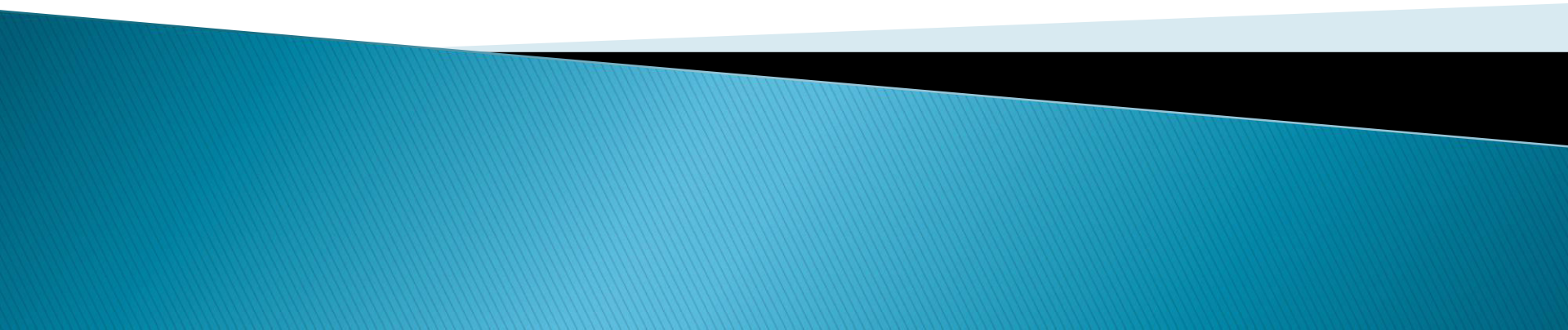


**B. Praveen Doss**  
**Assistant Professor**  
**YMCA College of Physical**  
**Education**  
Biomechanics and Kinesiology



# What is Biomechanics?

- ▶ Biomechanics is the study and application of the principles of mechanics, motion, and movement related to the biological systems of the human body.
- ▶ This field of study addresses the external forces applied to the body as well as the internal forces and resulting movement created by the musculoskeletal system.
- ▶ Kinesiology is derived from two Greek verbs which are translated to mean, “the study of movement” (Knudson, 2007). To ensure safe and effective selection of exercises, application of force, and movement of the body, fitness professionals must have a thorough understanding of anatomy, kinesiology, and biomechanics.

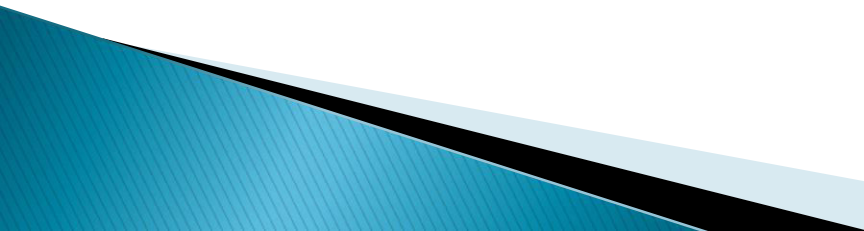
# History of kinesiology

- ▶ [Royal Central Institute of Gymnastics](#) ([sv](#)) G.C.I. was founded 1813 in Stockholm, Sweden by [Pehr Henrik Ling](#). It was the first [Physiotherapy](#) school in the world, training hundreds of medical gymnasts who spread the Swedish physical therapy around the entire world. In 1887, Sweden was the first country in the world to give a national state licence to physiotherapists/physical therapists.
- ▶ The Swedish medical gymnast and [kinesiologist Carl August Georgii](#) ([sv](#)), Professor at the Royal Gymnastic Central Institute GCI in Stockholm, was the one who created and coined the new international word **Kinesiology** in 1854.

- ▶ The term Kinesiology is a literal translation to Greek+English from the original Swedish word Rörelselära, meaning "Movement Science". It was the foundation of the Medical Gymnastics, the original Physiotherapy and Physical Therapy, developed for over 100 years in Sweden (starting 1813).
- ▶ The new medical therapy created in Sweden was originally called Rörelselära (sv), and later in 1854 translated to the new and invented international word "Kinesiology".
- ▶ The Kinesiology consisted of nearly 2,000 physical movements and 50 different types of massage therapy techniques. They were all used to affect various dysfunctions and even illnesses, not only in the movement apparatus, but also into the internal physiology of man. Thus, the original classical and Traditional Kinesiology was not only a system of rehabilitation for the body, or biomechanics like in

- ▶ In 1886, the Swedish Medical Gymnast Nils Posse (1862–1895) introduced the term kinesiology in the U.S. Nils Posse was a graduate of the Royal Gymnastic Central Institute in Stockholm, Sweden and founder of the Posse Gymnasium in Boston, MA.
- ▶ He was teaching at Boston Normal School of Gymnastics BNSG. The Special Kinesiology Of Educational Gymnastics was the first book ever written in the world with the word "Kinesiology" in the title of the book. It was written by Nils Posse and published in Boston, 1894–1895.

# Importance of kinesiology is physical education and sports

- ▶ By following the principles of kinesiology, the coach can guide his follow contestants to avoid sports injuries while performing.
  - ▶ Kinesiology helps the sports coach to get better results from their athletes and is usually helpful in the right performance of the sports skill and technique.
  - ▶ It enables the physical educators to reach right modes of physical activities to their pupils.
  - ▶ Physical educators that can impact various activities on the basis of knowledge of kinesiology.
  - ▶ Kinesiology helps physical educators and physicians in learning and correcting physical deformities of a person.
  - ▶ It enables the coach to provide effective scientific training of players.
  - ▶ Kinesiology plays an important role in the personality development of a sports person.
  - ▶ Kinesiology helps the sports coaches and trainers in the application of their relative methods of coaching efficiently and precisely.
- 

# The Pectoralis Major

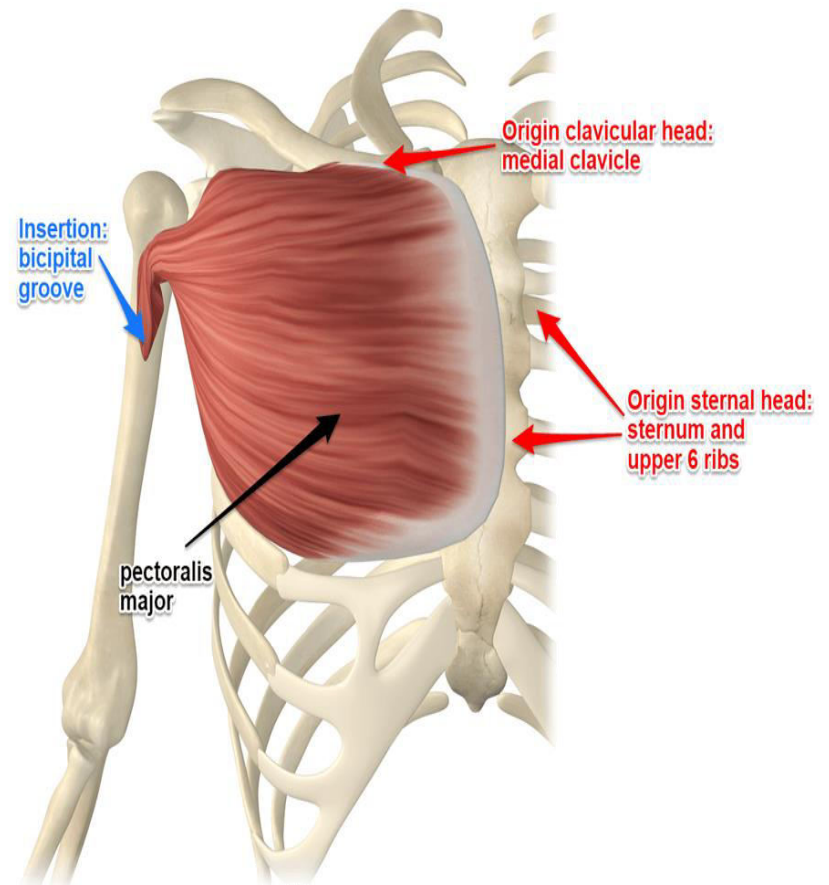
- ▶ The pectoralis major is a thick, fan-shaped muscle, situated at the chest of the human body.
- ▶ It makes up the bulk of the chest muscles and lies under the breast.
- ▶ The pectoralis major's primary functions are flexion, adduction, and internal rotation of the humerus.
- ▶ The pectoral major may colloquially be referred to as "pecs", "pectoral muscle" or "chest muscle" due to it being the largest and most superficial muscle in the chest area

# Origin

- ▶ **Clavicular head:** anterior surface of the medial half of the clavicle.
- ▶ **Sternocostal head:** anterior surface of the sternum, the superior six costal cartilages, and the aponeurosis of the external oblique muscle

## Insertion

- Lateral lip of the bicipital groove of the humerus.  
(anteromedial proximal humerus)





## Action

- ▶ Clavicular head: flexes the humerus  
Sternocostal head: horizontal and vertical adduction, extension, and internal rotation of the humerus
- ▶ Depression and abduction of the scapula.

**Antagonist:** Deltoid

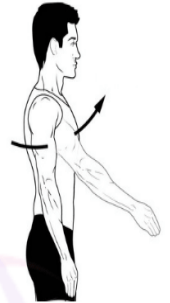
## Agonist and Antagonist

The muscle performing an action is the **Agonist**, while the muscle which contraction brings about an opposite action is the **Antagonist**.

# **Pectoralis major Action**



**Flexion of the  
humerus**

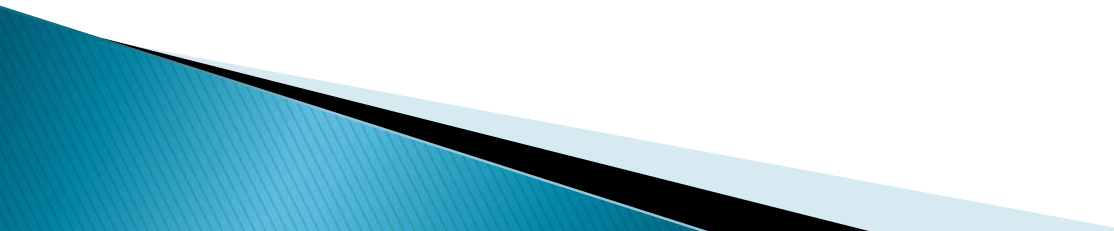


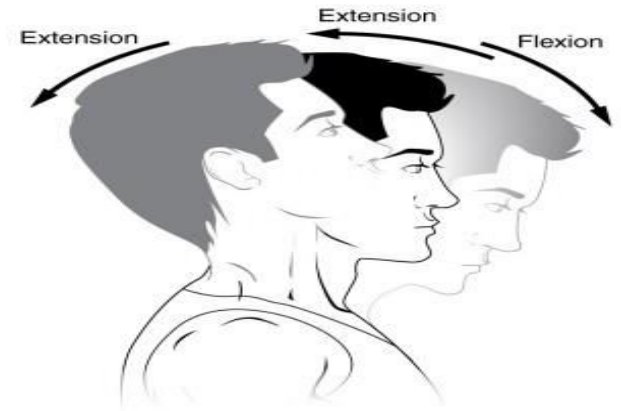
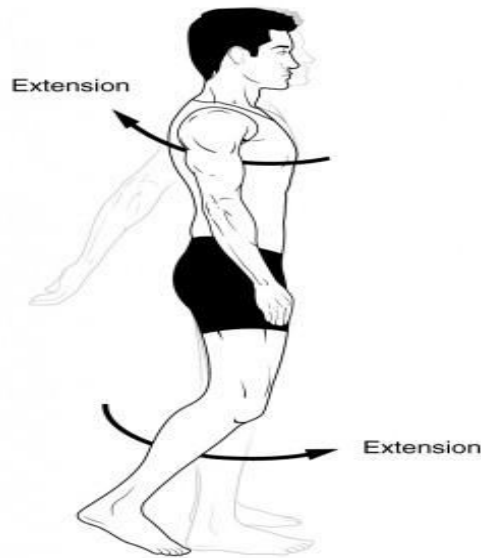
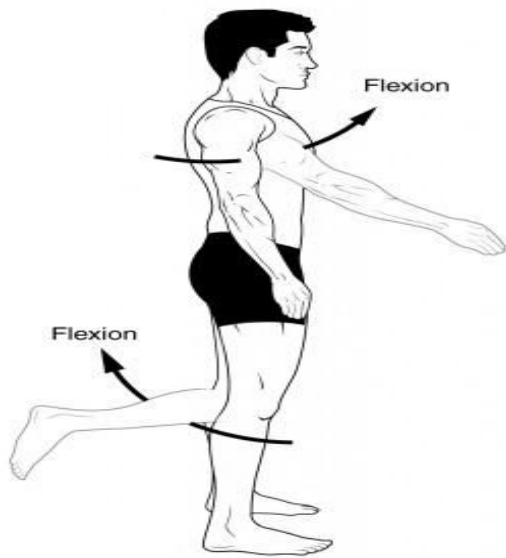
**Horizontal  
adduction of the  
humerus**

**Medial  
rotation of the  
humerus**



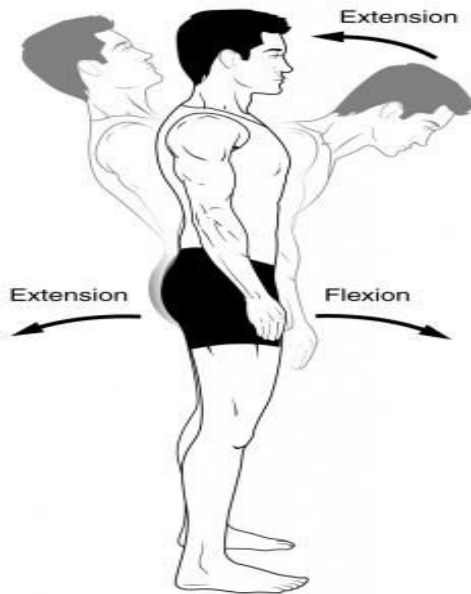
Theexcellentbody

- ▶ Flexion and extension
  - ▶ Abduction and adduction
  - ▶ Elevation and depression
  - ▶ Rotation
  - ▶ Circumduction
  - ▶ Dorsiflexion and Planter Flexion
  - ▶ Pronation and Supination
  - ▶ Inversion and eversion
  - ▶ Protraction and Retraction
- 

