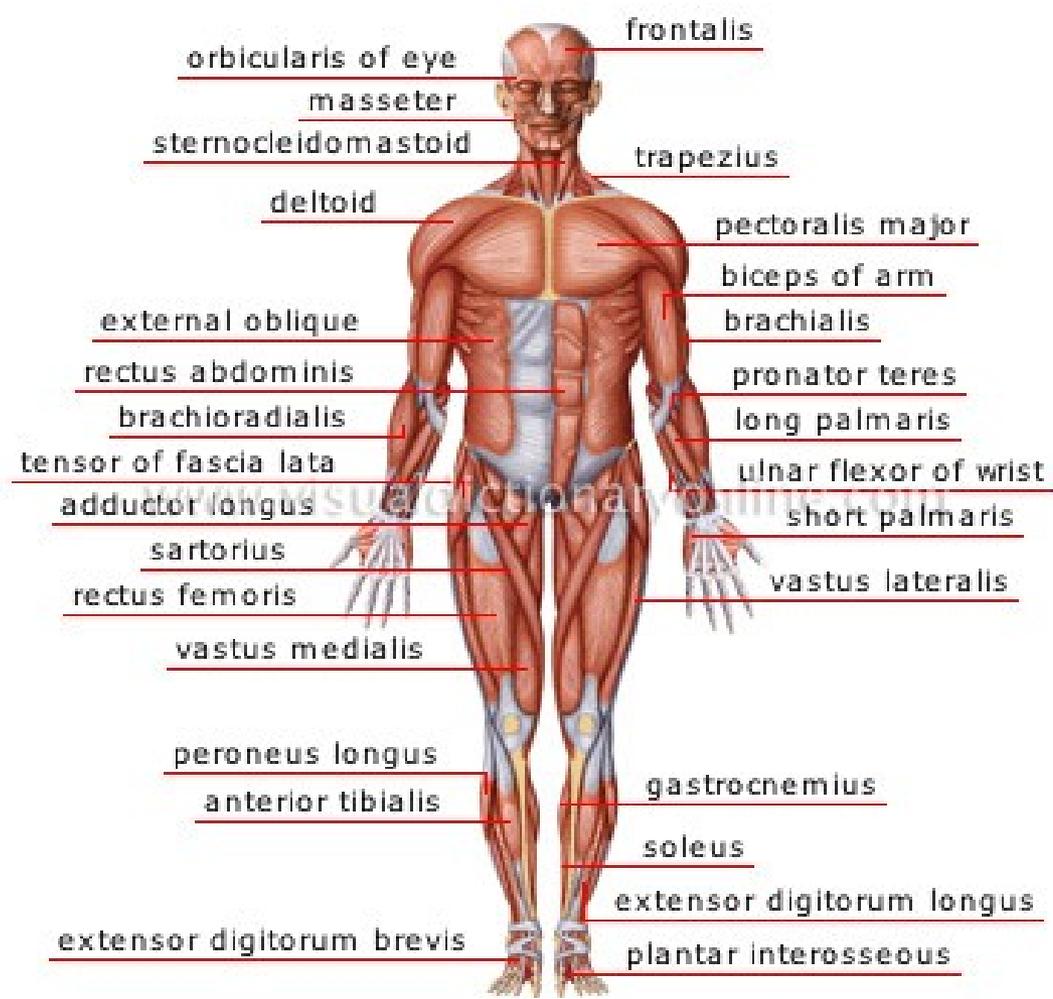


# The Muscular System

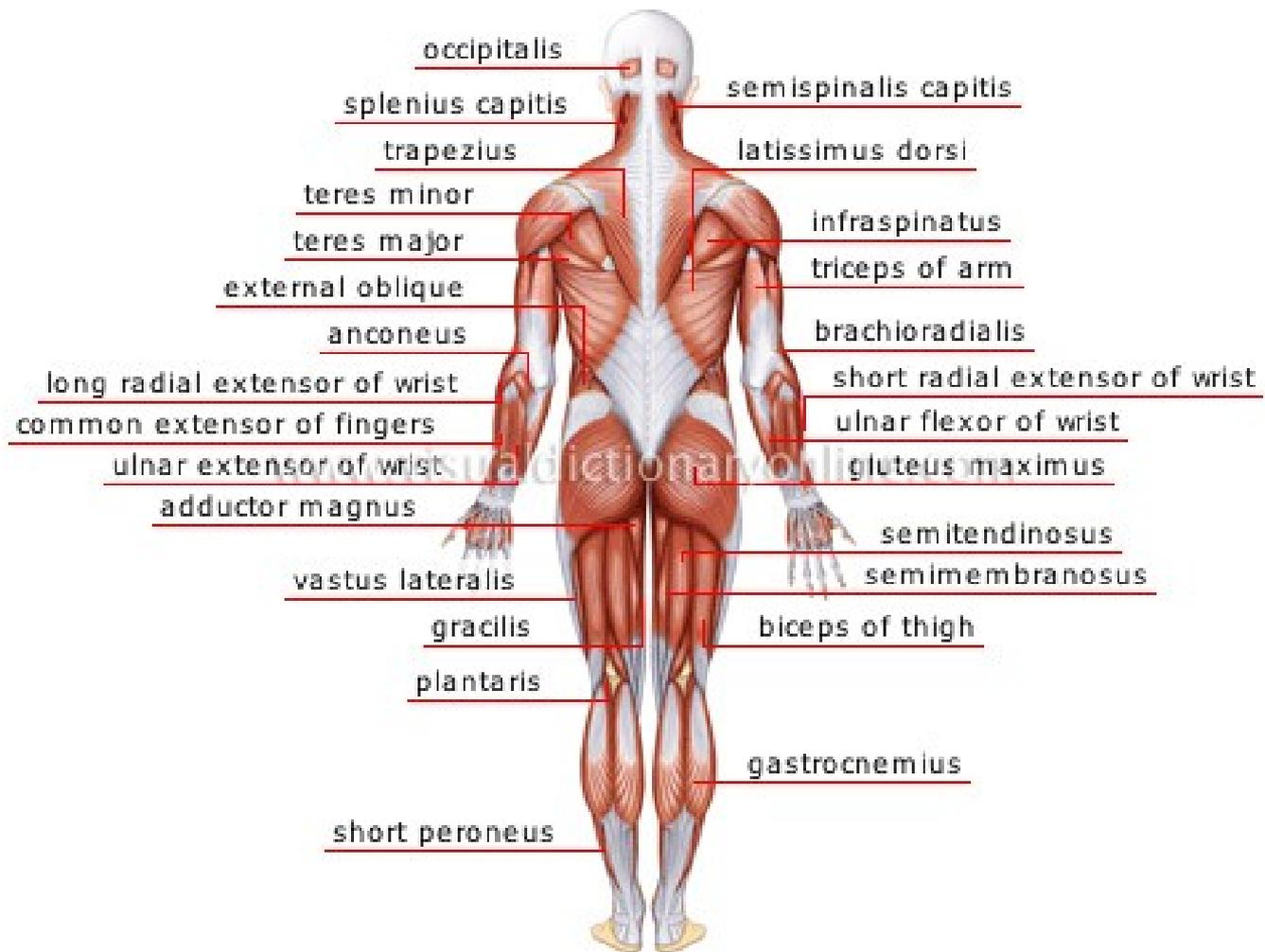
Specialized tissue that enable the body and its parts to move.



# Anterior View



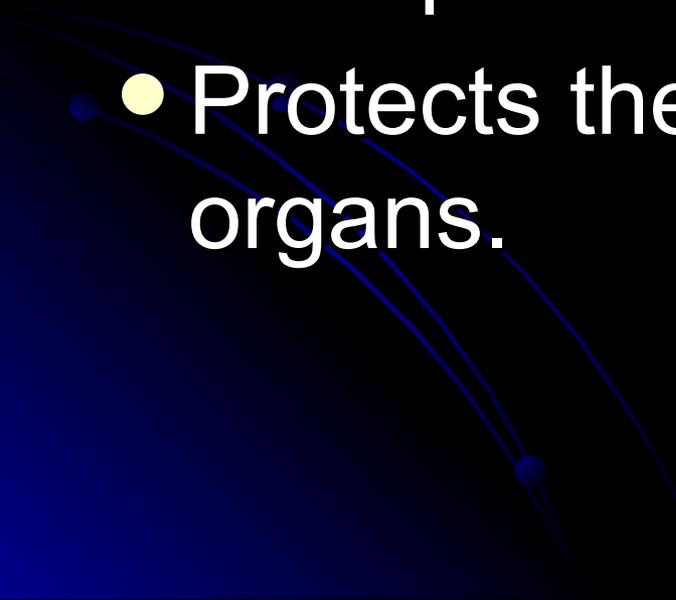
# Posterior View



# 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.

# 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

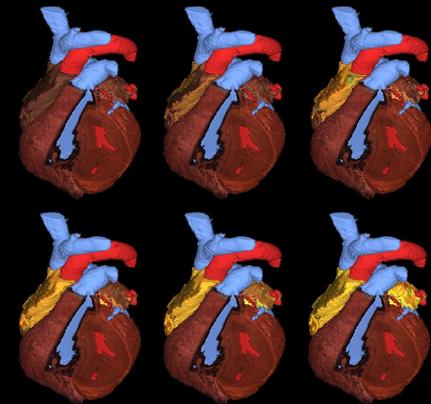
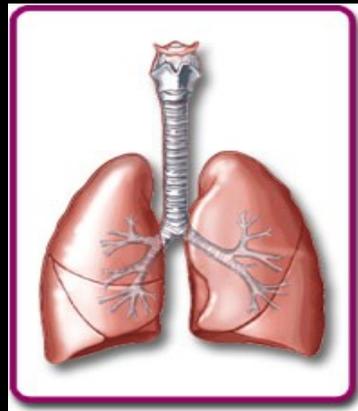
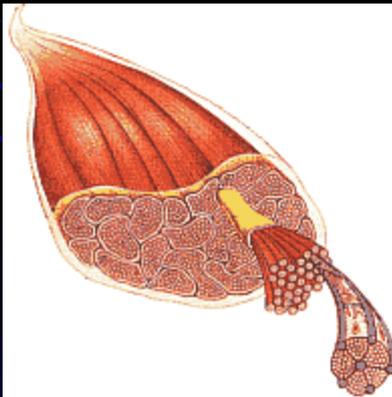
# The 3 Types of Muscles

