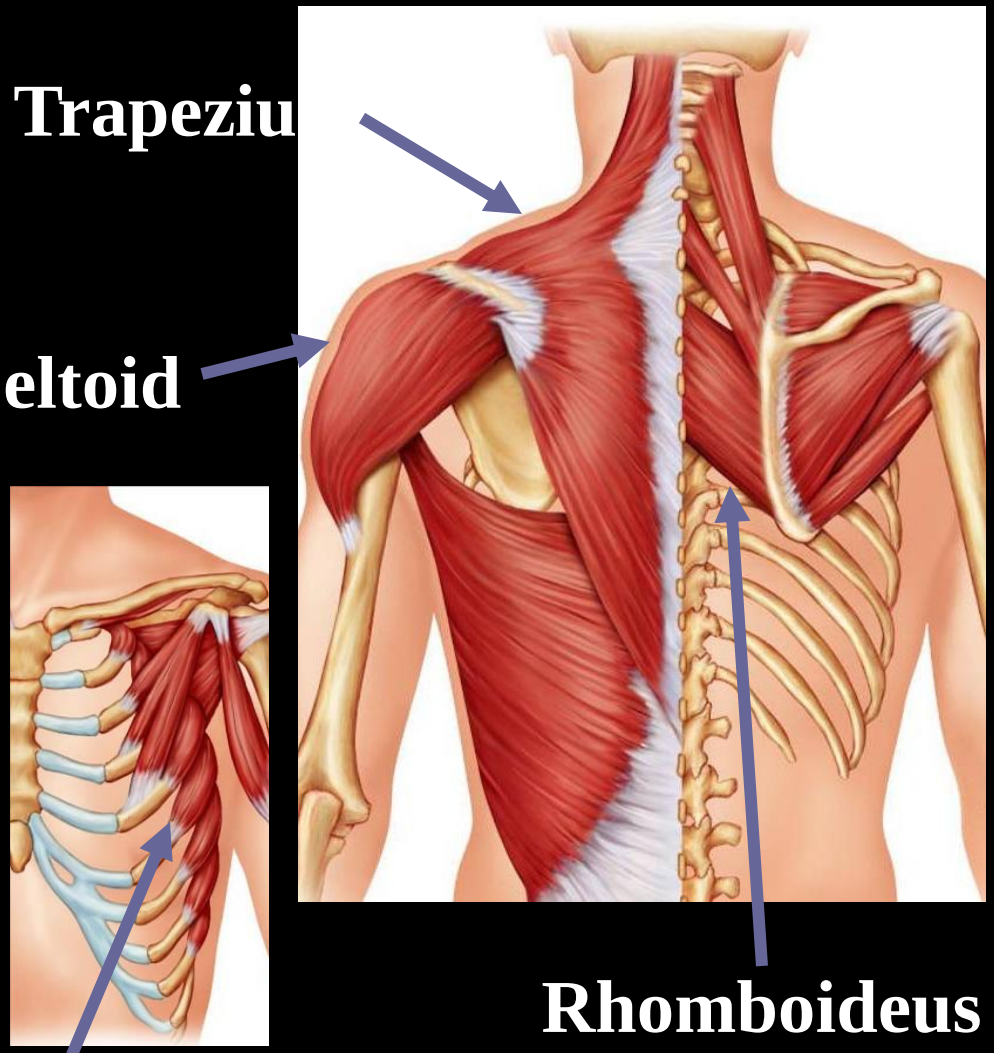
- **Epicranius**
  (around cranium)
- **Tibialis anterior**
  (front of tibia)