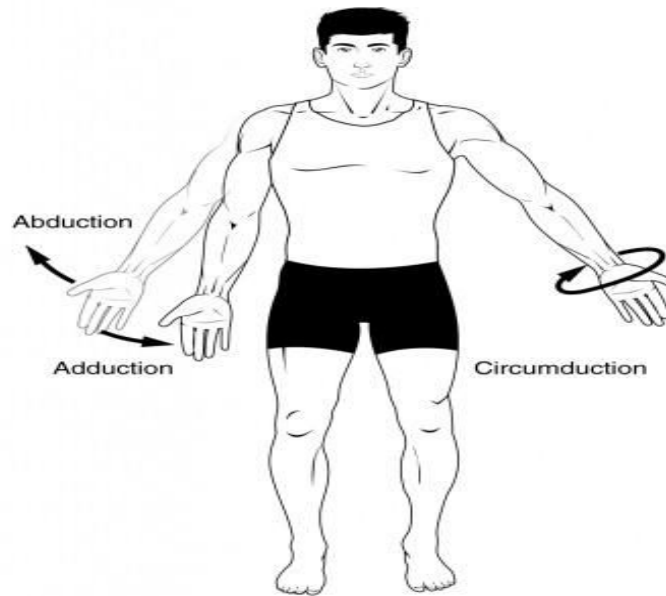


(a) and (b) Angular movements: flexion and extension at the shoulder and knees

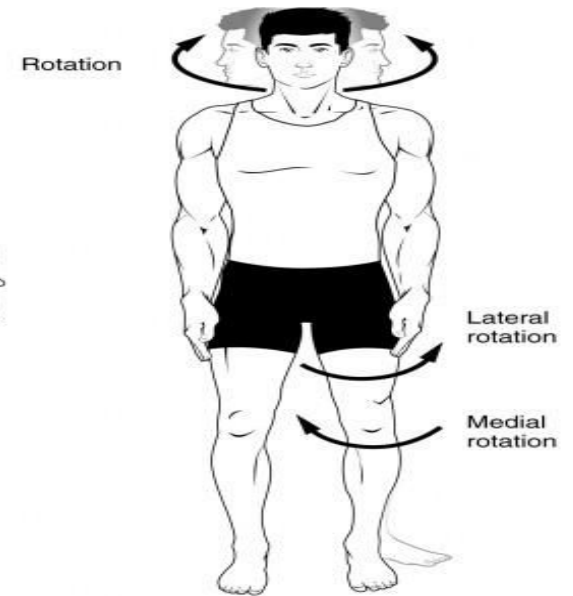
(c) Angular movements: flexion and extension of the neck



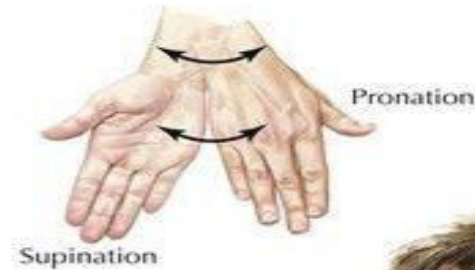
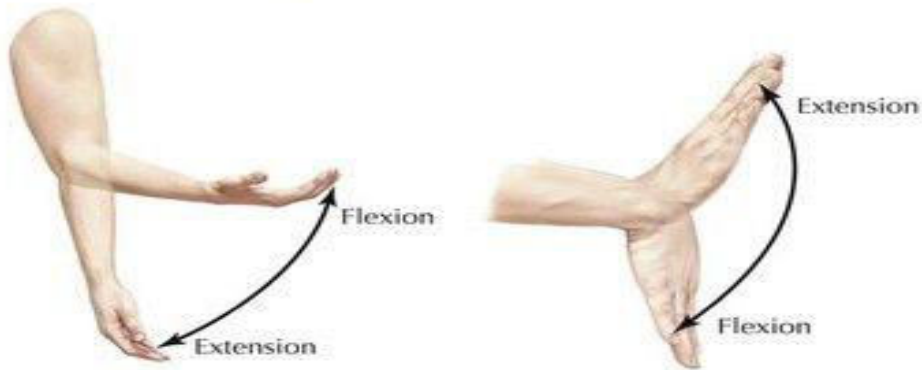
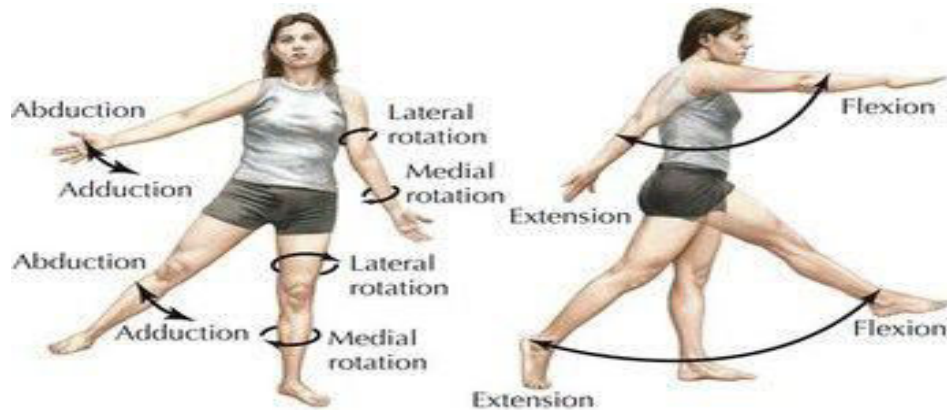
(d) Angular movements: flexion and extension of the vertebral column



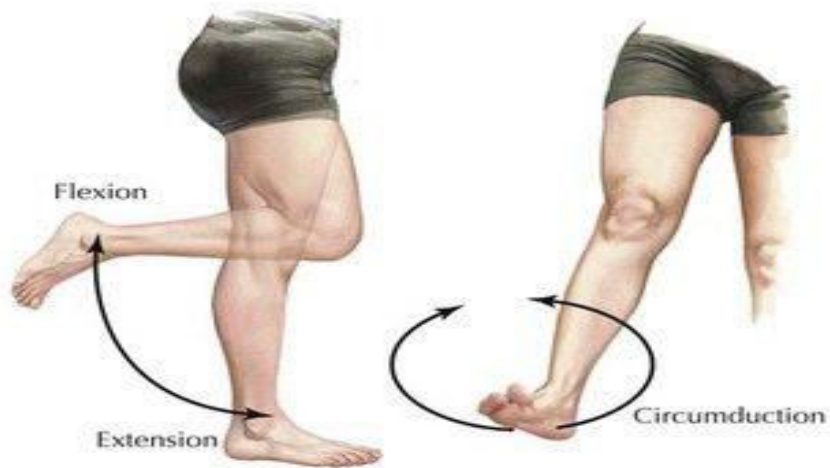
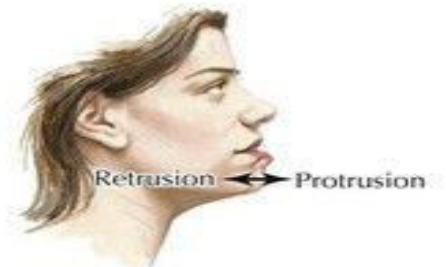
(e) Angular movements: abduction, adduction, and circumduction of the upper limb at the shoulder



(f) Rotation of the head, neck, and lower limb

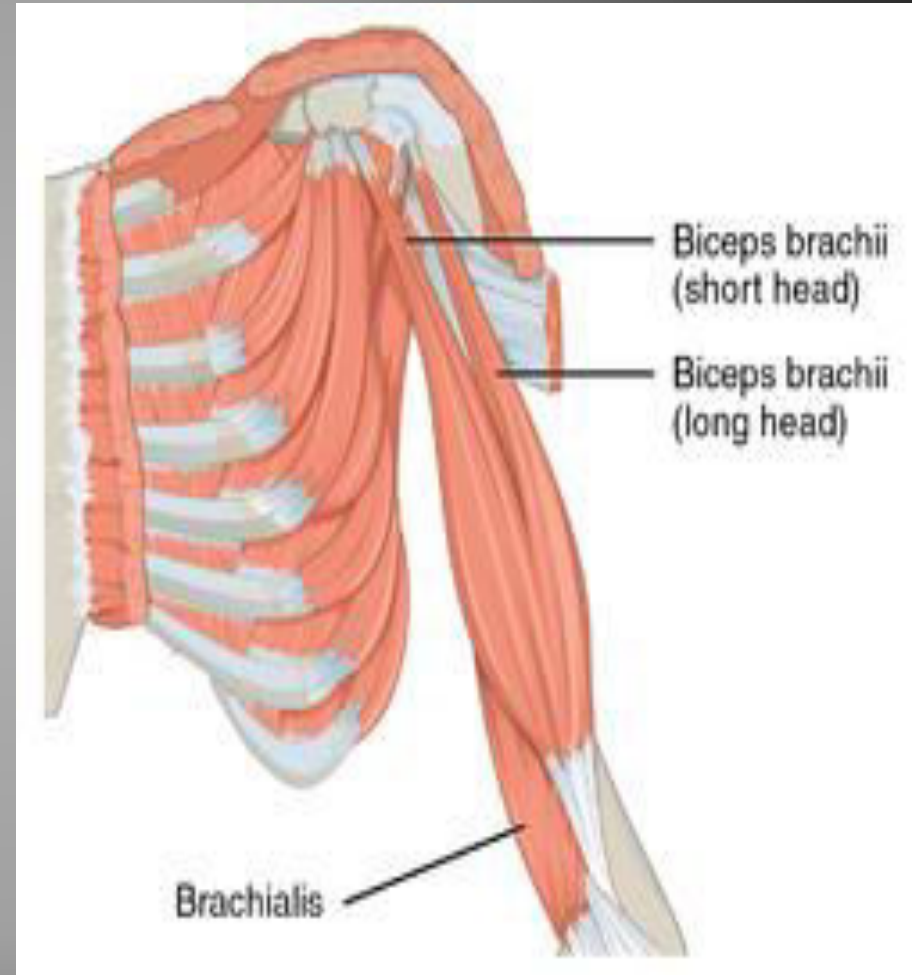


C. Machado  
— M.D. —



# Biceps –Biceps Brachii

- ▶ The biceps is a large muscle that lies on the front of the upper arm between the shoulder and the elbow.
- ▶ Both heads of the muscle arise on the scapula and join to form a single muscle belly which is attached to the upper forearm.
- ▶ While the biceps crosses both the shoulder and elbow joints, its main function is at the elbow where it flexes the forearm and supinates the forearm.

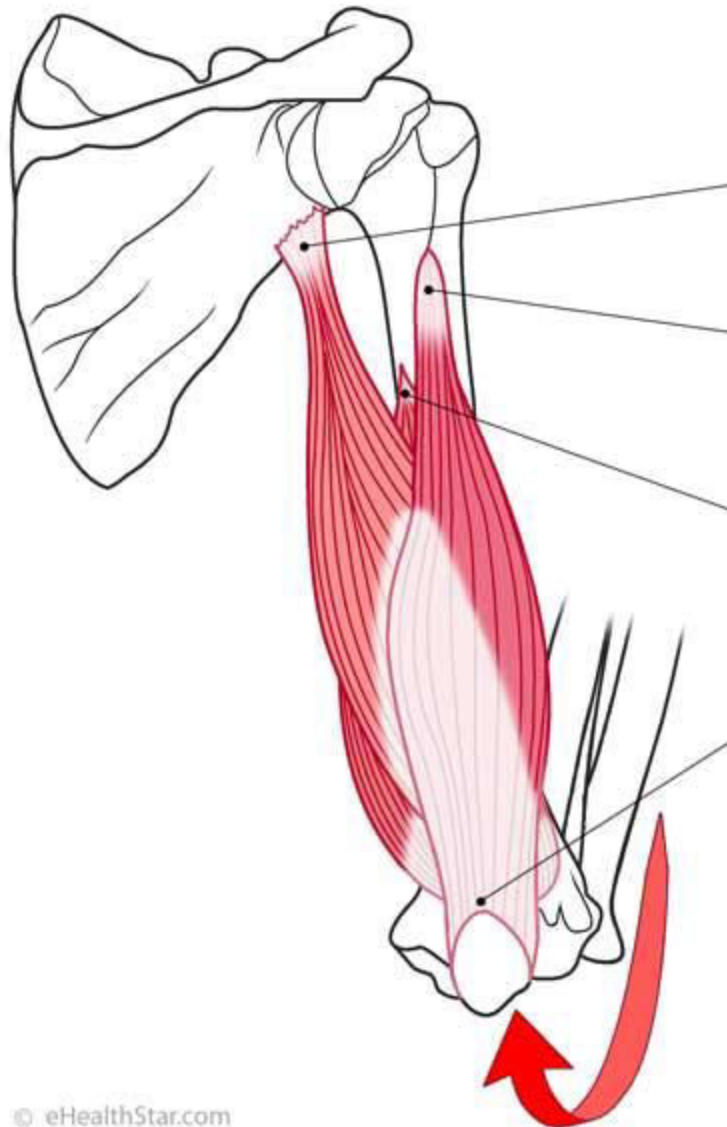


# Triceps Brachii



K

# Triceps Brachii



## Origin:

- Long head: infraglenoid tubercle of scapula
- Lateral head: humerus, above radial groove
- Medial head: humerus, below radial groove

Insertion: olecranon of ulna

Action: Extends forearm



## Origin

Short head: coracoid process of the scapula.

Long head: supraglenoid tubercle

## Insertion

Radial tuberosity and bicipital aponeurosis into deep fascia on medial part of forearm

## Actions

- Flexes elbow
- flexes and abducts shoulder
- supinates radioulnar joint in the forearm



## BIGGER BICEPS WORKOUT

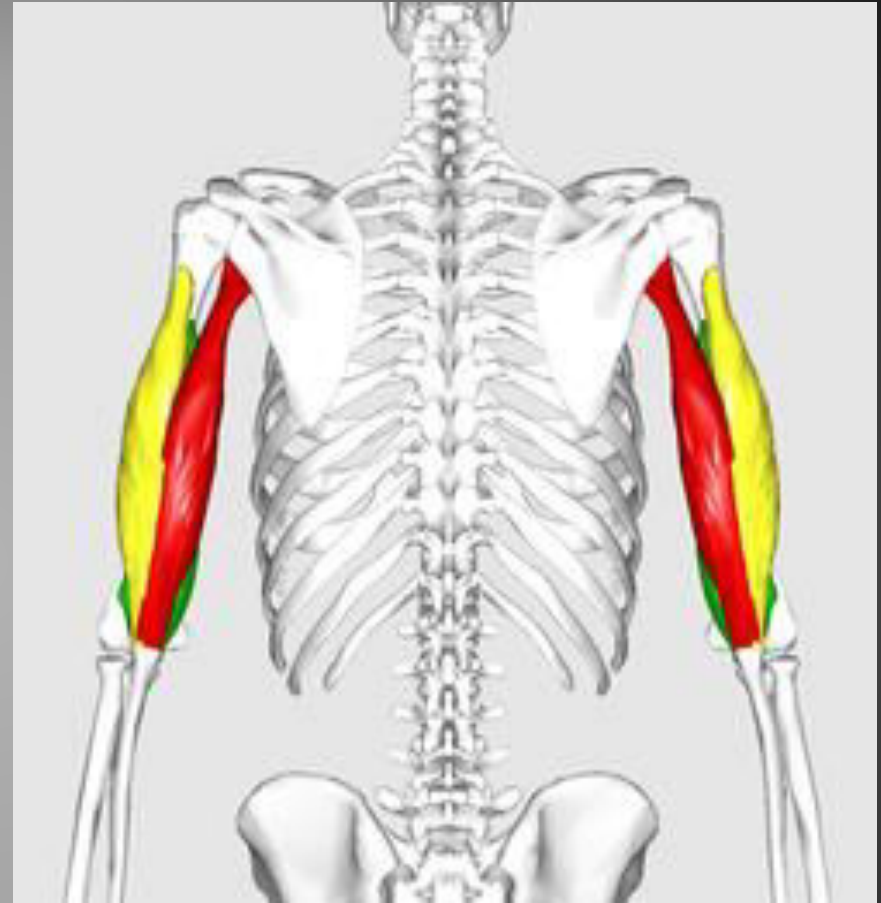


4 SETS OF 10 - 15 REPS FOR EACH EXERCISE



# Triceps

- ▶ The triceps, also triceps brachii (Latin for "three-headed muscle of the arm"), is a large muscle on the back of the upper limb of many vertebrates.
- ▶ It consists of 3 parts: the medial, lateral, and long head. It is the muscle principally responsible for extension of the elbow joint (straightening of the arm).