Types of Muscle

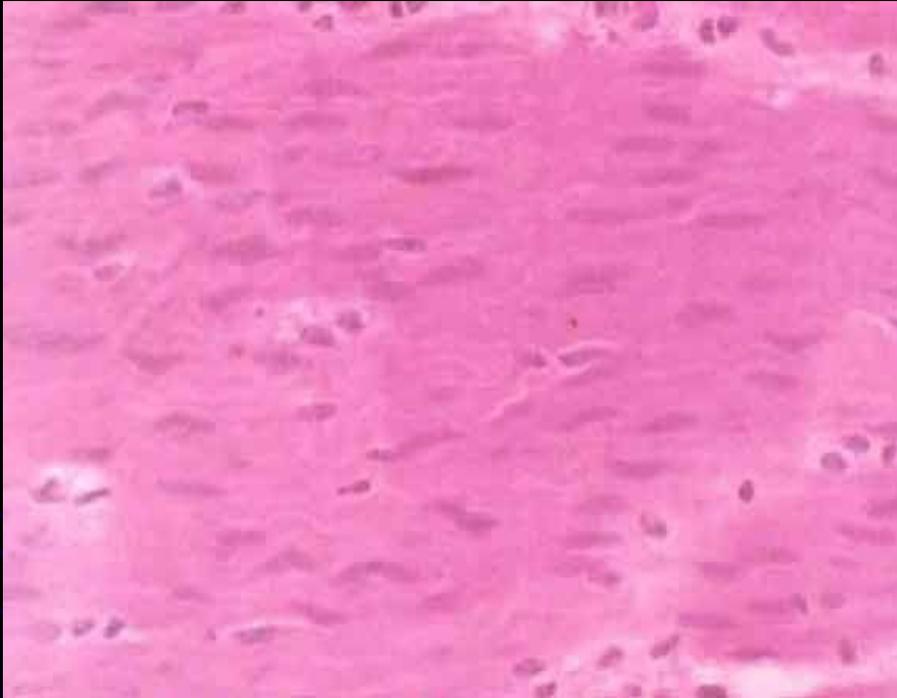
Skeletal Muscle

Smooth Muscle

Cardiac Muscle



# Smooth Muscle

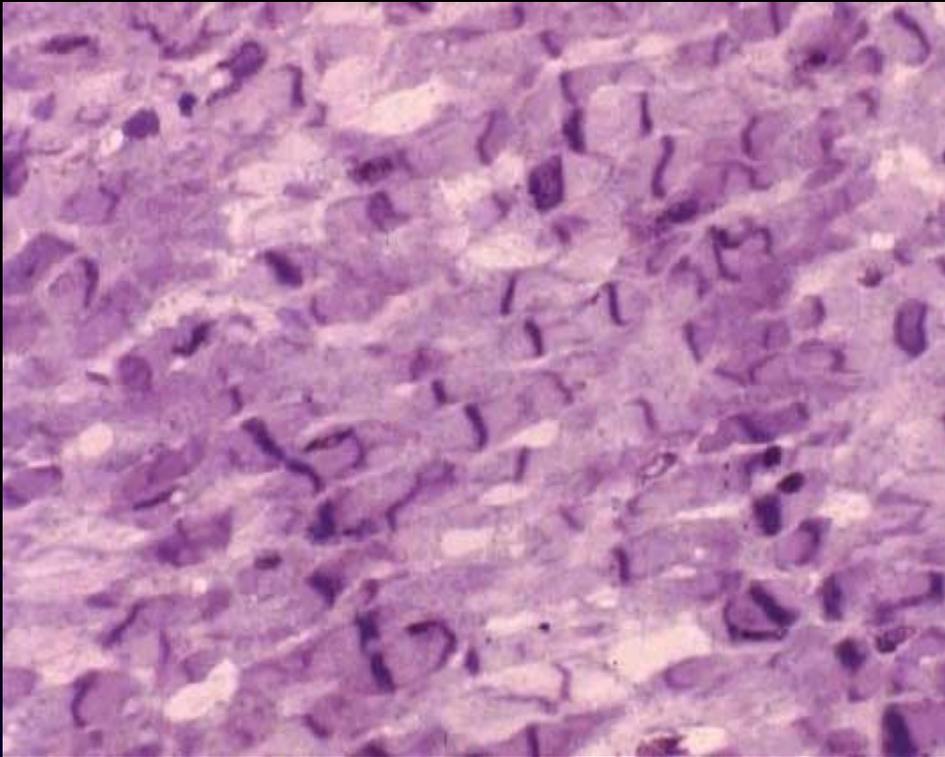


- Fibers are thin and spindle shaped.
- No striations
- Single nuclei
- Involuntary
- Contracts slowly

# Smooth Muscle

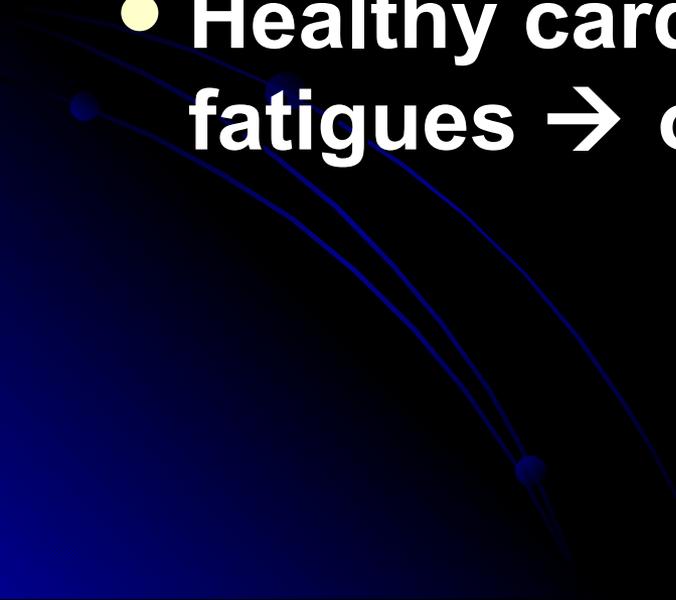
- **They fatigue... but very slowly**
- **Found in the circulatory system**
  - **Lining of the blood vessels**
  - **Helps in the circulation of the blood**
- **Found in the digestive system**
  - **Esophagus, stomach, intestine**
  - **Controls digestion**
- **Found in the respiratory system**
  -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

# Cardiac Muscle

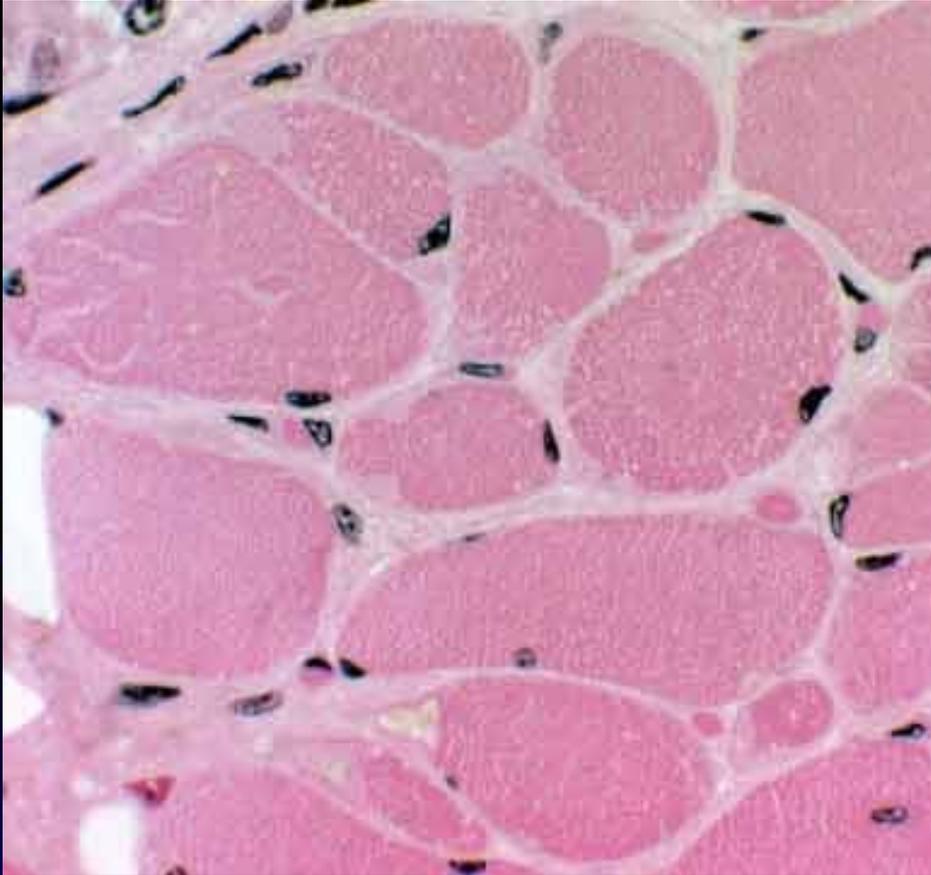


- Cells are branched and appear fused with one another
- Has striations
- Each cell has a central nuclei
- Involuntary