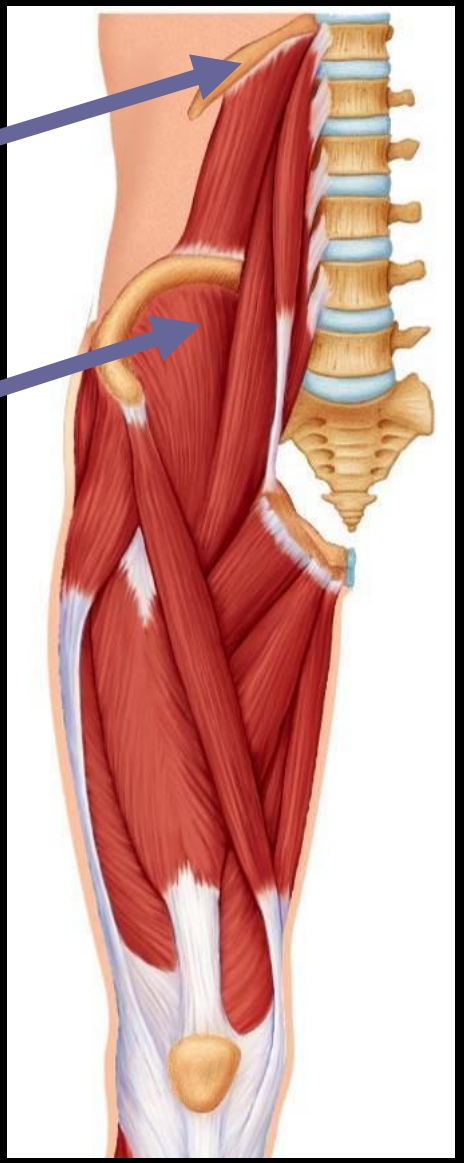
Naming Skeletal Muscles

- **Shape:**
  - deltoid (triangle)
  - trapezius (trapezoid, 2 parallel sides)
  - serratus (saw-toothed)
  - rhomboideus (rhomboid, 4 parallel sides)
  - orbicularis and sphincters (circular)



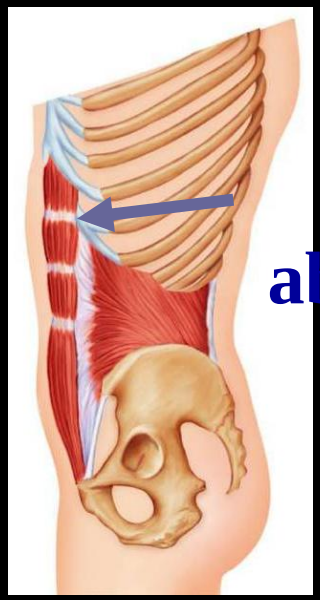
Muscles Named by Size

- maximus (largest)
- minimis (smallest)
- longus (longest)
- brevis (short)
- major (large)
- minor (small)