## ▶ **Origin**

- Long head: infraglenoid tubercle of scapula
- Lateral head: above the radial groove
- Medial head: below the radial groove

## ▶ **Insertion**

- Olecranon process of ulna

## ▶ **Actions**

- Extends forearm, long head extends, adducts arm, Extends shoulder

## ▶ **Antagonist**

- Biceps brachii muscle



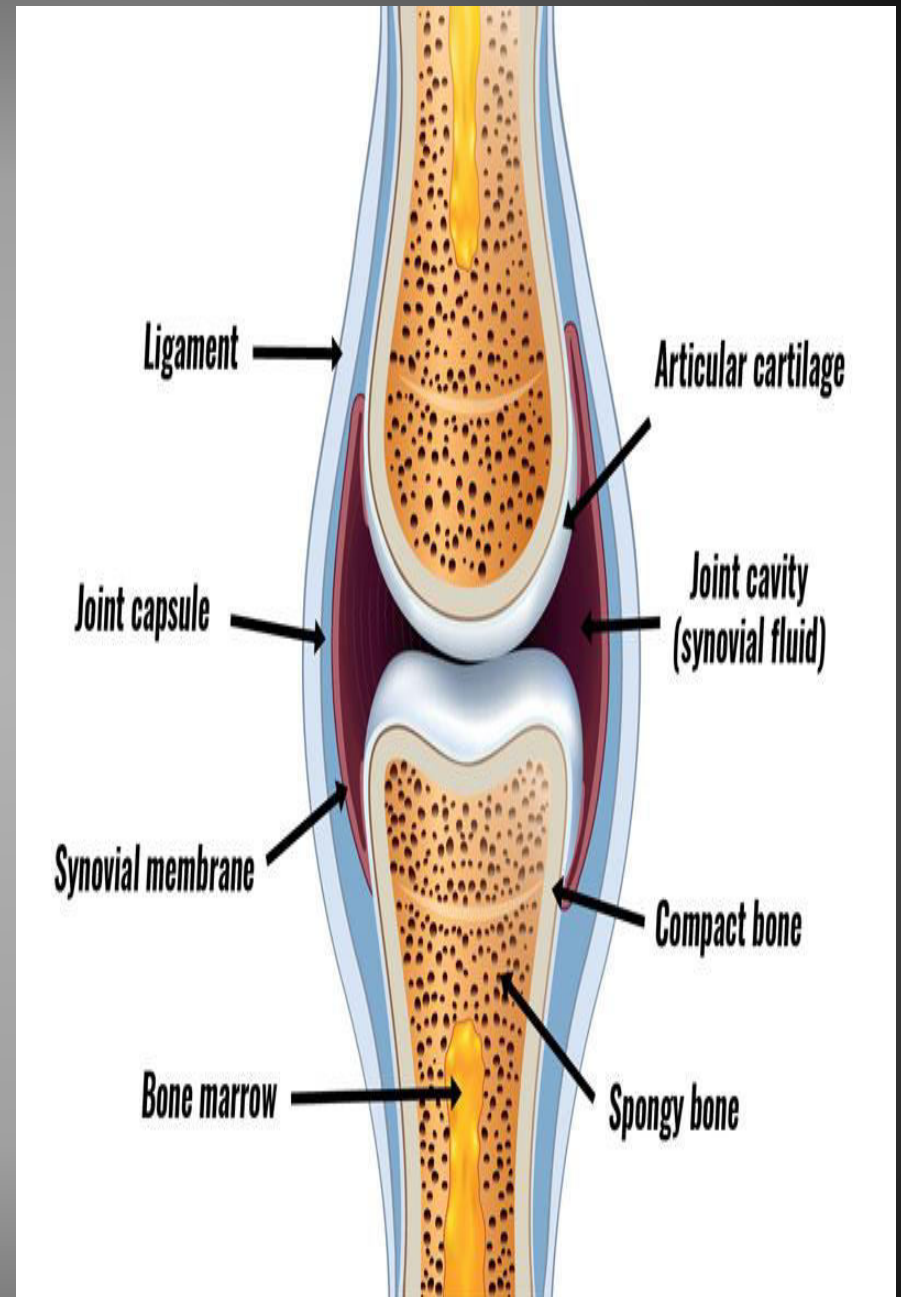
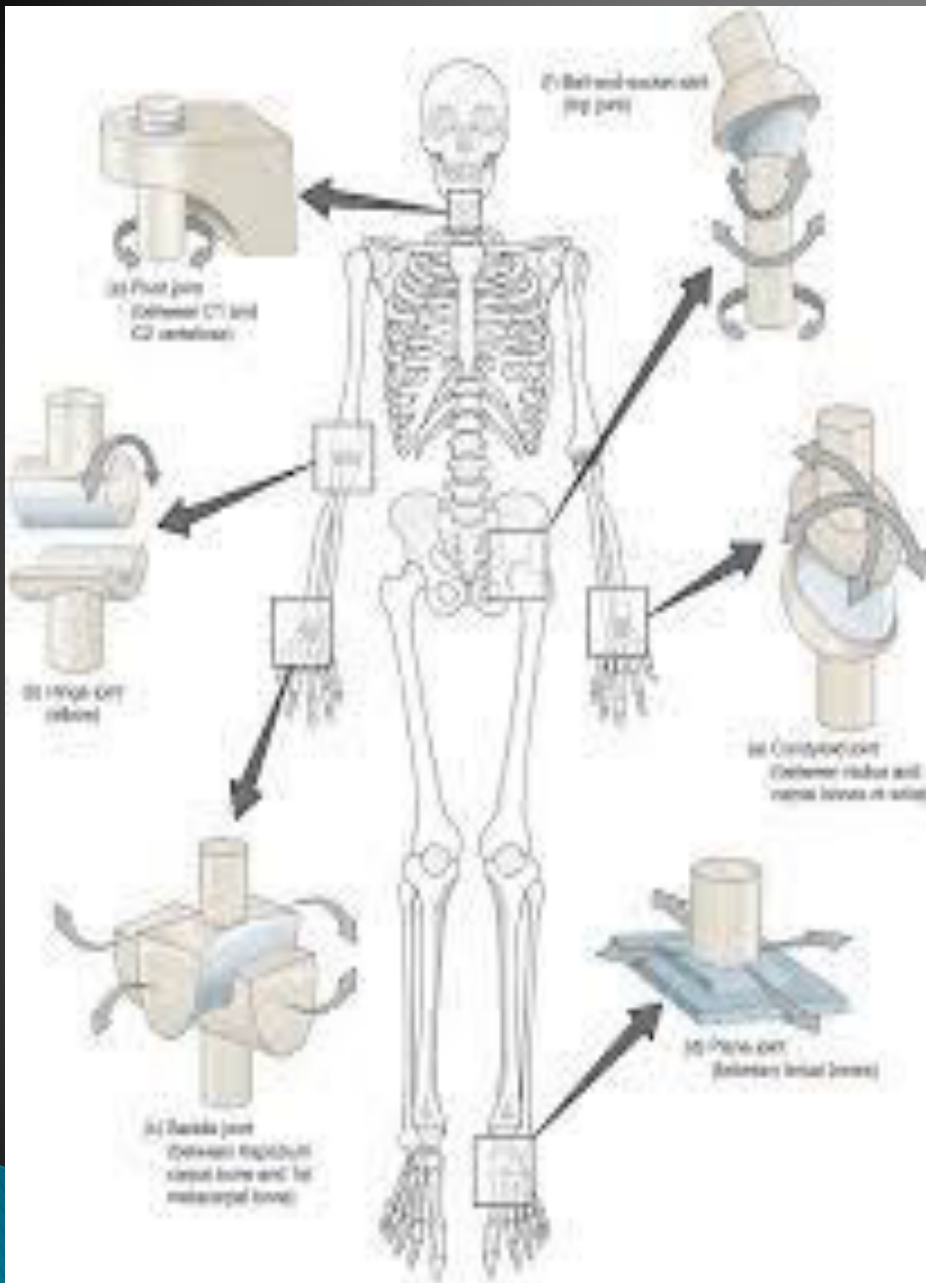
**Flexion**



**Extension**

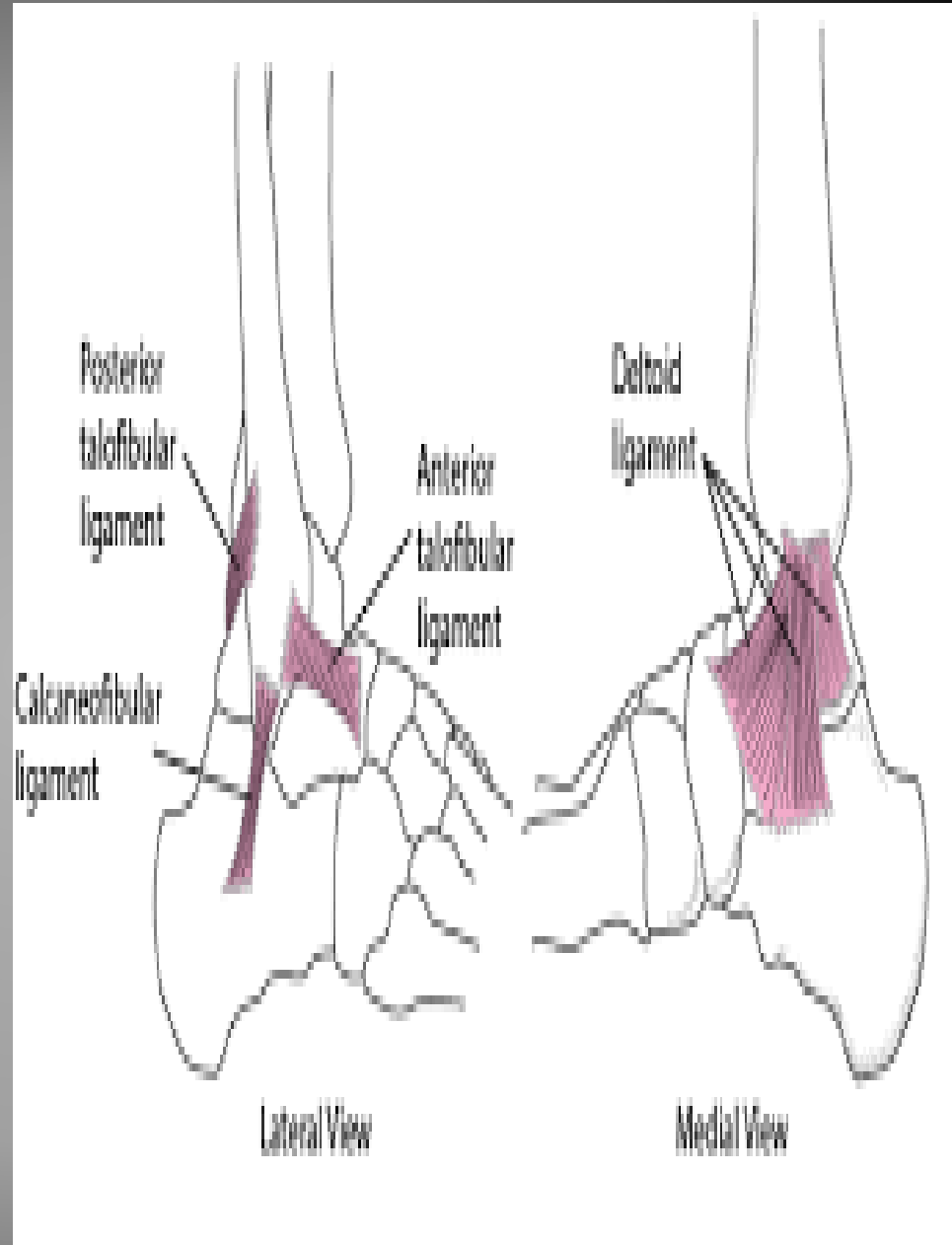
© **teachmeanatomy**  
The #1 Applied Human Anatomy (BSc) in the UK





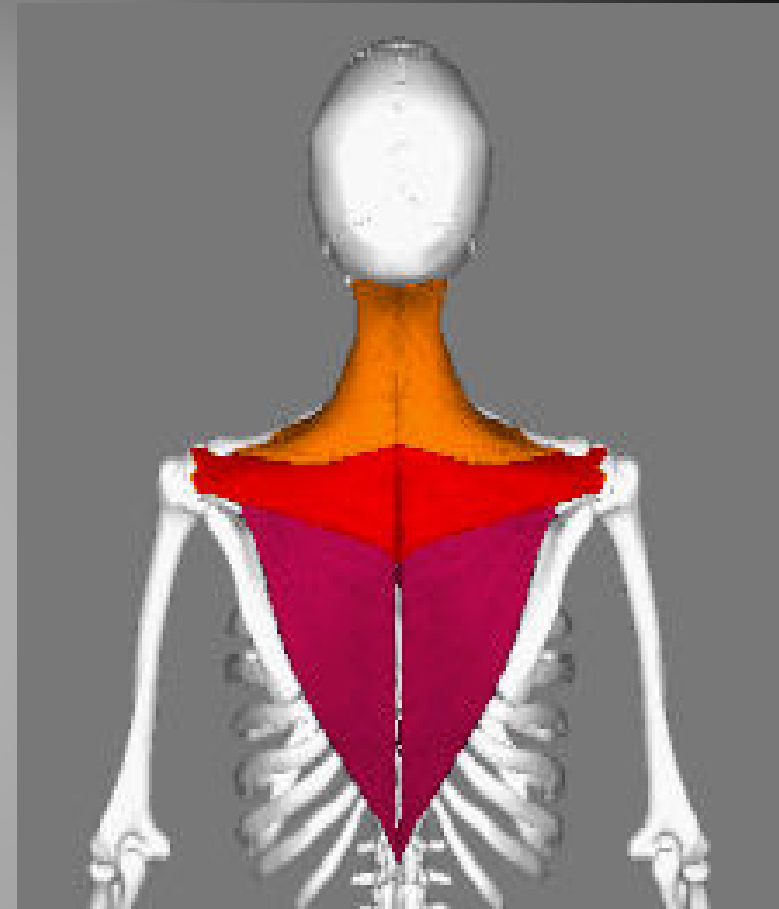


**Normal knee**



# Trapezius

- ▶ The trapezius is a large paired surface muscle that extends longitudinally from the occipital bone to the lower thoracic vertebrae of the spine and laterally to the spine of the scapula. It moves the scapula and supports the arm.
- ▶ The trapezius has three functional parts:
- ▶ an upper (descending) part which supports the weight of the arm;
- ▶ a middle region (transverse), which retracts the scapula; and a
- ▶ lower (ascending) part which medially rotates and depresses the scapula.