# Cardiac Muscle

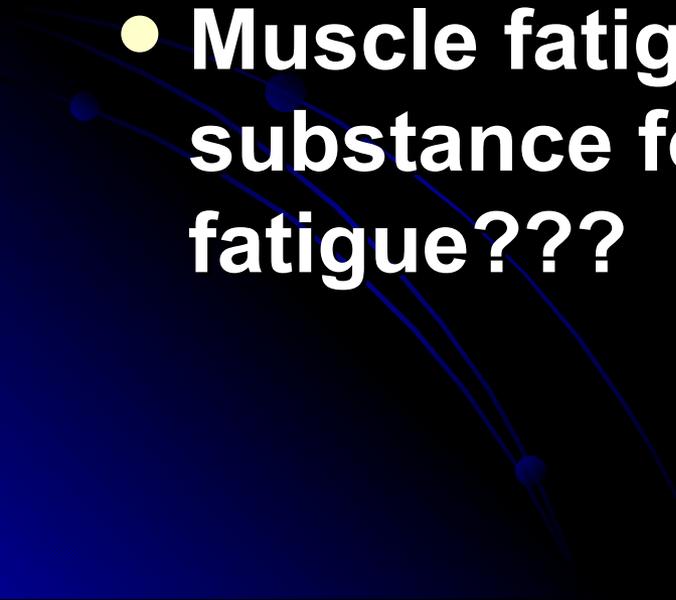
- Found **ONLY** in the heart
  - Contractions of the heart muscles pump blood throughout the body and account for the heartbeat.
  - Healthy cardiac muscle **NEVER** fatigues → or else...
- 

# Skeletal Muscle

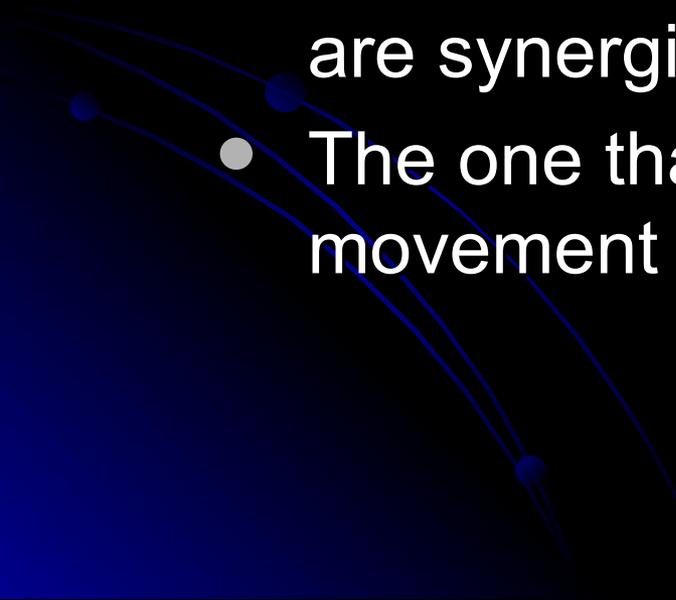


- Fibers are long and cylindrical
- Has many nuclei
- Has striations
  - Have alternating dark and light bands
- Voluntary

# 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???**
- 

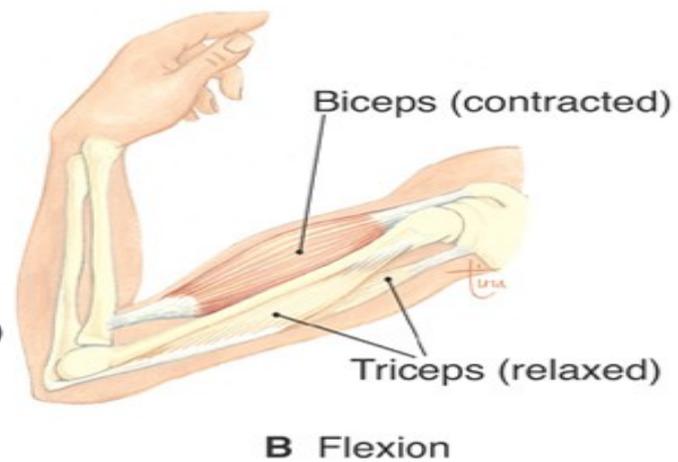
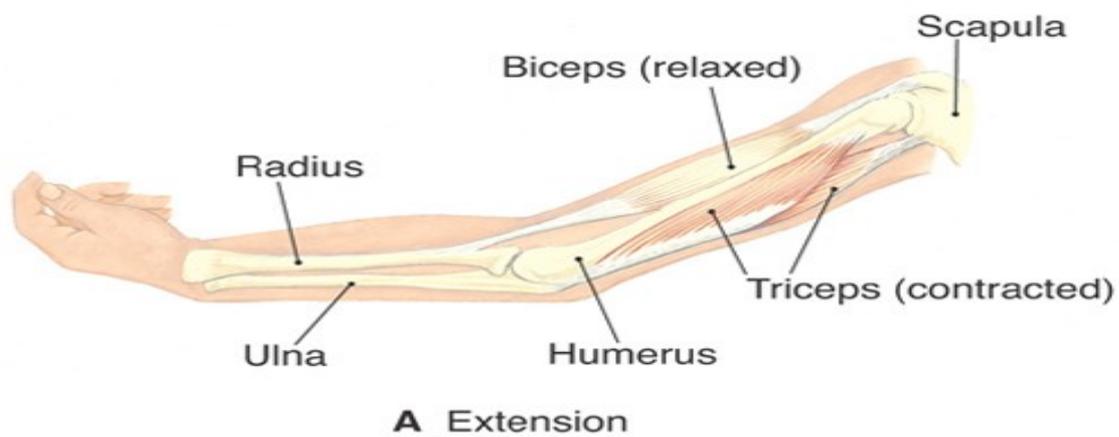
# Functions of Skeletal Muscle

- 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.



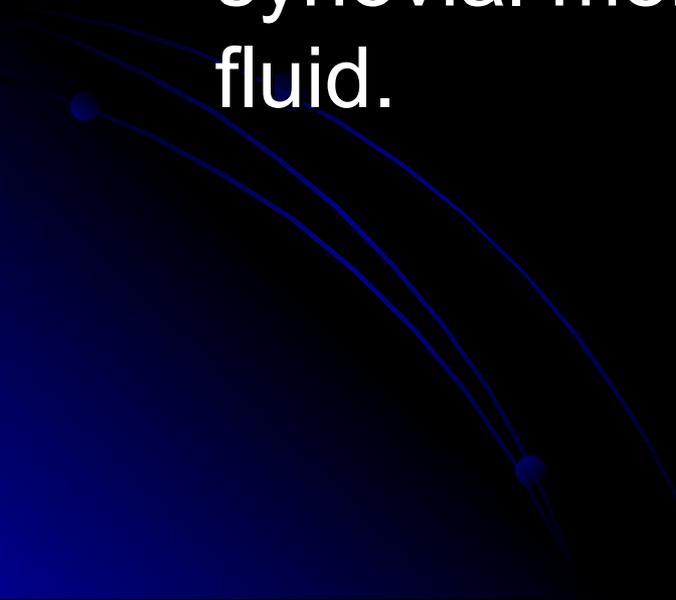
# Functions of Skeletal Muscle

- 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.

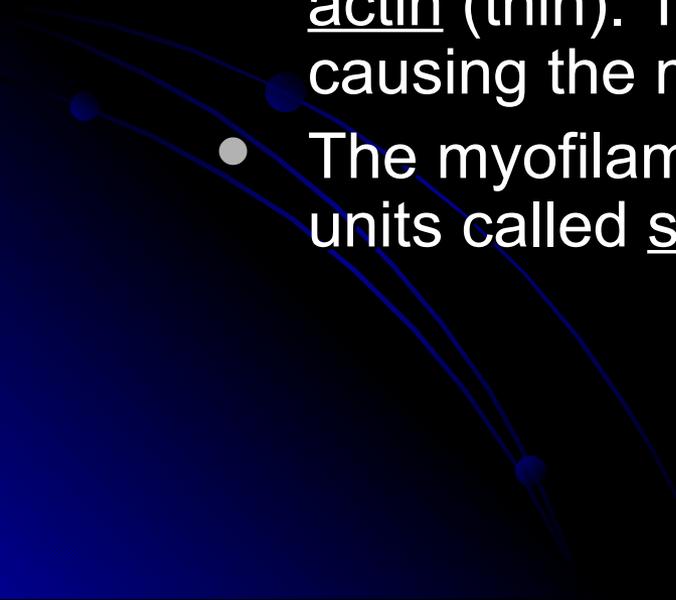
# Structure of Skeletal Muscle

- 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.
- 

# Structure of Skeletal Muscle

- Contribution of the nervous system
  - Electrochemical impulses travel from the frontal lobes of the cerebrum via motor nerves to the muscle fibers and cause them to contract.
  - Sensation is a function of the brain – impulses are integrated in the parietal lobes of the cerebrum (conscious muscle sense) and in the cerebellum (unconscious). These activities promote coordination.