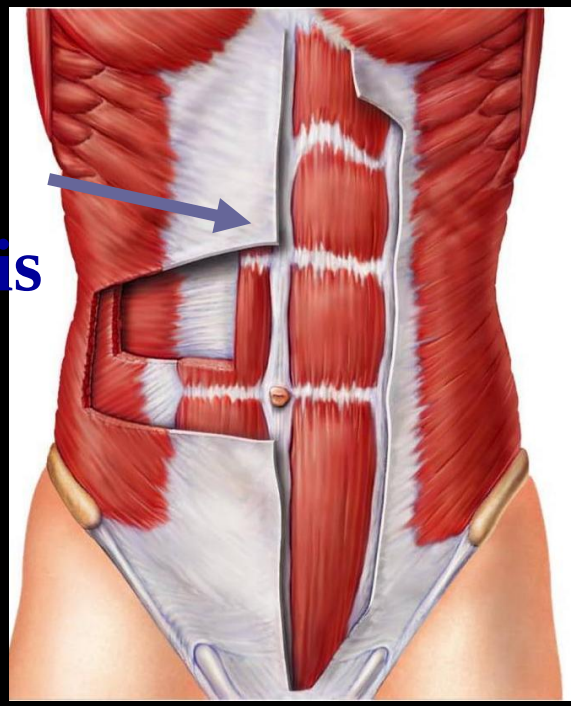


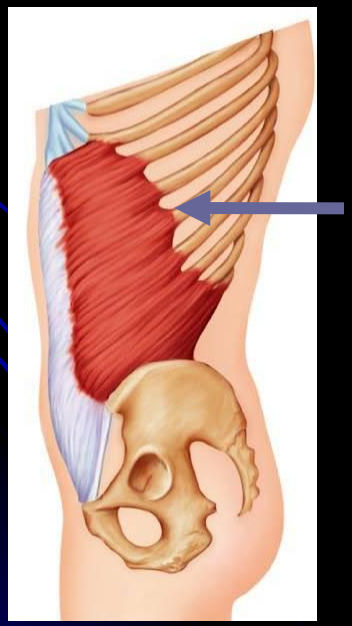
Muscles Named by Direction of Fibers

- Rectus (straight) –parallel to long axis
- Transverse
- Oblique



Rectus abdominis

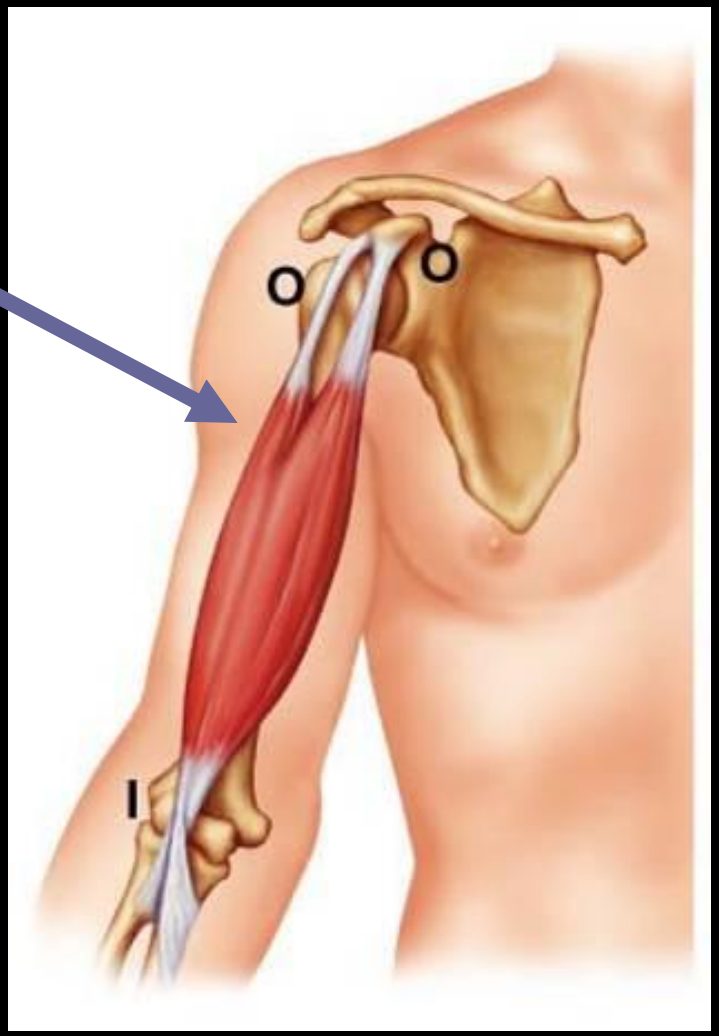




External oblique

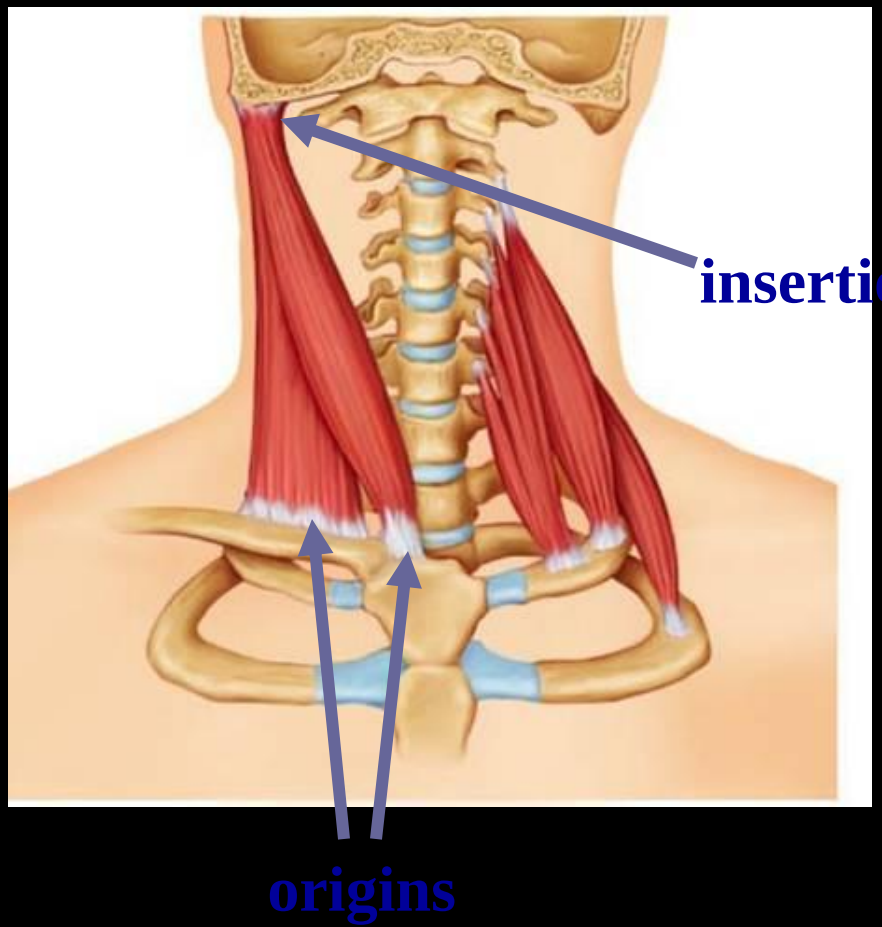