Superior fibers of the trapezius  
Middle fibers of the trapezius  
Inferior fibers of the trapezius



## ▶ Origin

- External occipital protuberance, spinous processes of vertebrae C7–T12, Nuchal ligament, Occipital Bone
- Medial one-third of superior nuchal line External occipital protuberance Ligamentum nuchae T1–T12 spine
- Corresponding supraspinous ligaments

## ▶ Insertion

- posterior border of the lateral one-third of the clavicle, acromion process, and spine of scapula

## ▶ Actions

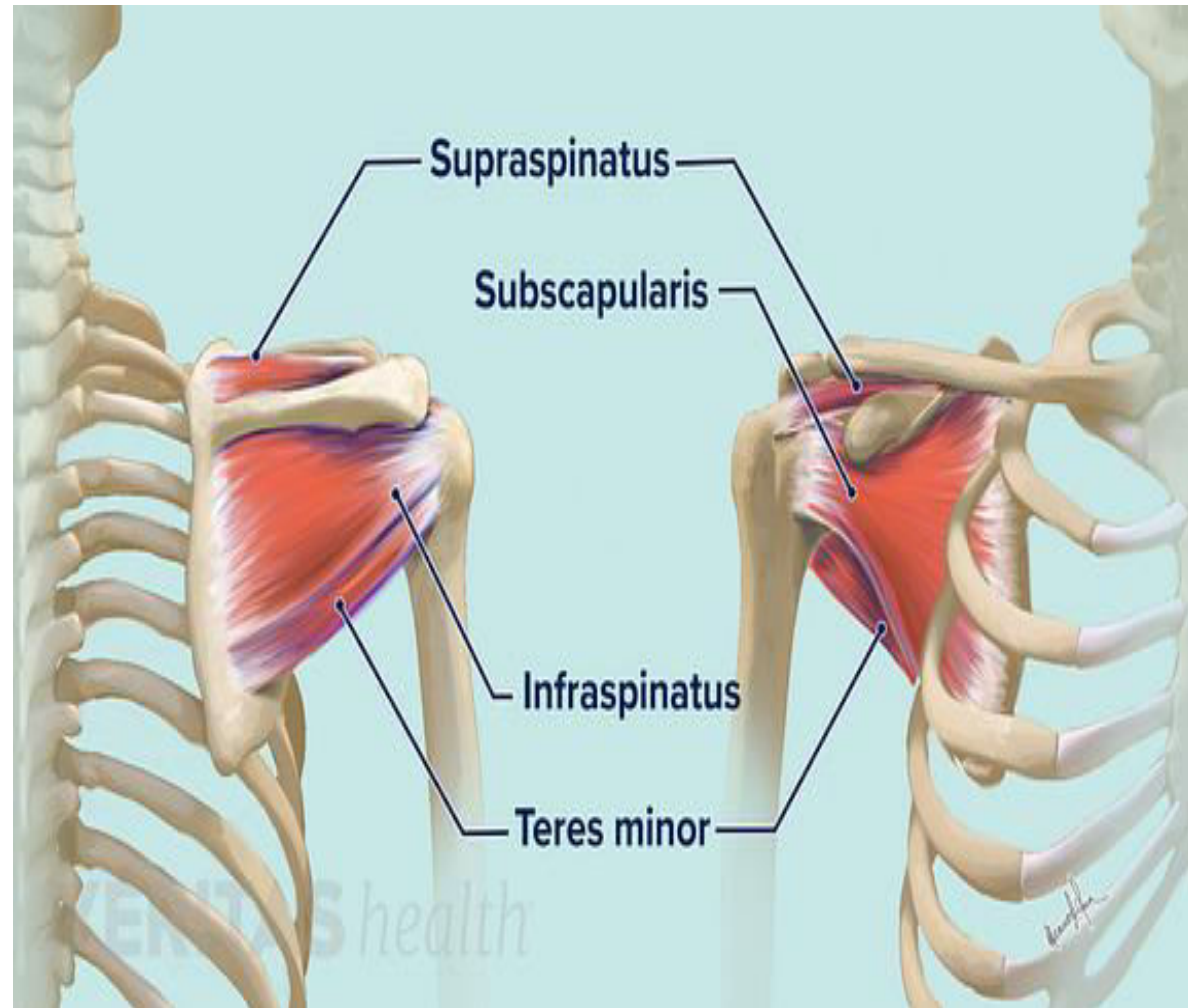
- Rotation, retraction, elevation, and depression of scapula

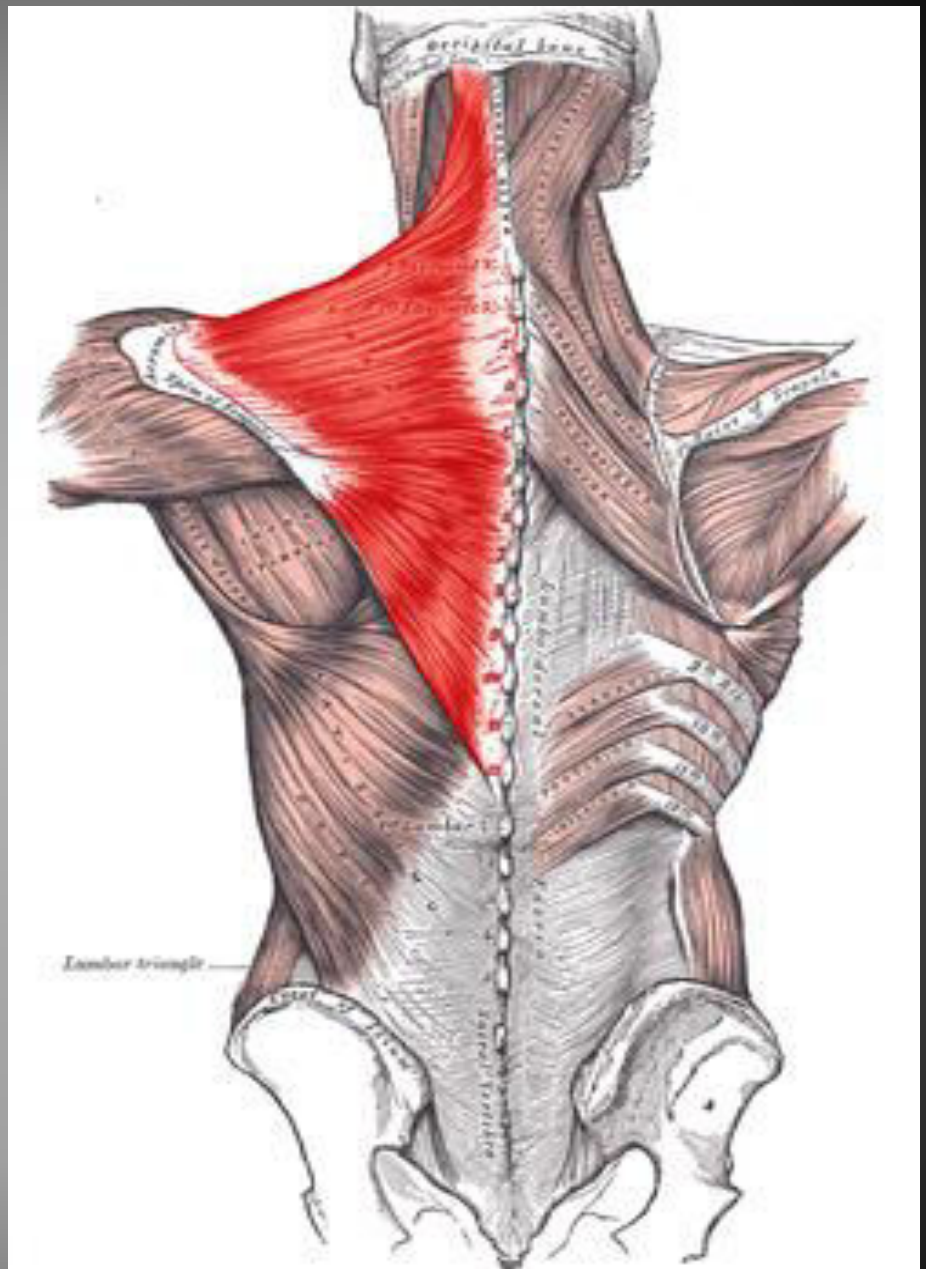
## ▶ Antagonist

- Serratus anterior muscle, Latissimus dorsi, Great chest muscle

## The rotator cuff includes the following muscles

- ▶ Subscapularis.
- ▶ Infraspinatus.
- ▶ Supraspinatus.
- ▶ Teres minor.





# Sartorius

- ▶ The sartorius muscle is the longest muscle in the human body. It is a long, thin, superficial muscle that runs down the length of the thigh in the anterior compartment.
- ▶ The name Sartorius comes from the Latin word sartor, meaning tailor, [and it is sometimes called the tailor's muscle. This name was chosen in reference to the cross-legged position in which tailors once sat. In French, a muscle name itself "couturier" comes from this specific position which is referred to as "sitting as a tailor" (in French : "s'asseoir en tailleur"). Additionally, antique sewing machines required continuous crossbody pedaling. This combination of lateral rotation and flexion of the hip and flexion of the knee gave tailors particularly developed sartorius muscles.

## Origin

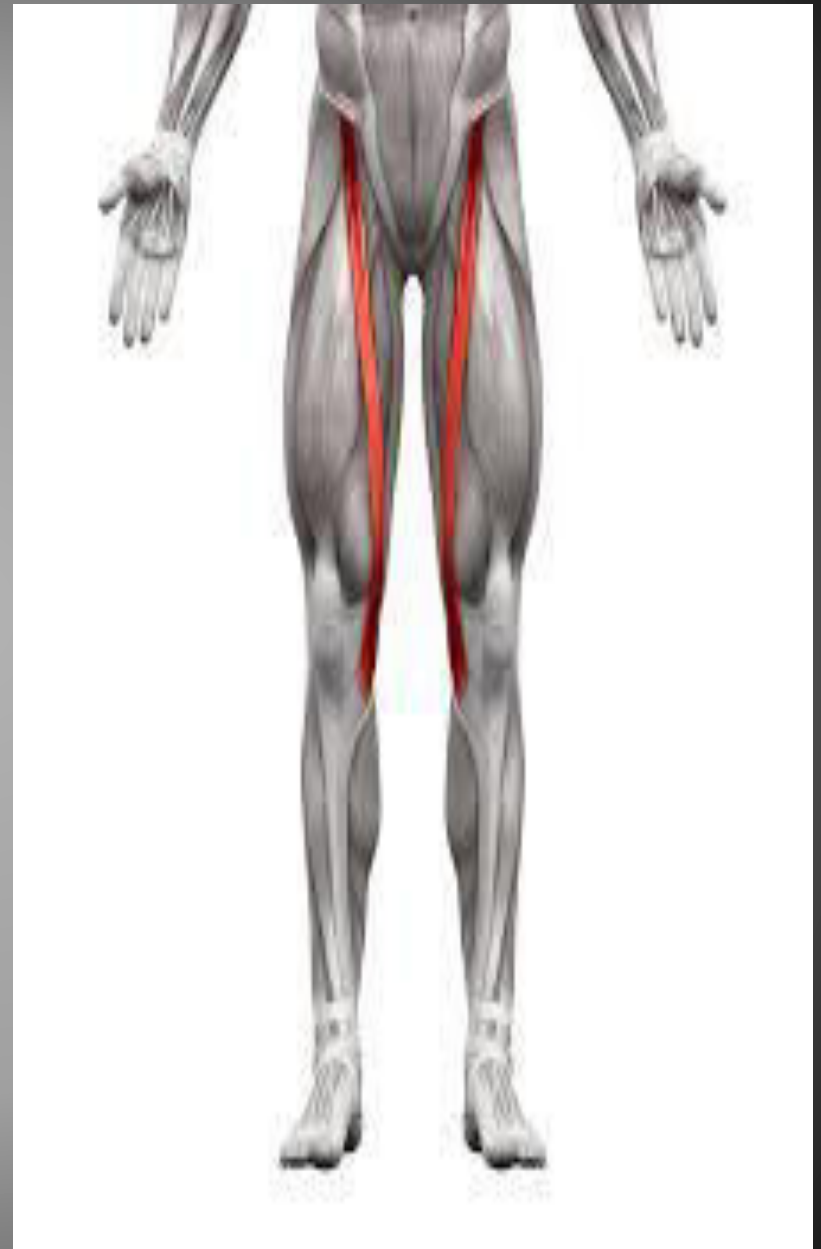
Anterior superior iliac spine of the pelvic bone

## Insertion

Anteromedial surface of the proximal tibia in the pes anserinus

## Actions

Flexion, abduction, and lateral rotation of the hip, flexion of the knee





# *Sartorius*

## •ORIGIN

- Anterior superior iliac spine (ASIS)

## •ACTIONS

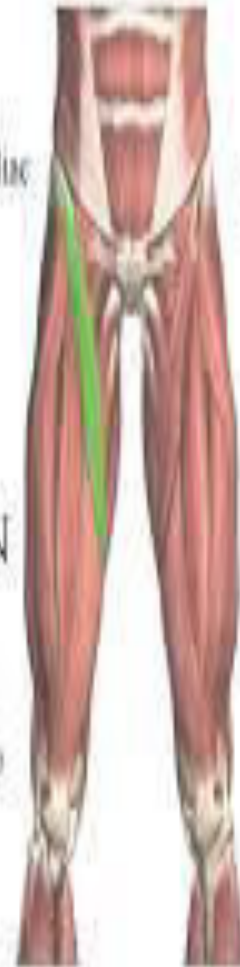
- Flexes hip and knee
- Laterally rotates thigh if flexed at the hip

## •INSERTION

- Upper medial surface of body of tibia, contributes to patellar anserine

## •INNERVATION

- Branches of femoral nerve, L2 - L3



# Quadriceps femoris muscle

- ▶ **The quadriceps femoris also called the quadriceps extensor, quadriceps or quads) is a large muscle group that includes the four prevailing muscles on the front of the thigh.**
- ▶ **It is the great extensor muscle of the knee, forming a large fleshy mass which covers the front and sides of the femur. The name derives from Latin four-headed muscle of the femur.**