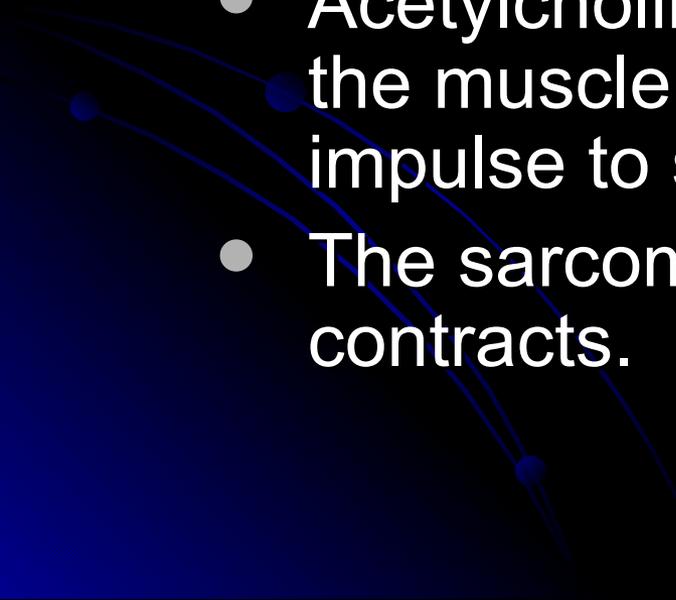
# Structure of Skeletal Muscle

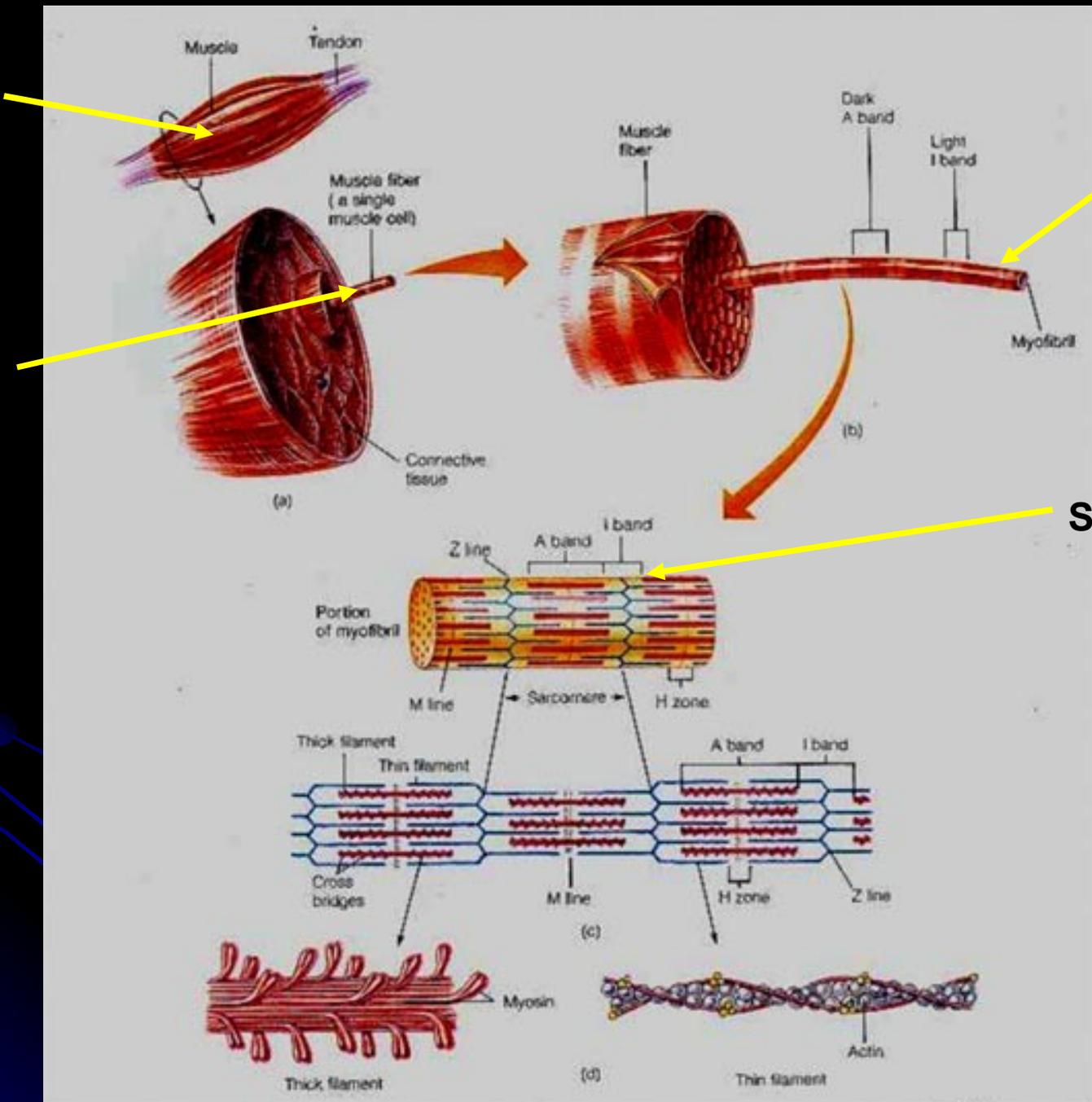
- Microscopic anatomy
    - Muscle cells (fibers) are grouped in a highly organized way in the muscle. The membrane that surrounds the muscle cell is called the sarcolemma.
    - Muscle cells are filled with 2 types of fine threadlike proteins called myofilaments: myosin (thick) and actin (thin). These structures slide past each other causing the muscle cell to contract or shorten.
    - 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.

# 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.
- 



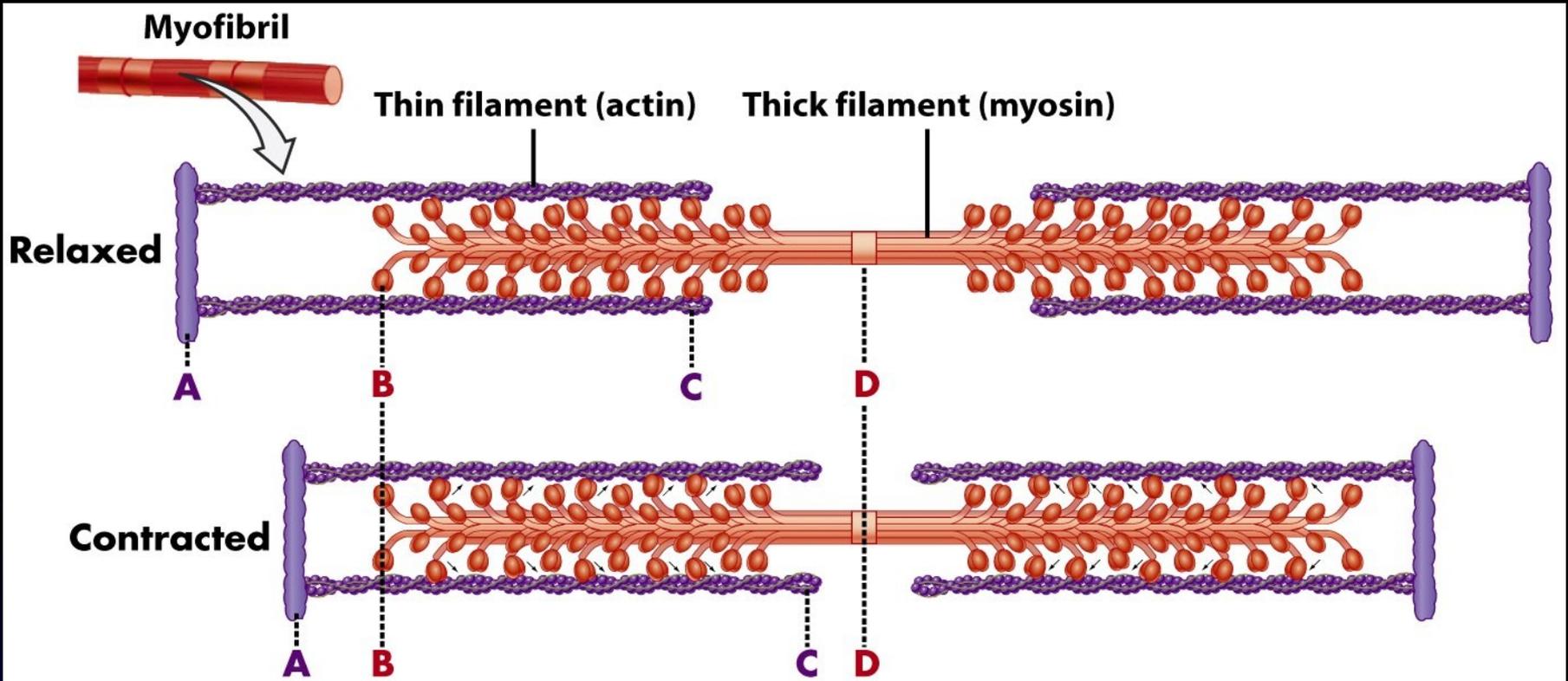
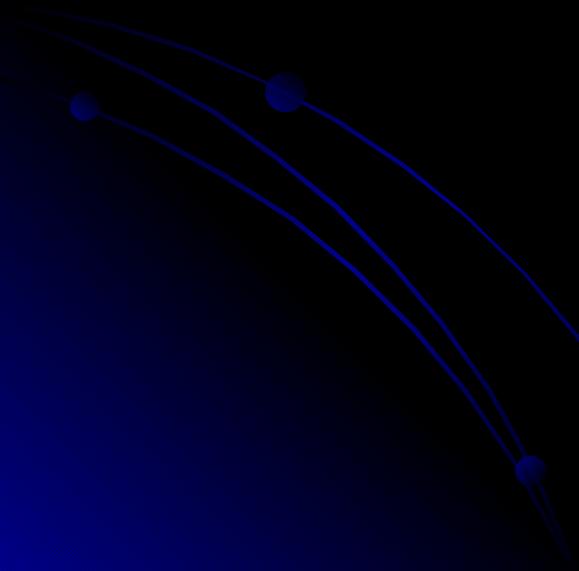
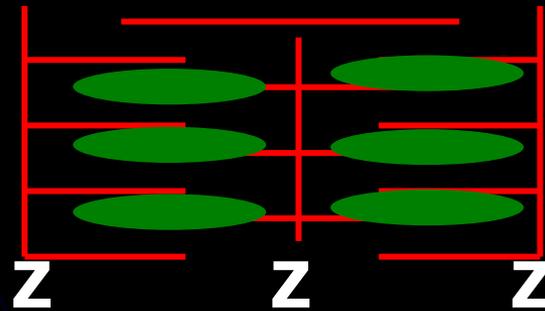
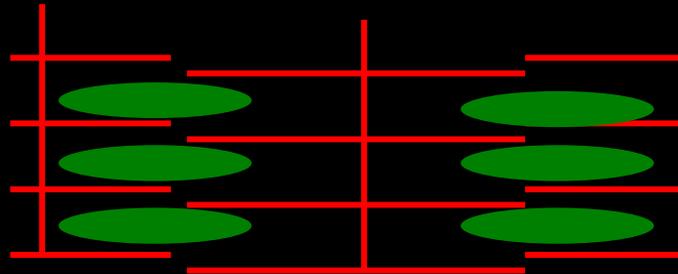
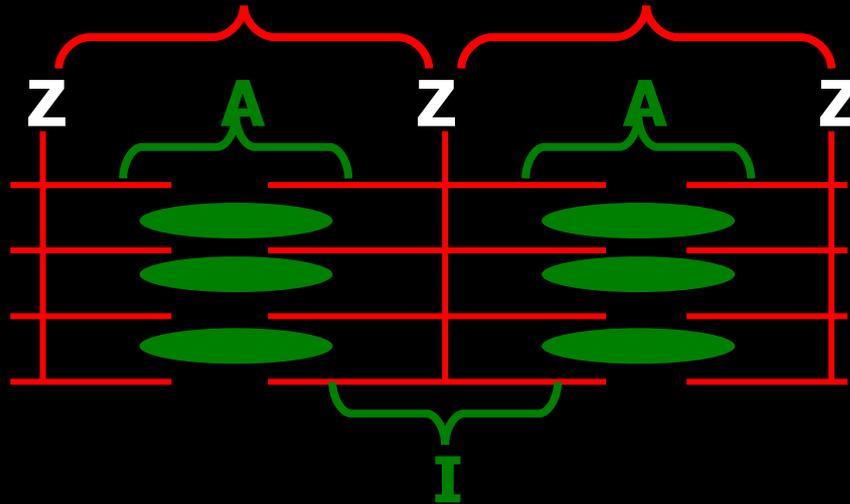