Muscles Named for Number of Origins

- Biceps (2)
- Triceps (3)
- Quadriceps (4)



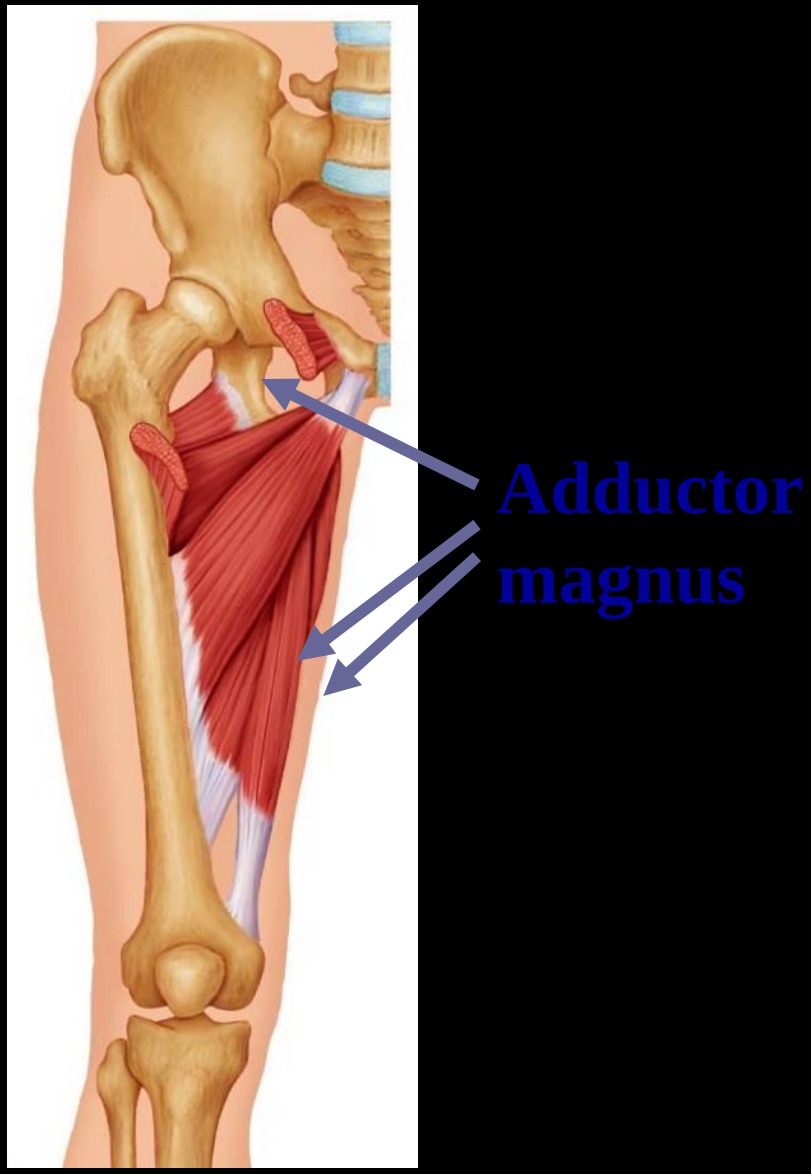
Muscles Named for Origin and Insertion

Sternocleidomastoid originates from sternum and clavicle and inserts on mastoid process of temporal bone