## ▶ Origin

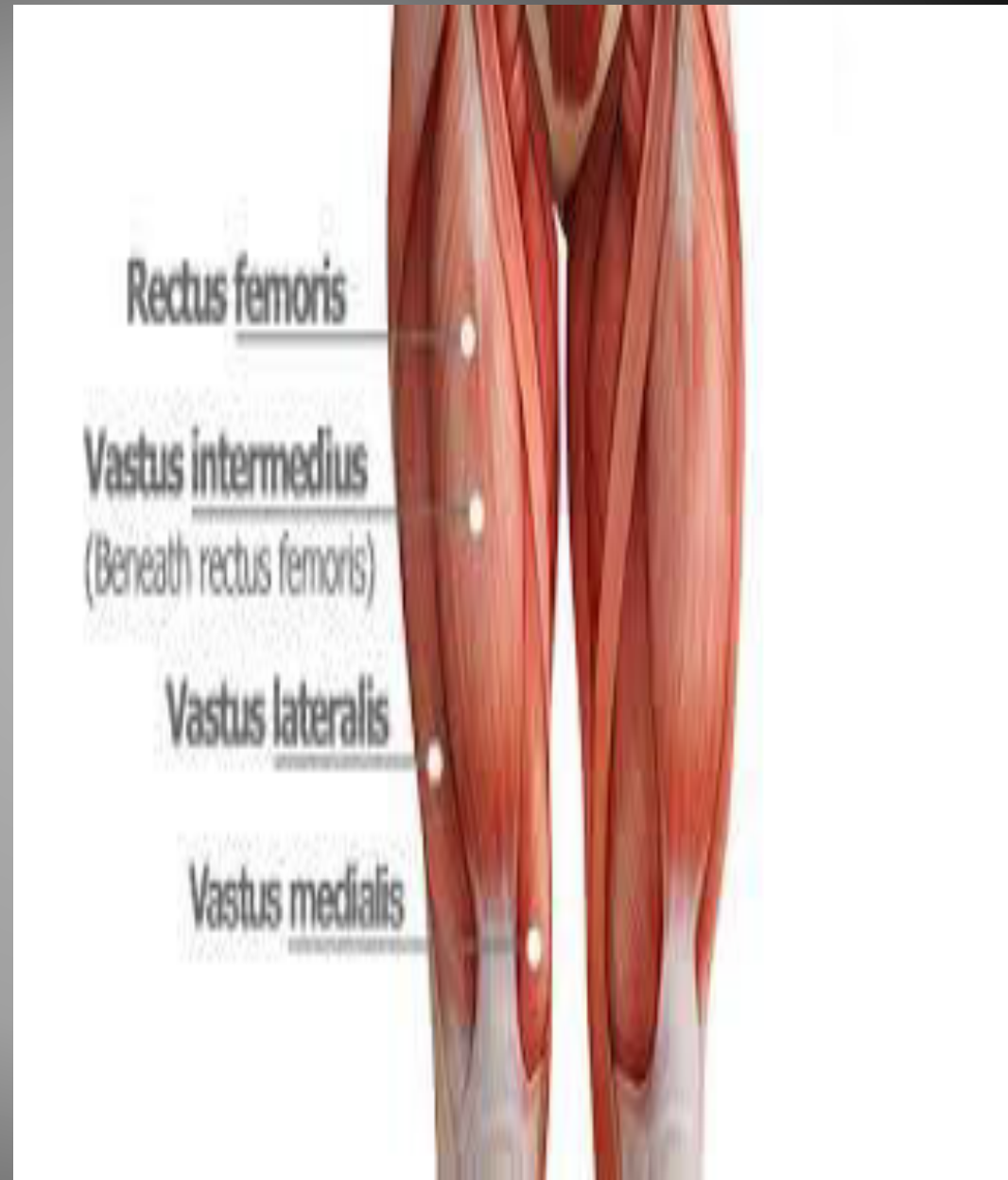
- Combined rectus femoris and vastus muscles

## ▶ Insertion

- Tibial tuberosity

## ▶ Actions

- Knee extension; Hip flexion (Rectus femoris only)





# Vastus lateralis muscle

## ▶ Origin

- Greater trochanter, Intertrochanteric line, and Linea aspera of the Femur

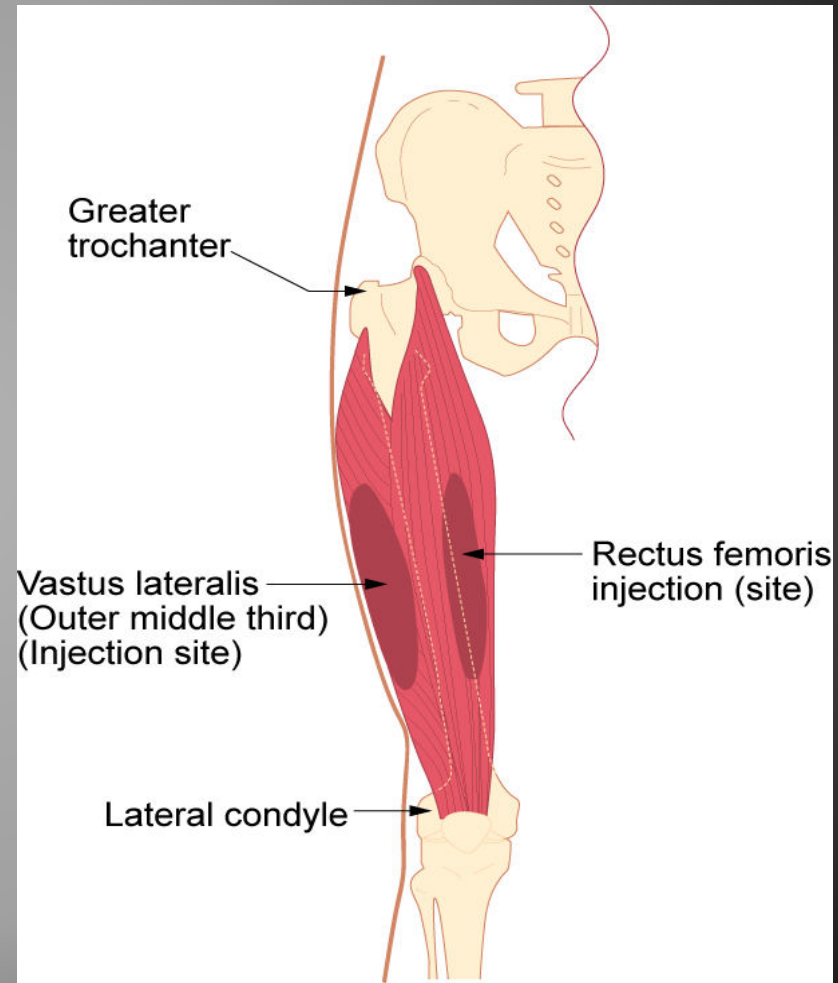
## ▶ Insertion

- Patella by the Quadriceps tendon and Tibial tuberosity by the Patellar ligament

## ▶ Actions

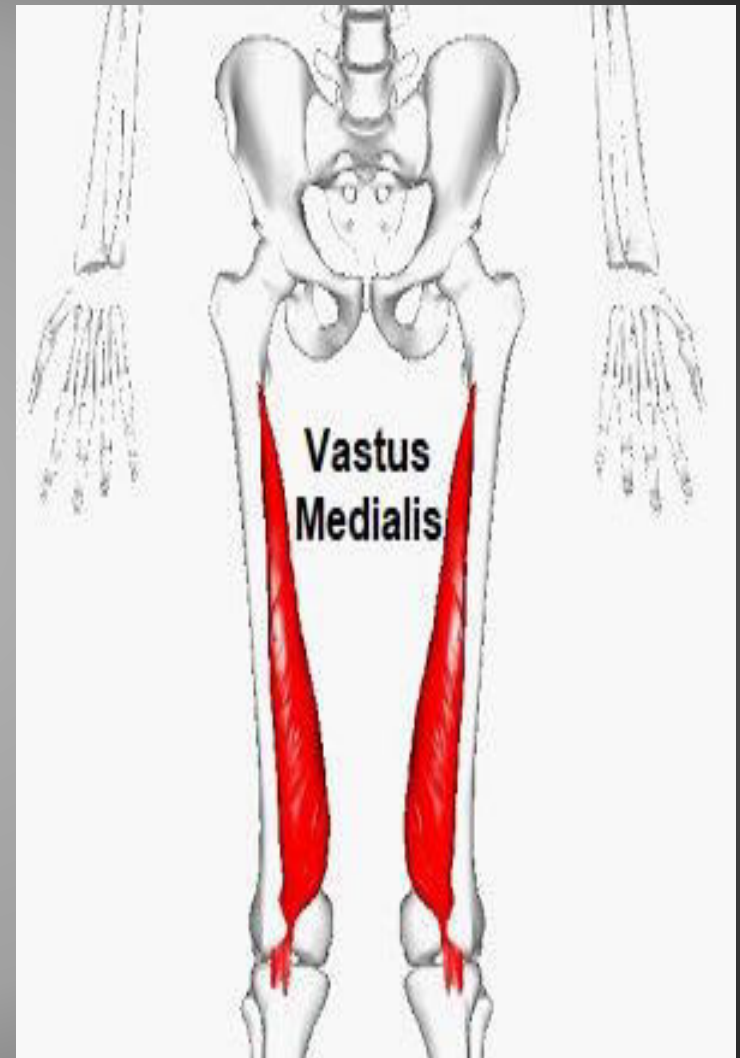
- Extends and stabilizes knee

## ▶ Antagonist Hamstrin



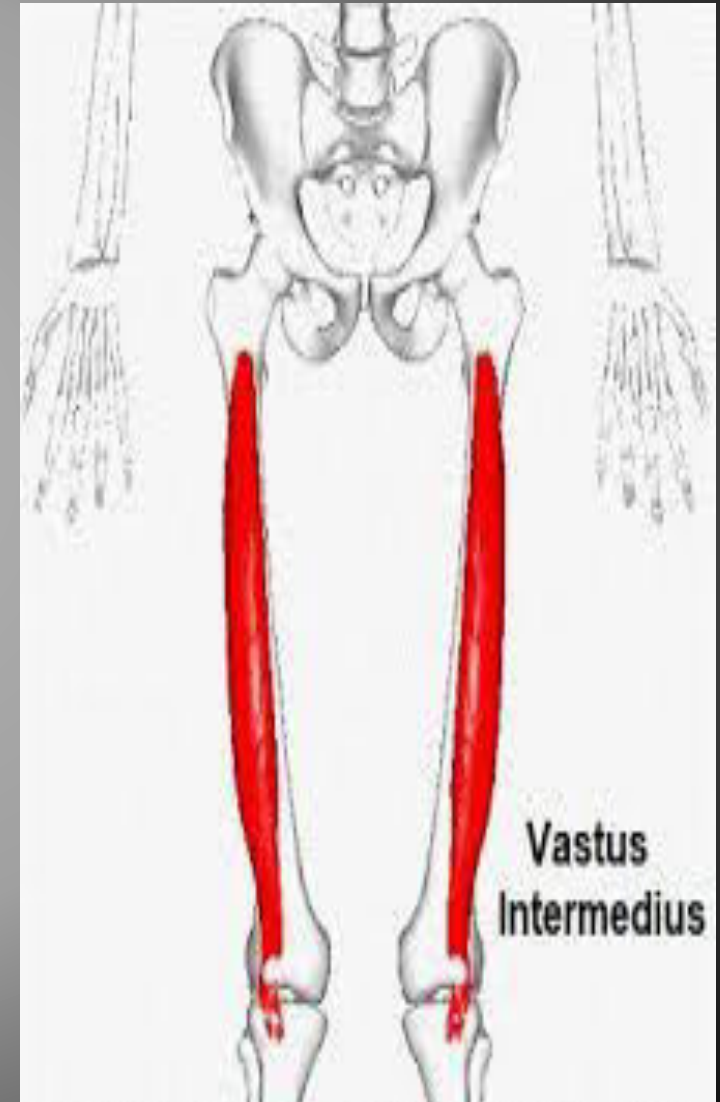
# Vastus medialis

- ▶ **Origin**
  - Medial side of femur
- ▶ **Insertion**
  - Quadriceps tendon
- ▶ **Actions**
  - Extends knee



# Vastus intermedius muscle

- ▶ **Origin**
  - Anterolateral femur
- ▶ **Insertion**
  - Quadriceps tendon
- ▶ **Actions**
  - Extension of knee joint



# Rectus femoris muscle

## ▶ Origin

- anterior inferior iliac spine and the exterior surface of the bony ridge which forms the groove on the iliac portion of the acetabulum

## ▶ Insertion

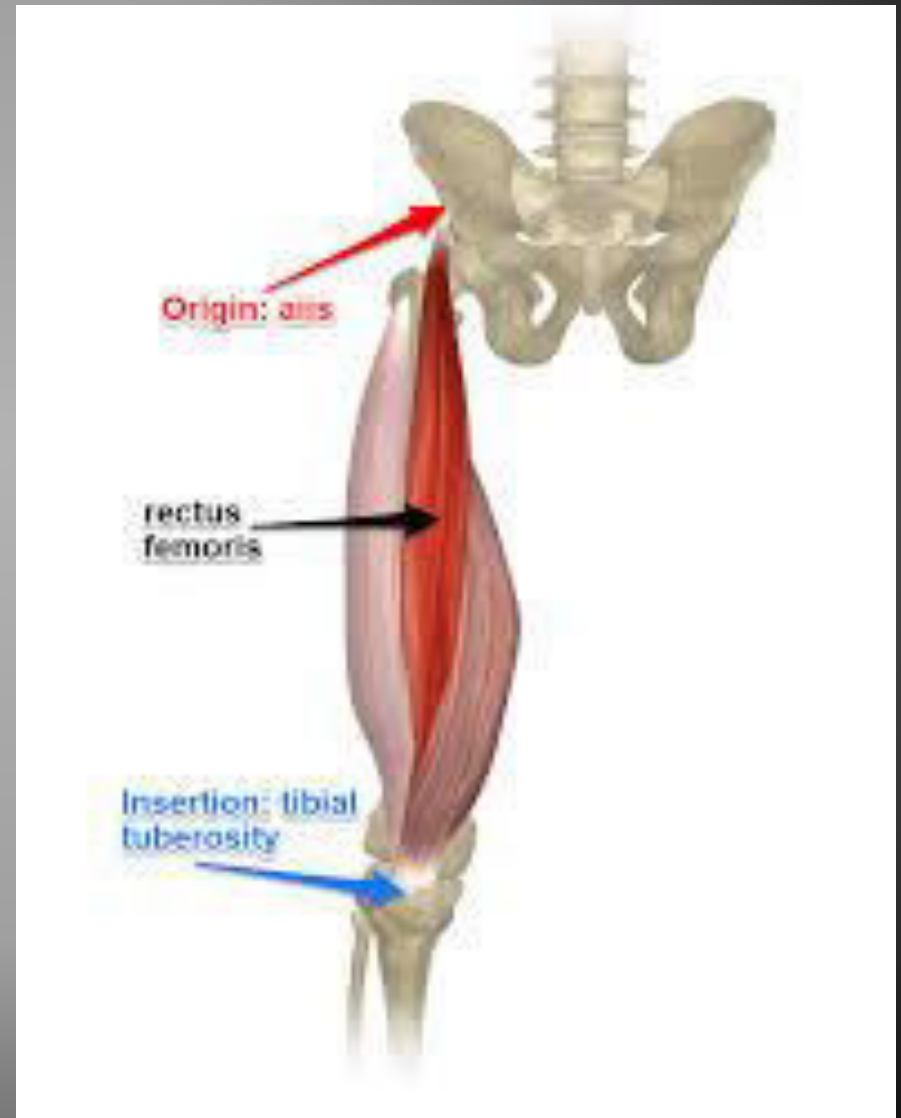
- inserts into the patellar tendon as one of the four quadriceps muscles