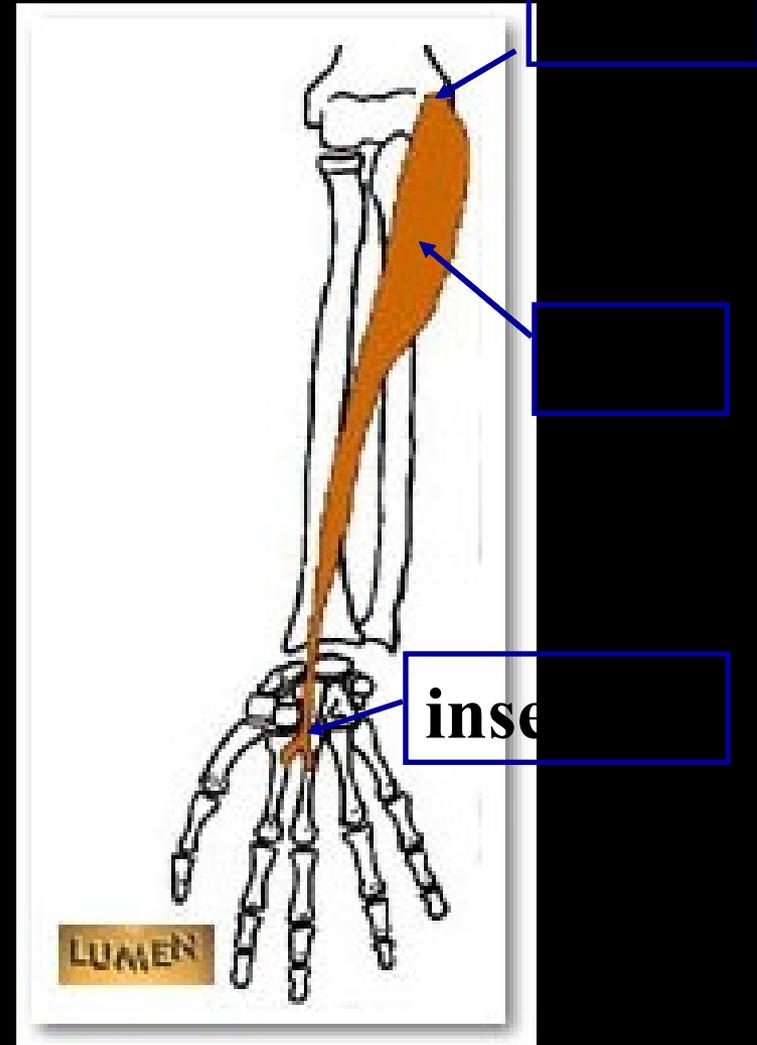
Figure 46-21 Biological Science, 2/e  
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# Sarcomere