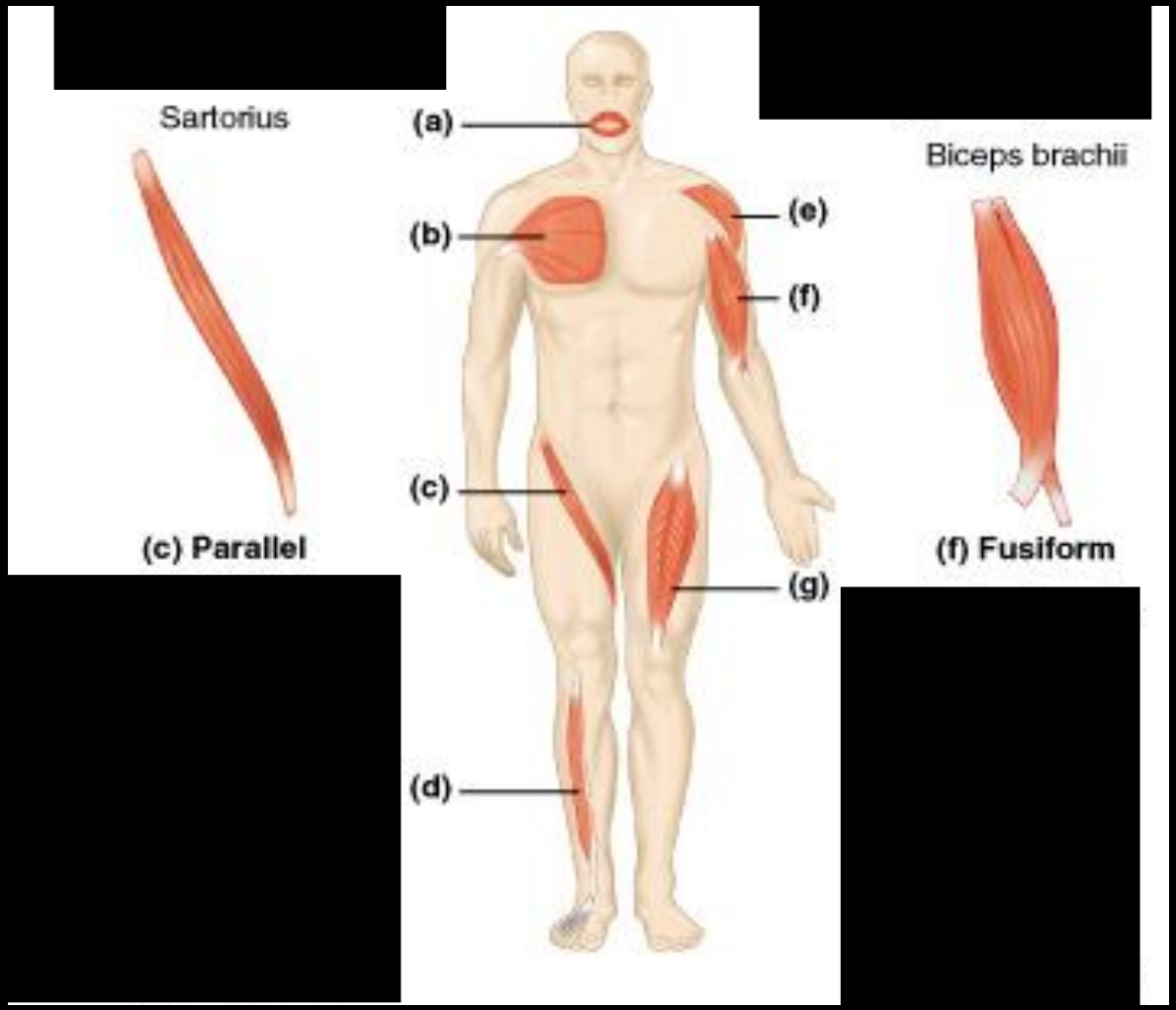
Muscles Named for Action

- Flexor carpi radialis (extensor carpi radialis)
  - flexes wrist
- Abductor pollicis brevis (adductor pollicis)
  - flexes thumb
- Abductor magnus
  - abducts thigh
- Extensor digitorum
  - extends fingers