## ▶ Actions

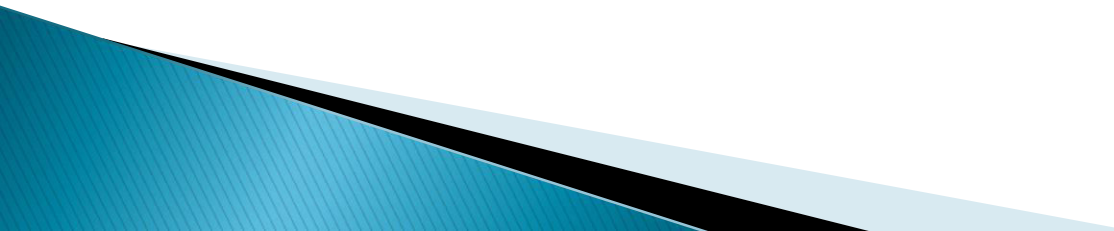
- knee extension; hip flexion

## ▶ Antagonist

Hamstring

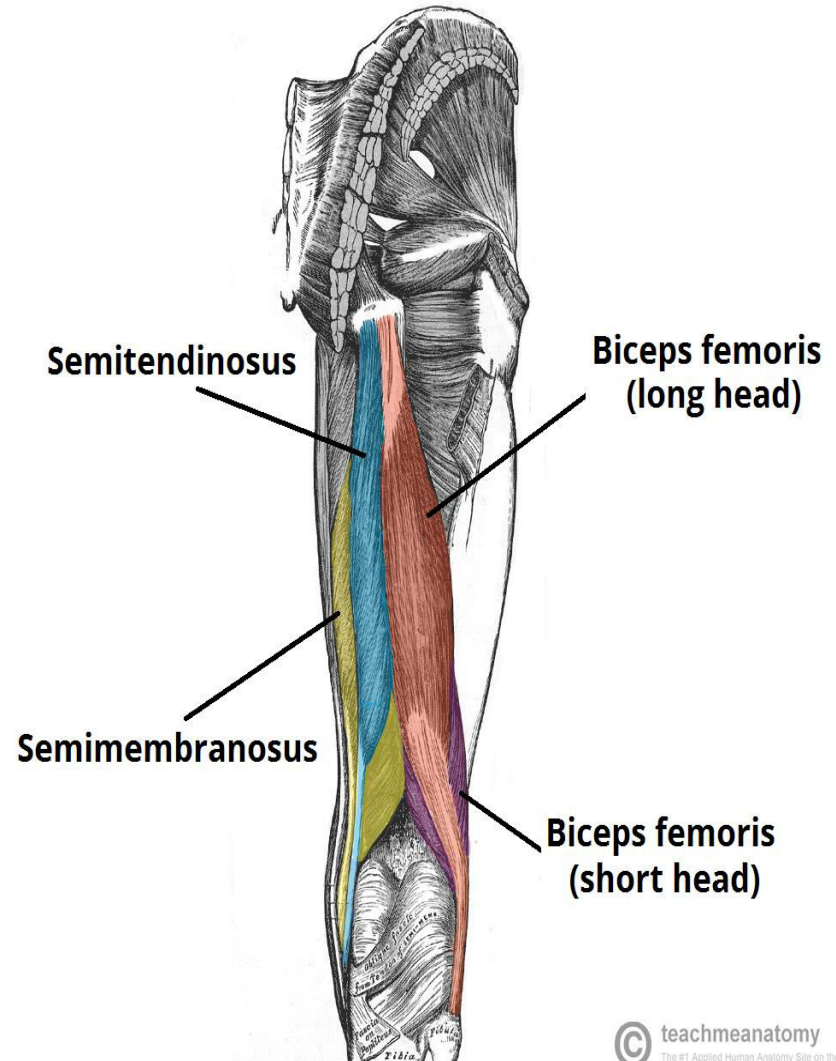


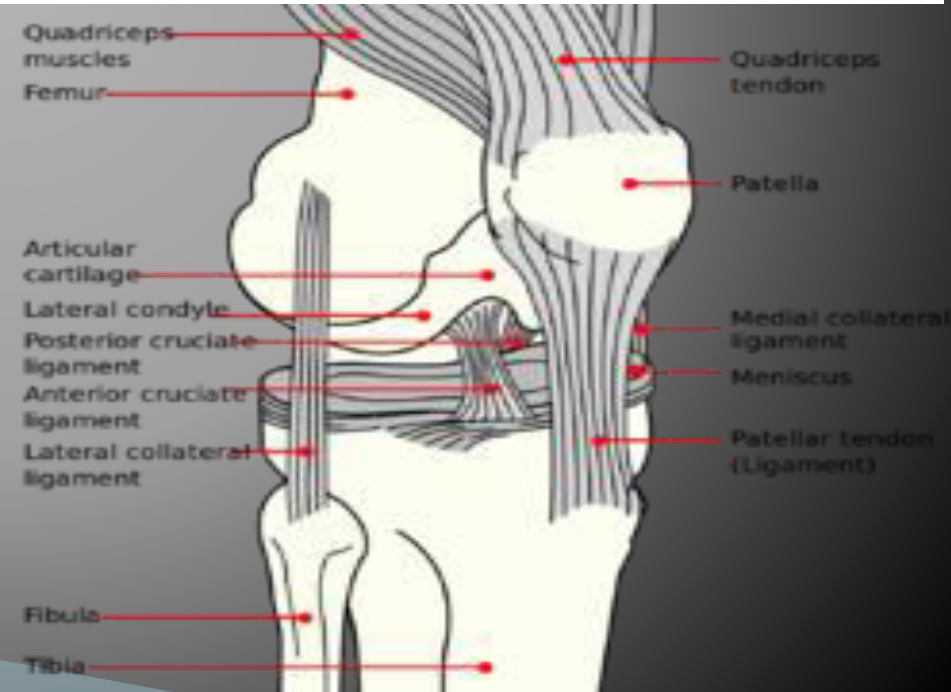
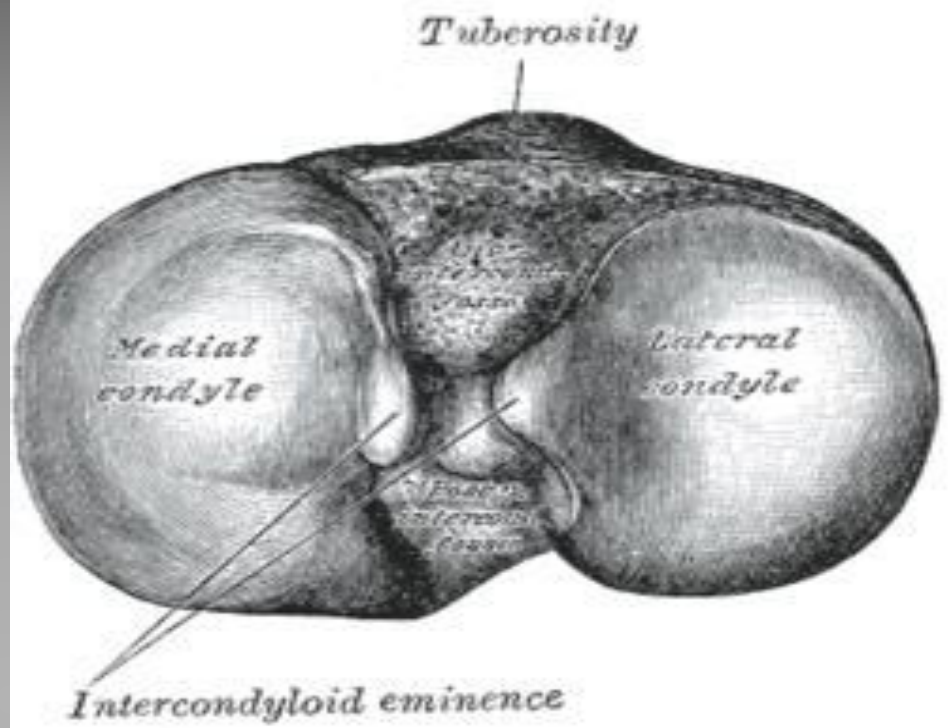
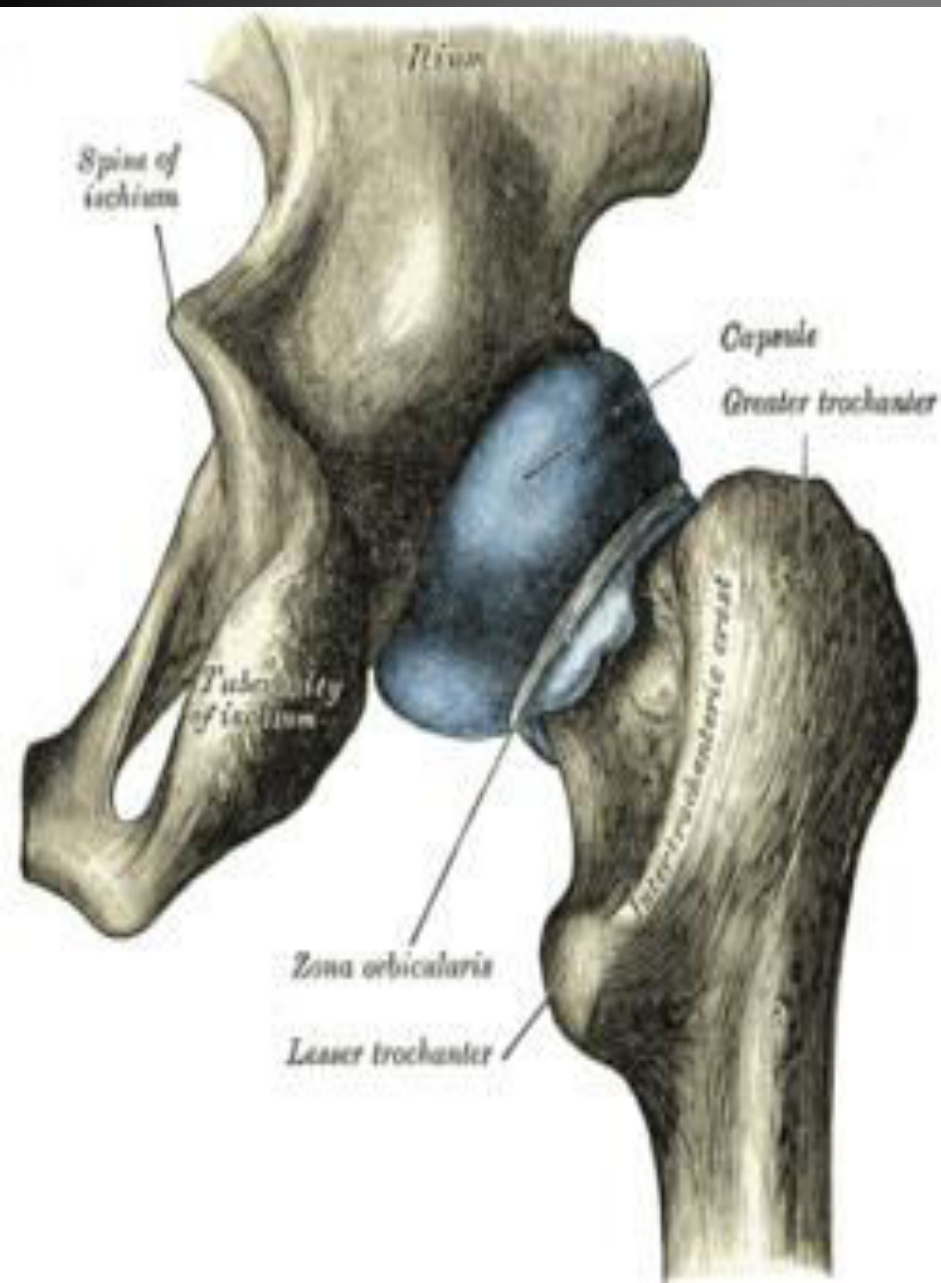
# Hamstring

- ▶ In human anatomy, a hamstring is any one of the three posterior thigh muscles in between the hip and the knee (from medial to lateral: semimembranosus, semitendinosus and biceps femoris). The hamstrings are quite susceptible to injury.
  - ▶ In quadrupeds, the hamstring is the single large tendon found behind the knee or comparable area.
- 

# Semimembranosus muscle

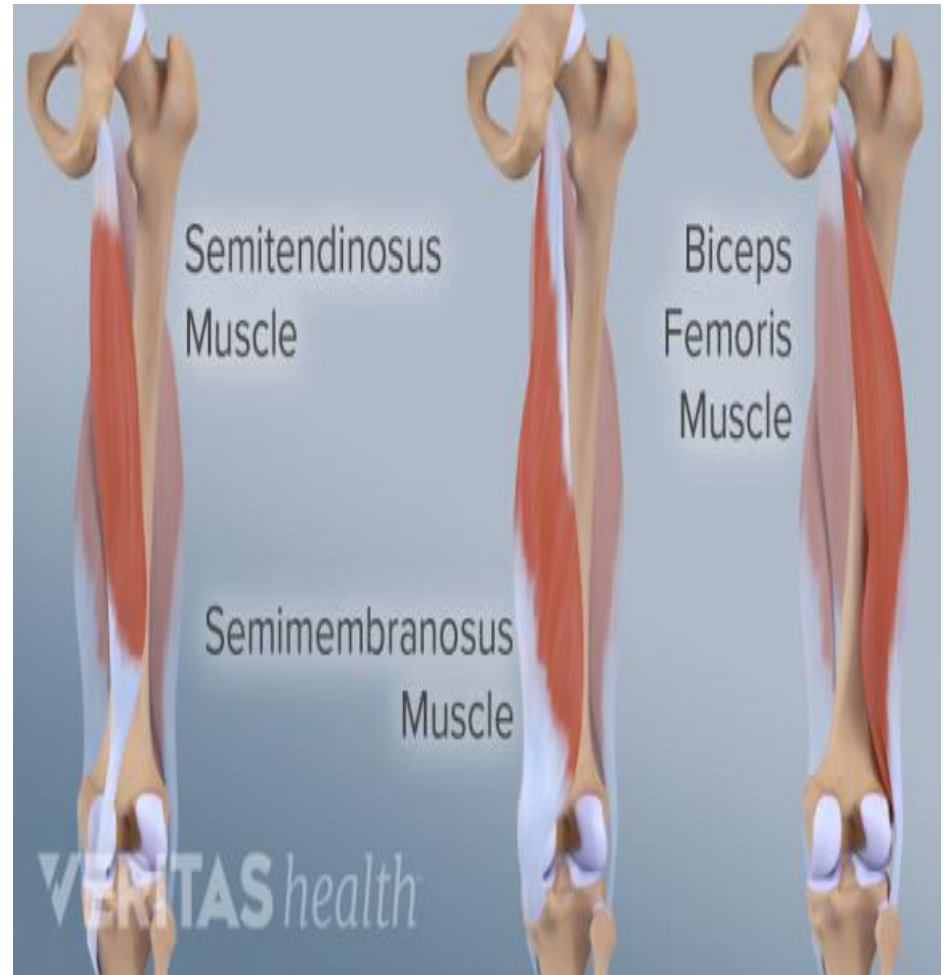
- ▶ **Origin**
  - Ischial tuberosity
- ▶ **Insertion**
  - Medial condyle of tibia
- ▶ **Actions**
  - Extension of hip and flexion of knee
- ▶ **Antagonist**
  - Quadriceps muscle and Tensor fasciae latae