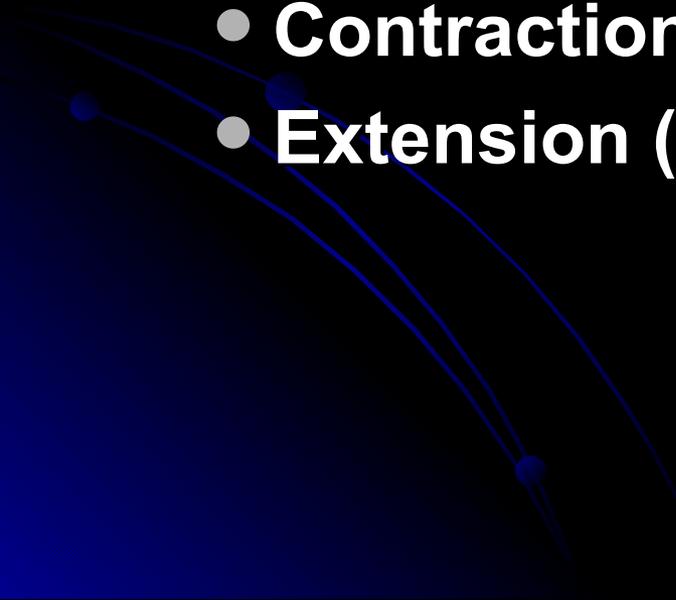


# Movement of Muscles

- **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

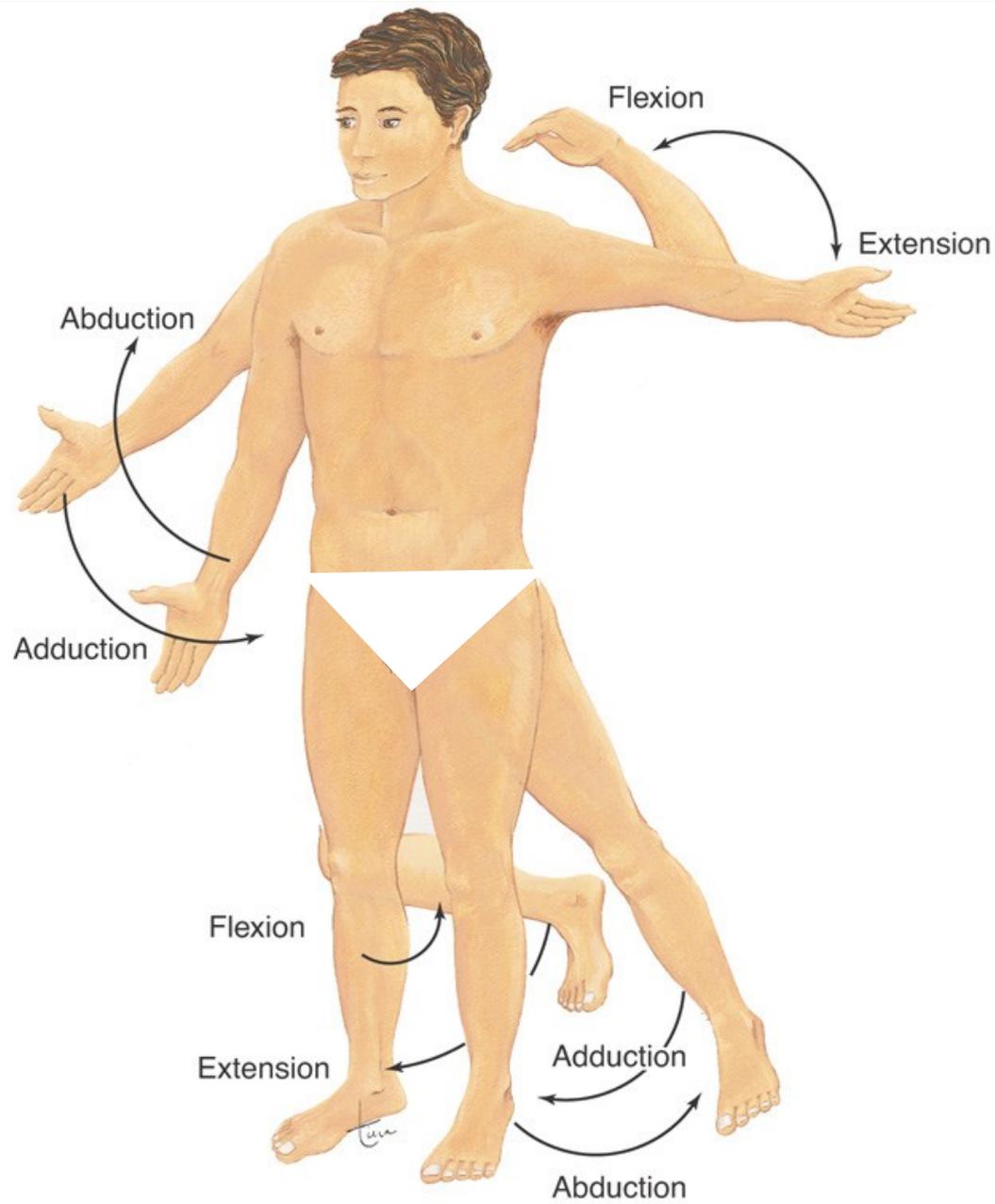


# Movement of skeletal muscle

- **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



# 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

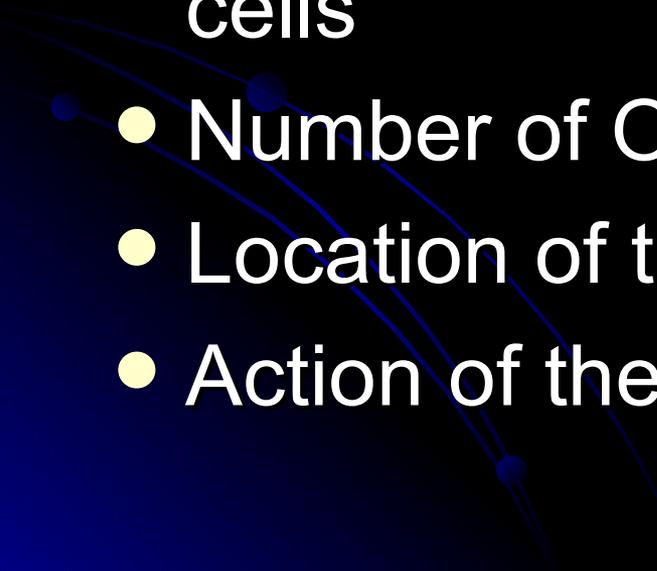
## 5. Crunches

- abdomen → contract
- back muscles → extend

## 7. Point toes

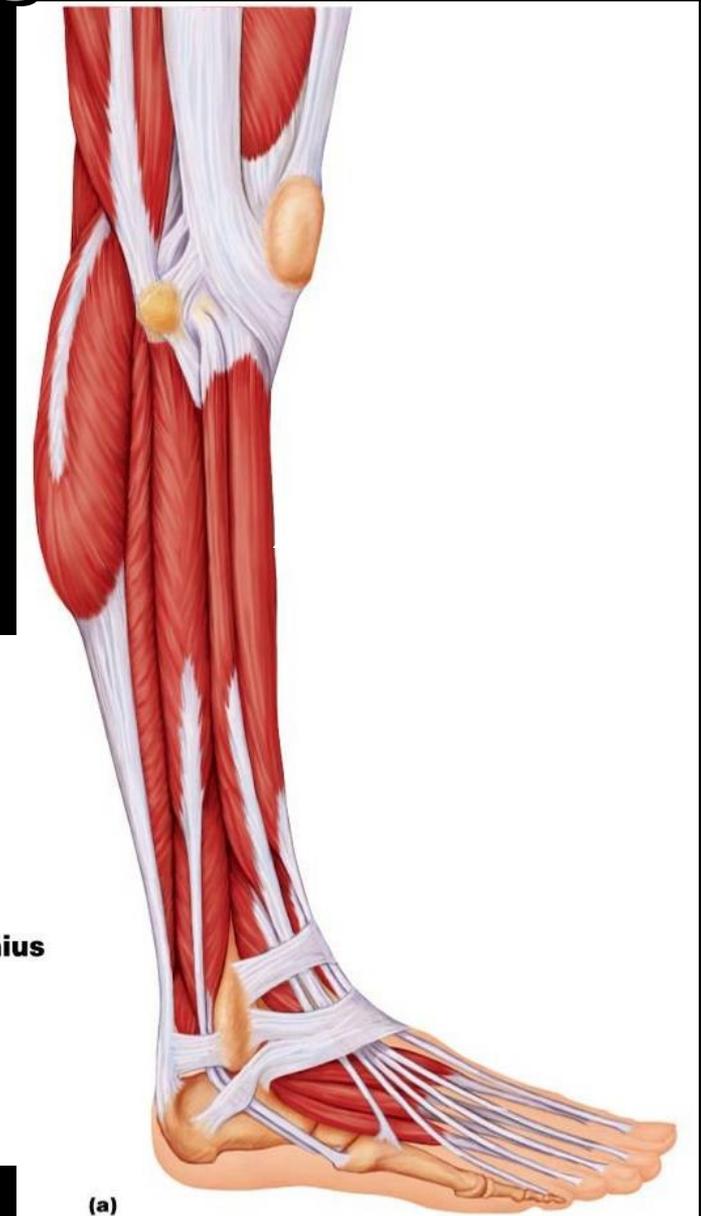
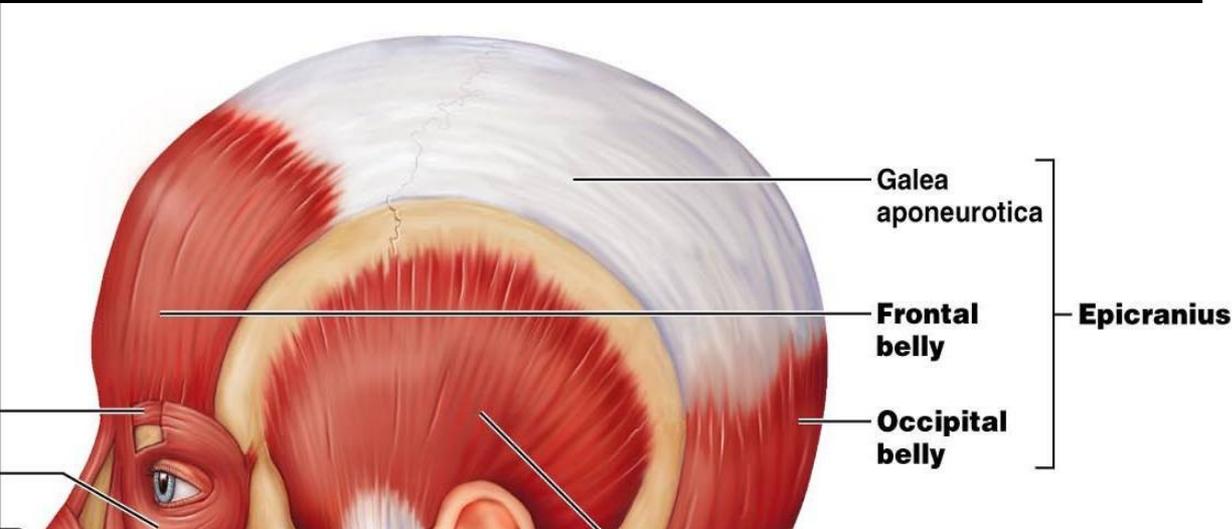
- calf muscle → contract
- shin muscle → extend

# 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
- 

# Muscles Named by Location

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



# Naming Skeletal Muscles

- **Shape:**

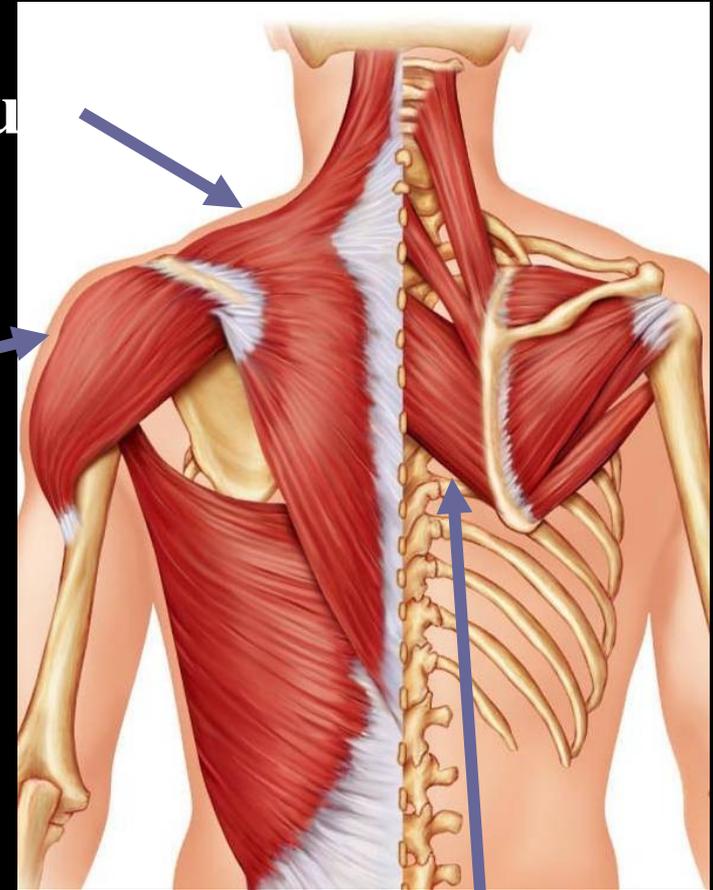
- deltoid (triangle)
- trapezius (trapezoid, 2 parallel sides)
- serratus (saw-toothed)
- rhomboideus (rhomboid, 4 parallel sides)
- orbicularis and sphincters (circular)