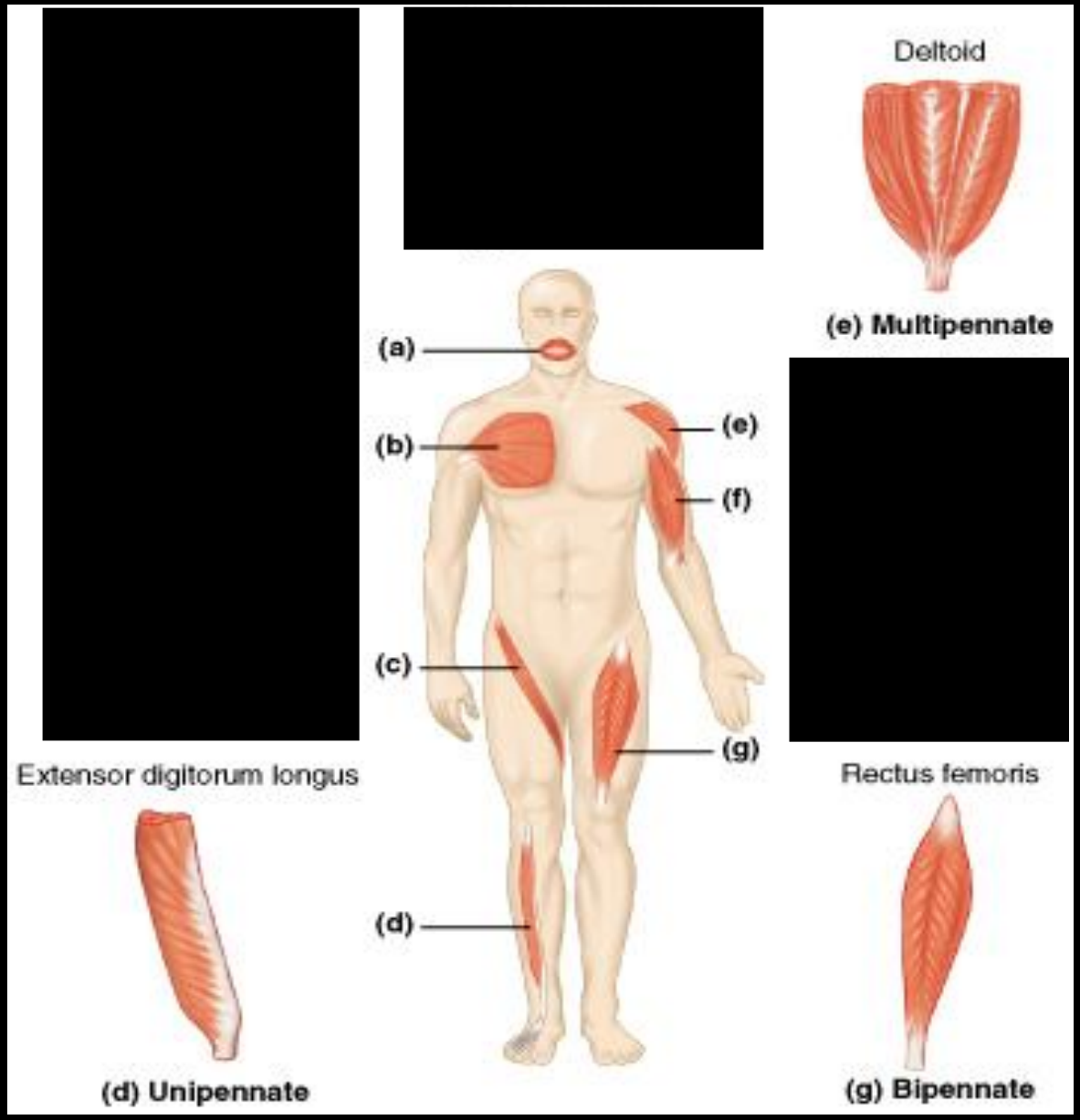
Arrangement of Fascicles

- **Parallel**
  - strap-like
  - ex: sartorius
- **Fusiform**
  - spindle shaped
  - ex: biceps femor



Arrangement of Fascicles

- **Pennate**
  - "feather shaped"
- **Unipennate**
  - ex: extensor digitorum longus
- **Bipennate**
  - ex: rectus femoris
- **Multipennate**
  - ex: deltoid



Arrangement of Fascicles

- **Convergent**
  - ex: pectoralis major
- **Circular**
  - sphincters
  - ex: orbicularis oris