# Semitendinosus muscle

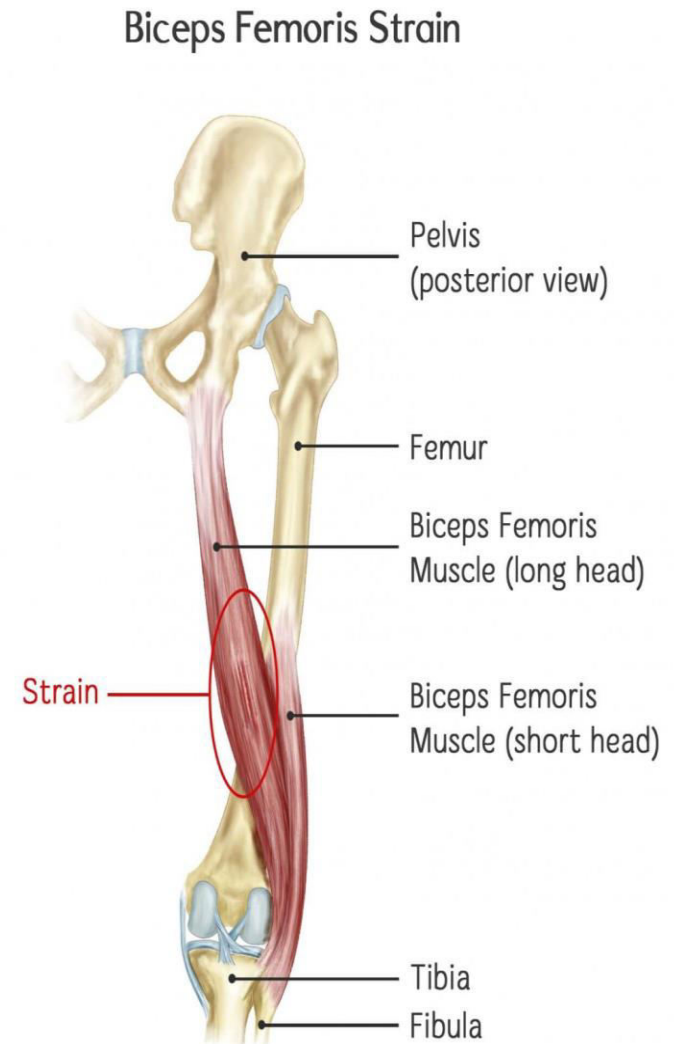
- ▶ **Origin**
  - Lower Quadrangular part of tuberosity of the ischium
- ▶ **Insertion**
  - Pes anserinus (tibia)
- ▶ **Actions**
  - Flexion of knee, extension of the hip joint
- ▶ **Antagonist**
  - Quadriceps muscle



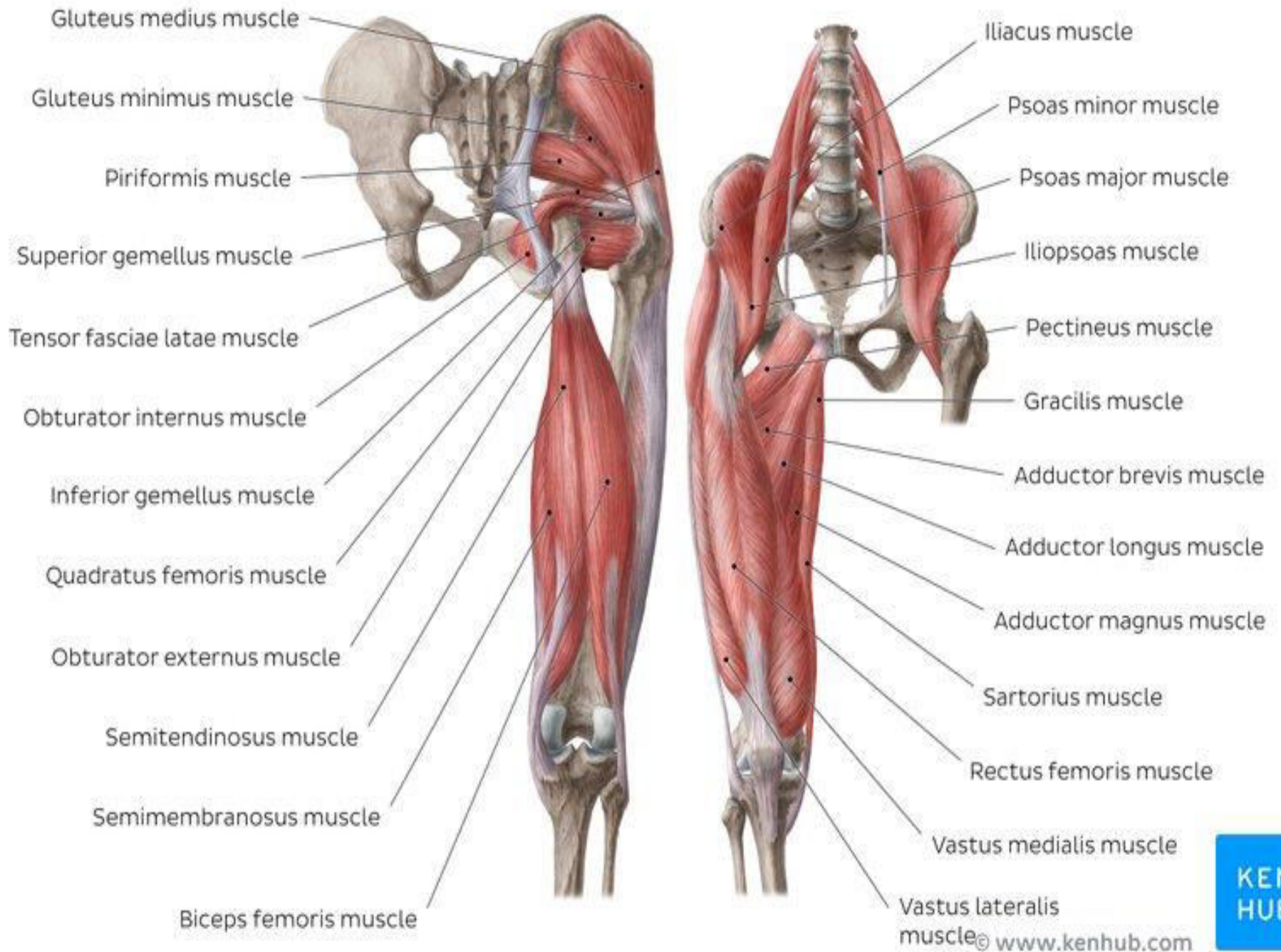


# Biceps femoris muscle

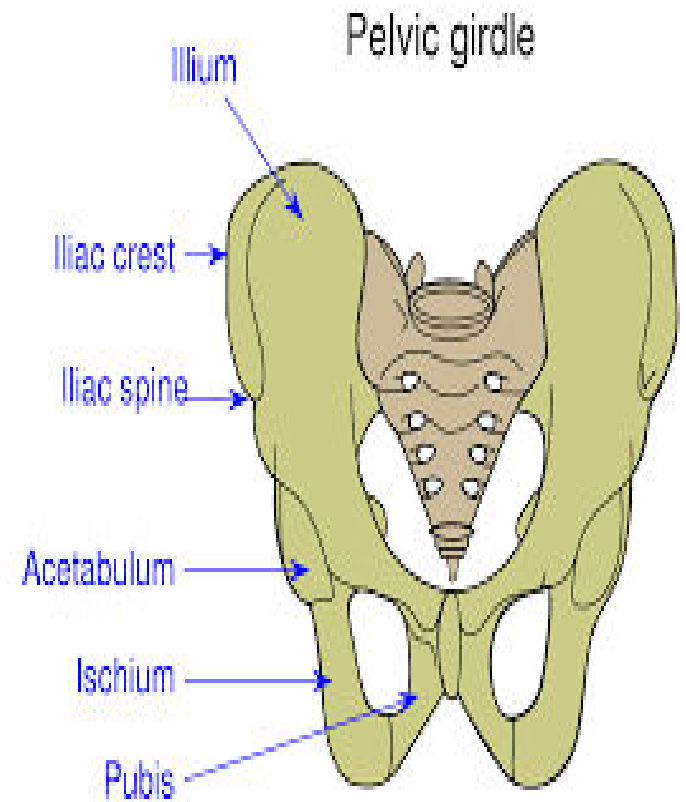
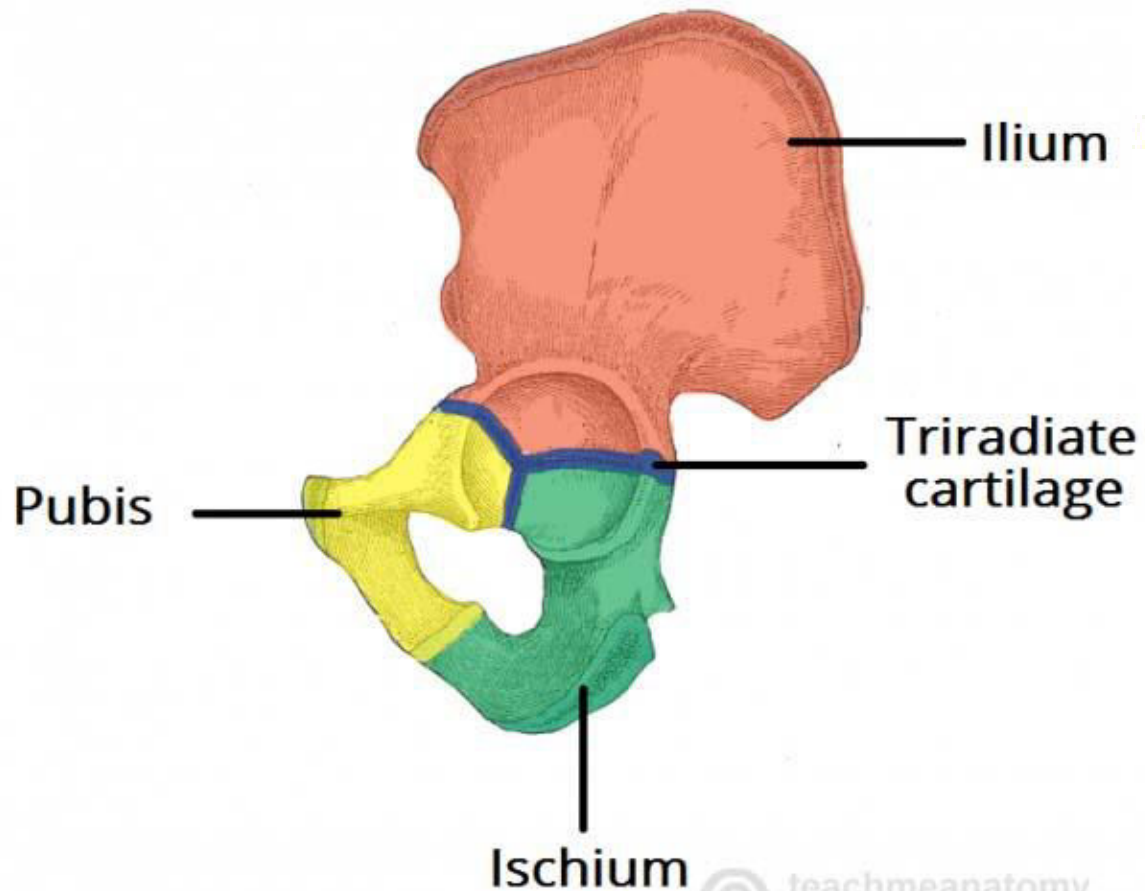
- ▶ **Origin**
  - tuberosity of the ischium, linea aspera, femur
- ▶ **Insertion**
  - the head of the fibula which articulates with the back of the lateral tibial condyle
- ▶ **Actions**
  - flexes knee joint, laterally rotates knee joint (when knee is flexed), extends hip joint (long head only)
- ▶ **Antagonist**
  - Quadriceps muscle