**Trapezius**

**Deltoid**



**Serratus anterior**



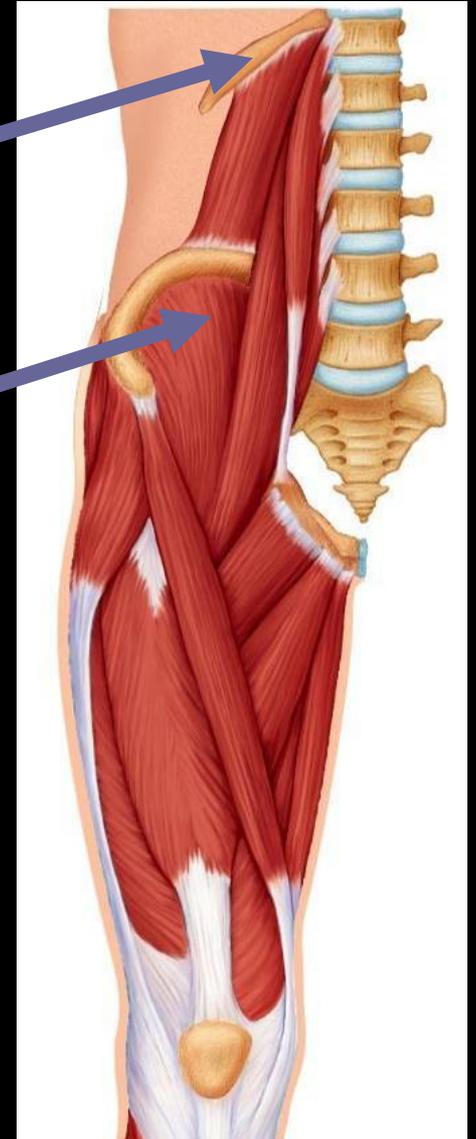
**Rhomboideus major**

# Muscles Named by Size

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

**Psoas  
minor**

**Psoas  
major**



# Muscles Named by Direction of Fibers

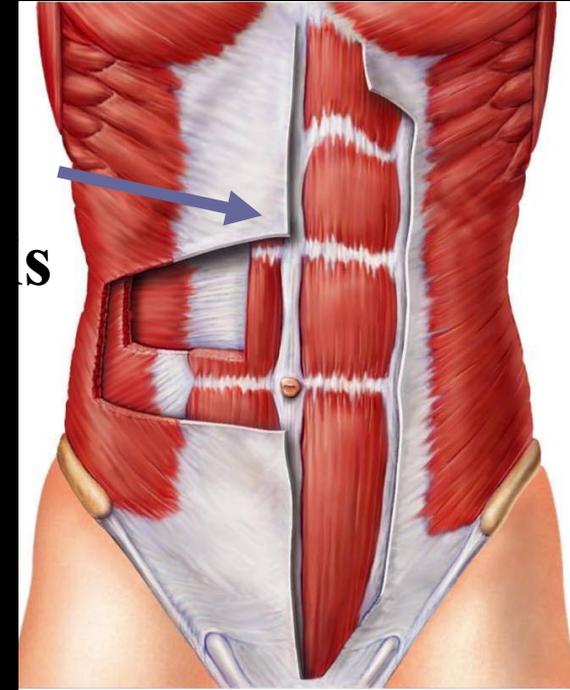
- Rectus (straight)  
–parallel to long axis

- Transverse

- Oblique



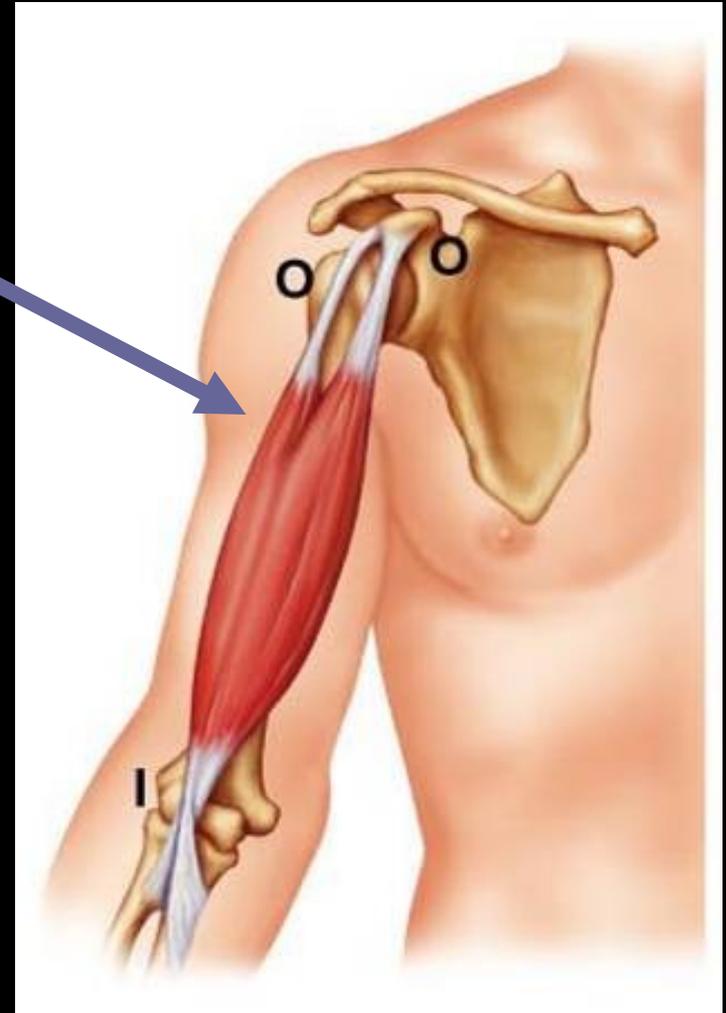
**External oblique**



# Muscles Named for Number of Origins

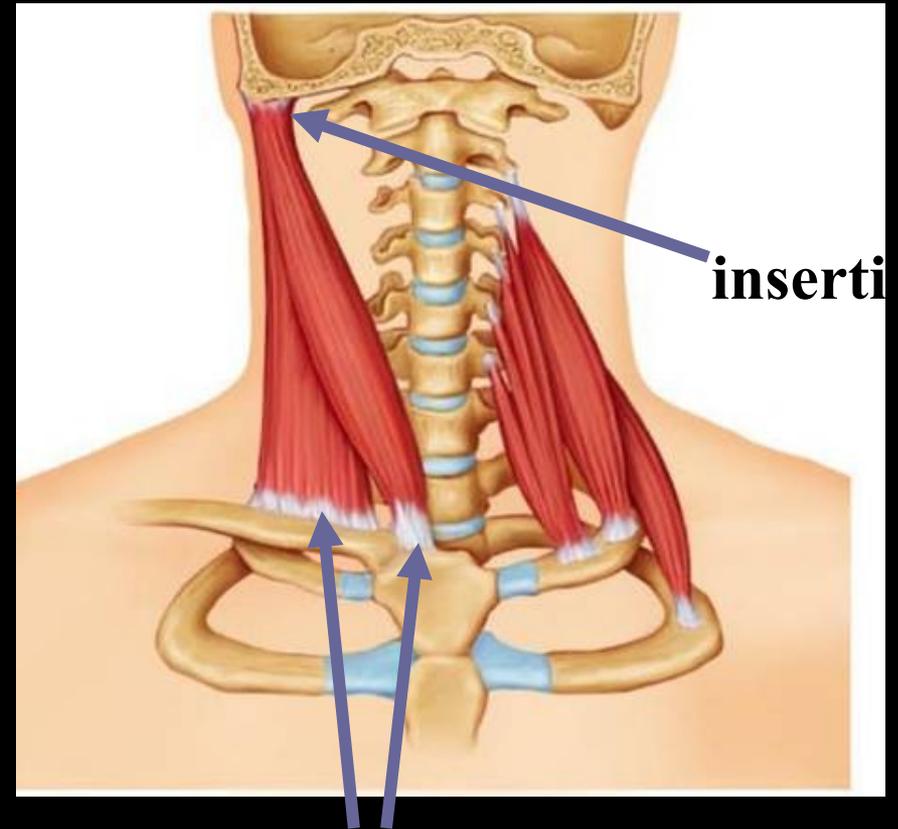
- Biceps (2)
- Triceps (3)
- Quadriceps (4)

**Biceps  
brachii**



# 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



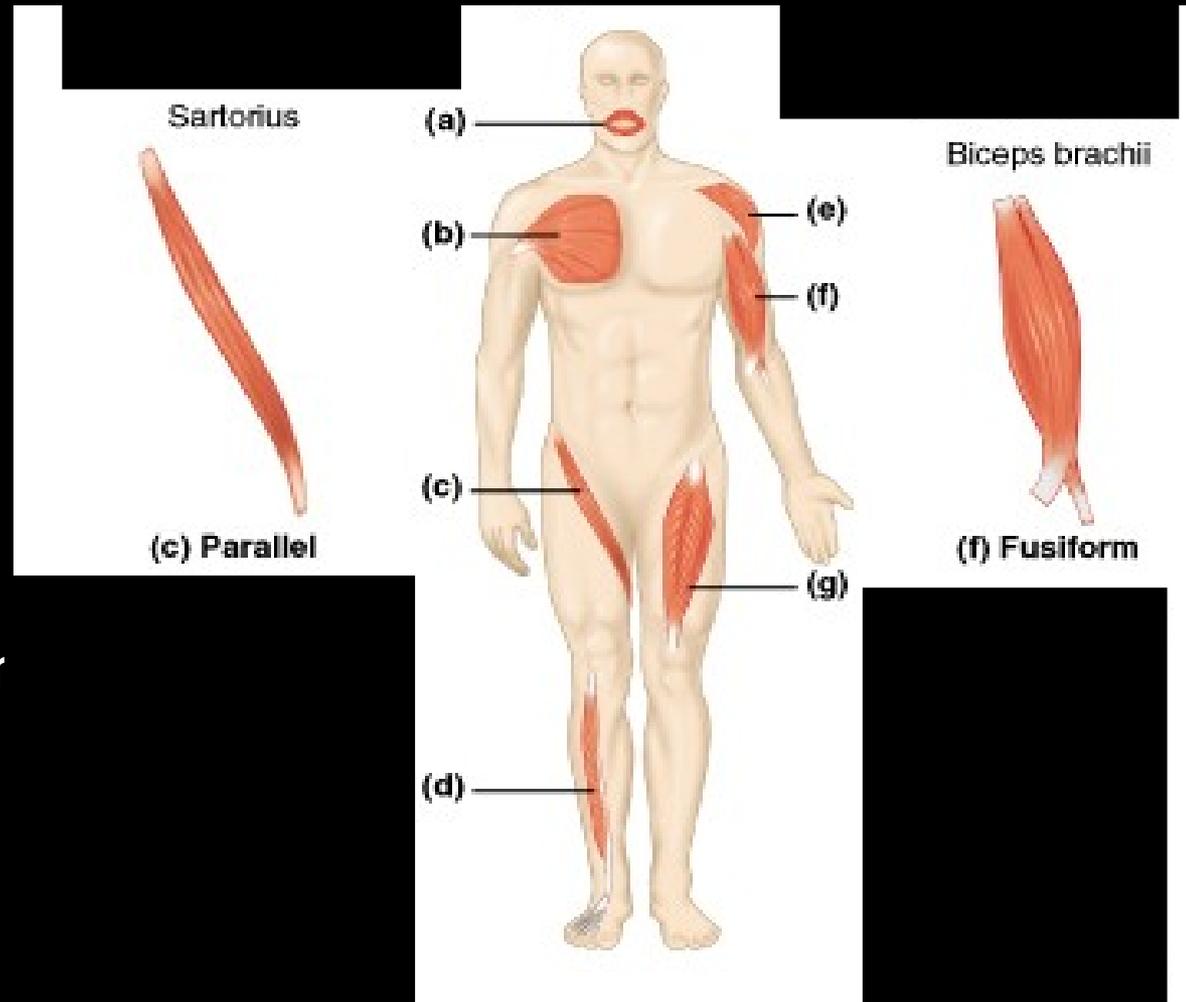
# Arrangement of Fascicles

- **Parallel**

- strap-like
- ex: sartorius

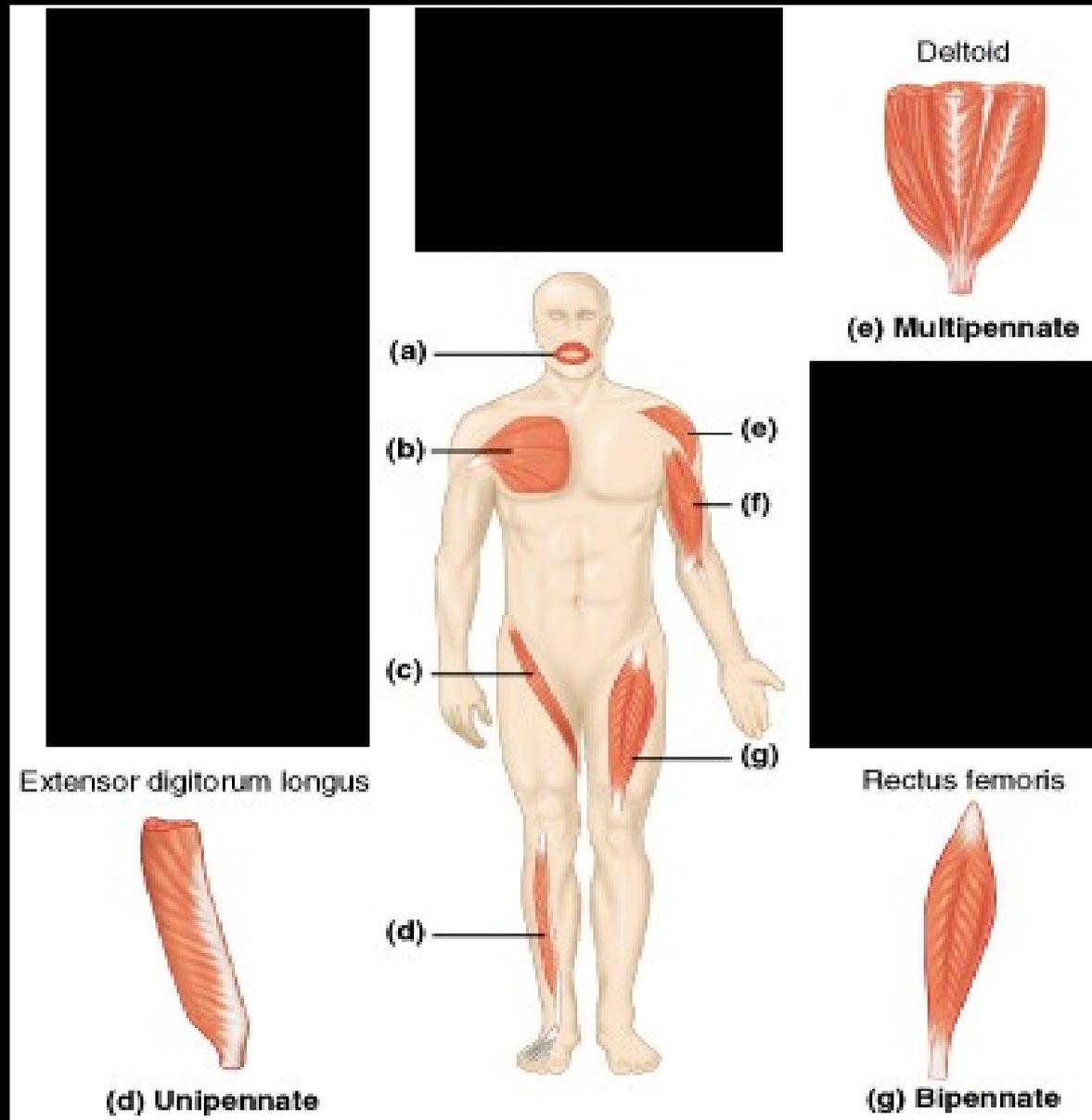
- **Fusiform**

- spindle shaped
- ex: biceps femor



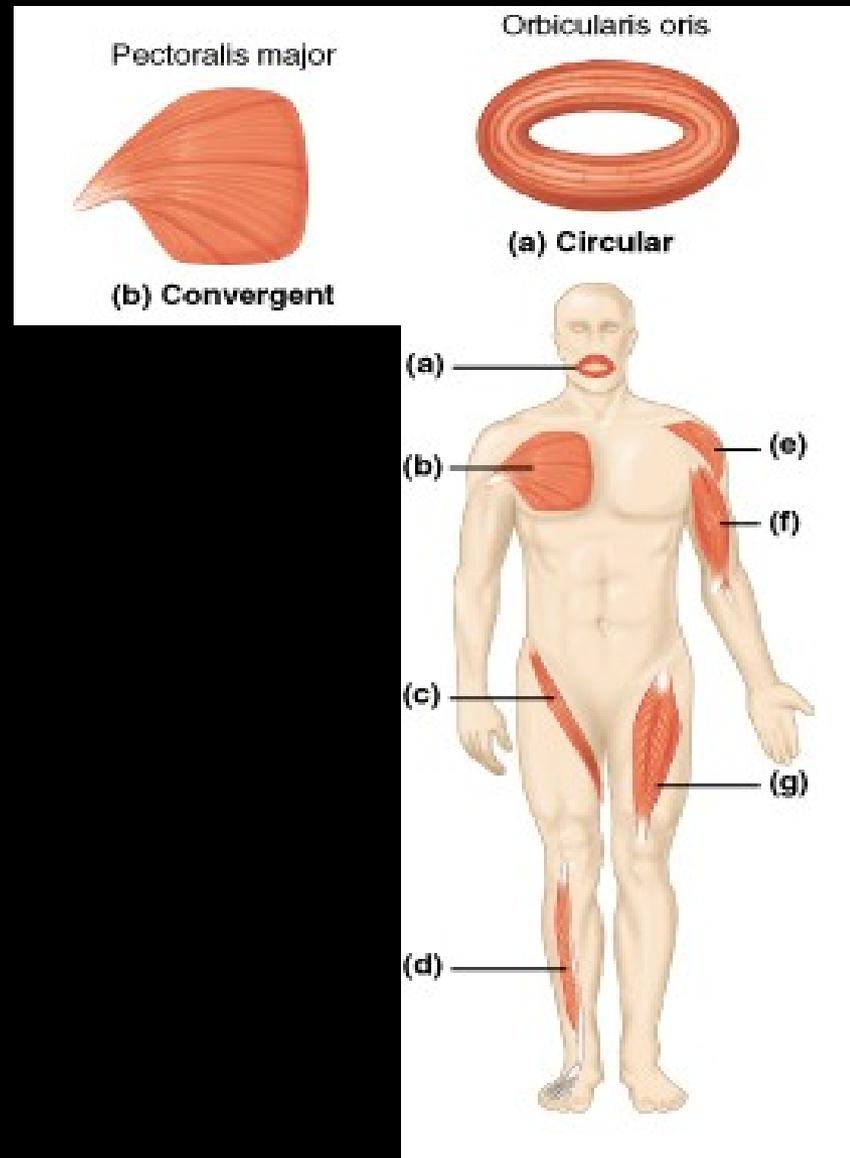
# Arrangement of Fascicles

- **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



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.**