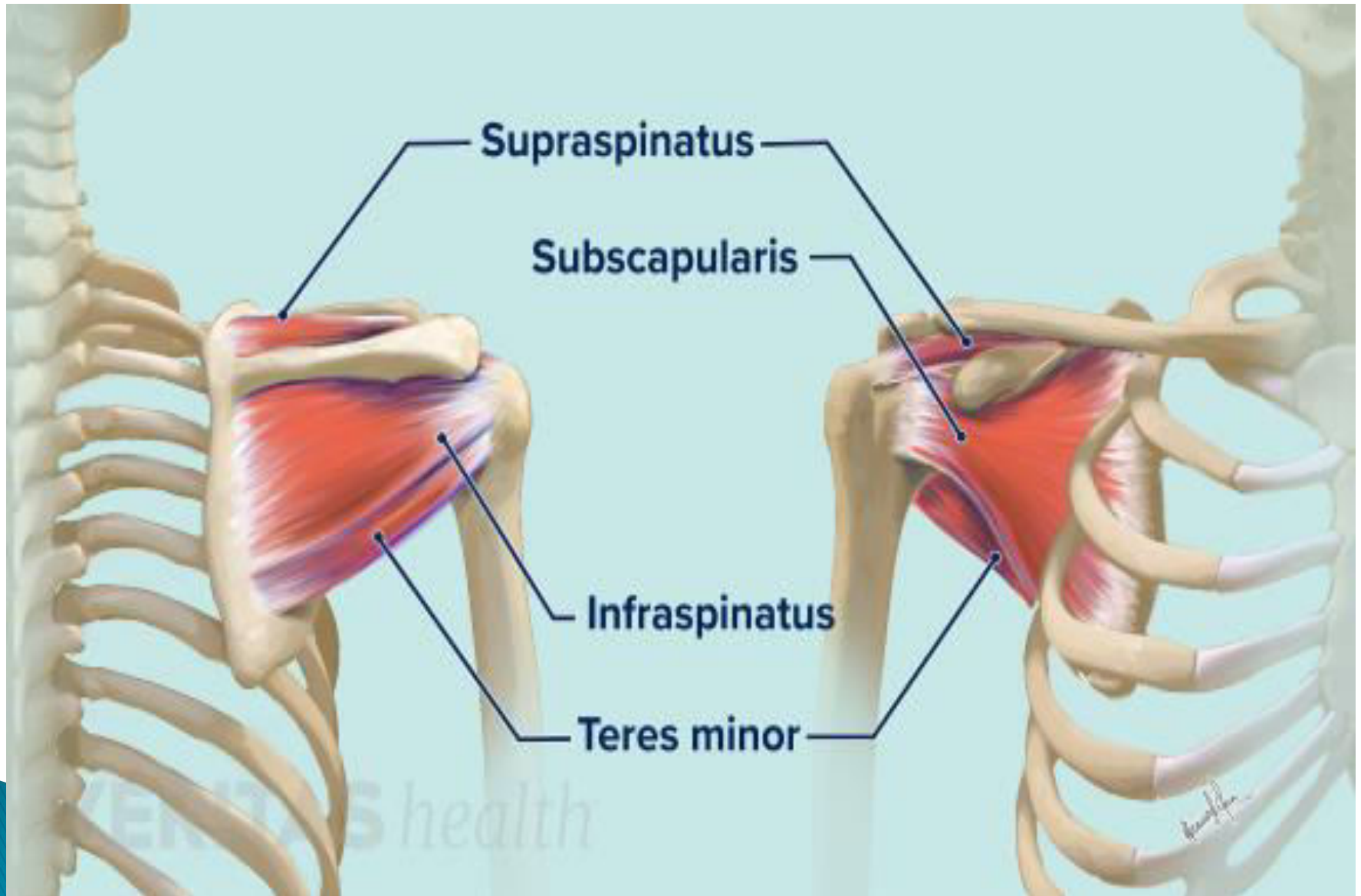
Back View



# Pelvis Bone



# Rotator cuff muscles

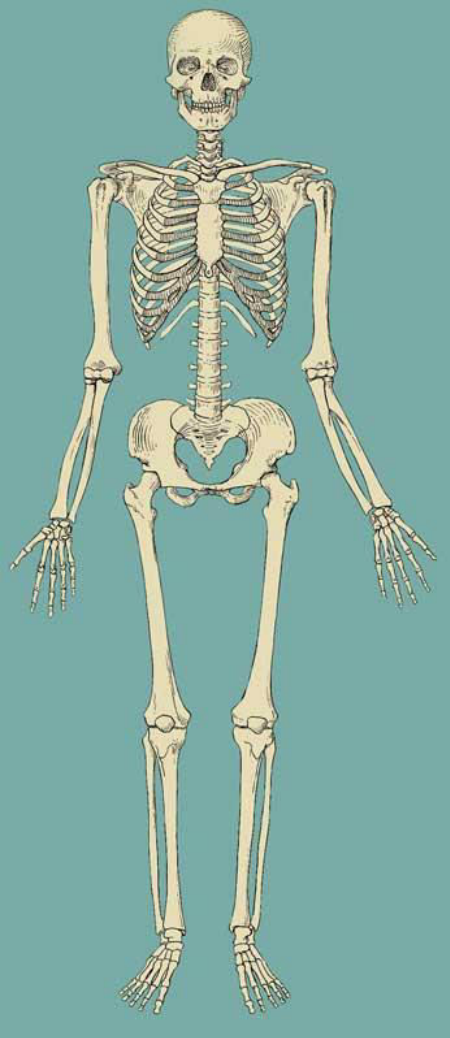


# The Anatomical Position



Orienting ourselves with the body

# What is it?



The anatomical position is:

*“the universal accepted starting point used to describe or analyze anatomical terms or movement.”*

To be in correct anatomical position, the body must meet 3 criteria:

1. Upright, standing position
2. Face and feet pointing forward
3. Arms at the side, palms facing forward

But how do we use the anatomical position to describe movement?



Before looking specifically at movement, we first have to understand how to describe movement. :

1. Planes
2. Axes
3. Position



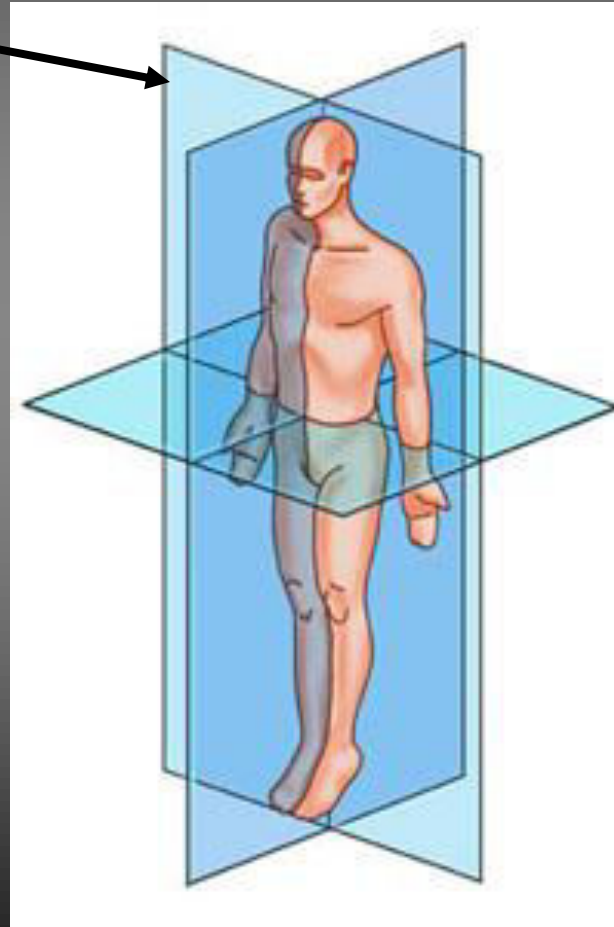
You will be learning and expected to use a new language from here on in!

# Anatomical Planes

- relate to positions in space and found at right angles to each other
- these planes can be positioned on any specific parts of the body

## Frontal(Coronal)

- vertical; splits the body into front and back halves





## Frontal section of the human face



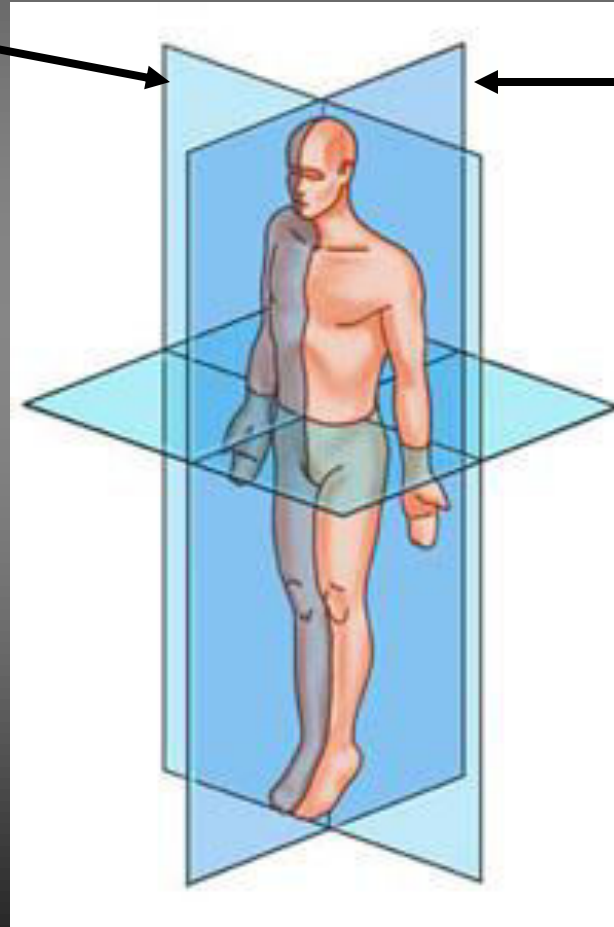
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# Anatomical Planes

- relate to positions in space and found at right angles to each other
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## Frontal(Coronal)

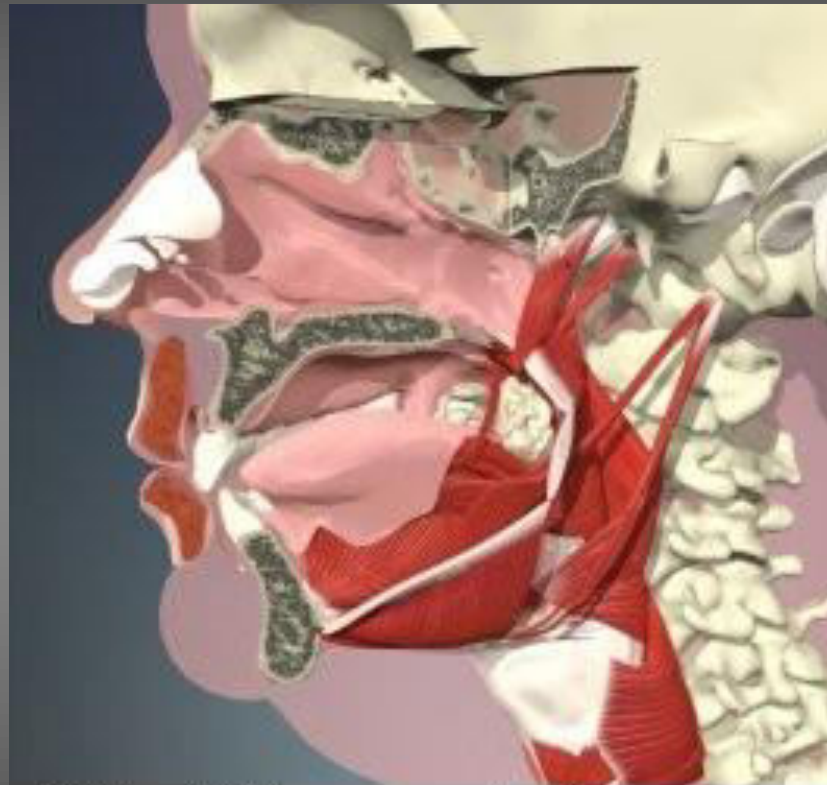
-vertical; splits the body into front and back halves



## Sagittal

-vertical; splits the body into left and right halves

## Sagittal view of the human face



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# Anatomical Planes

-relate to positions in space and found at right angles to each other

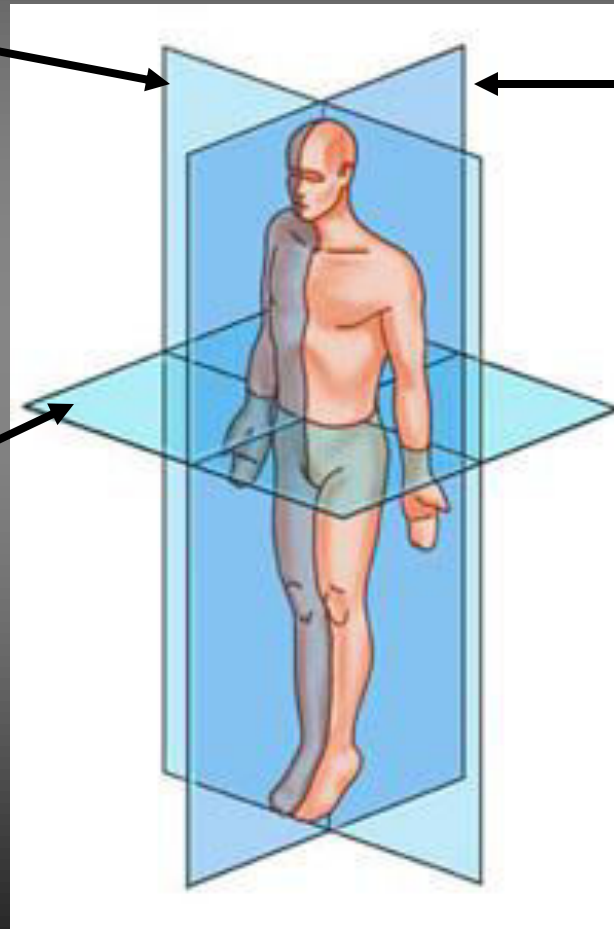
-these planes can be positioned on any specific parts of the body

## Frontal(Coronal)

-vertical; splits the body into front and back halves

## Transverse

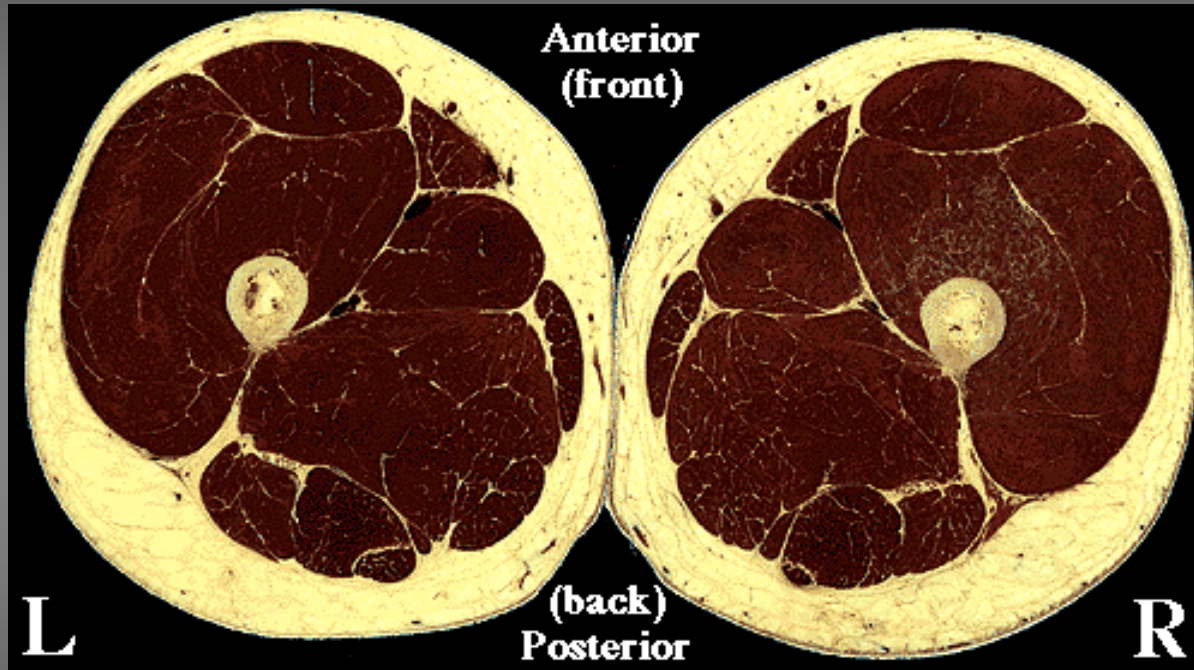
-horizontal; splits the body into upper and lower halves



## Sagittal

-vertical; splits the body into left and right halves

## Transverse view of the human thigh

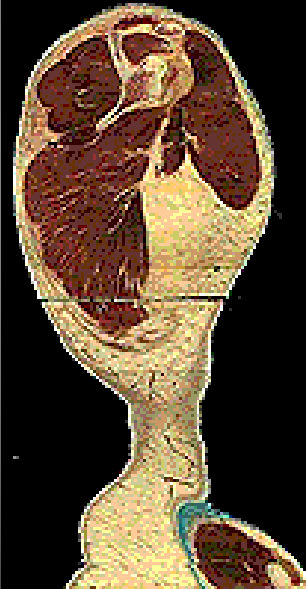


## The Frontal Plane

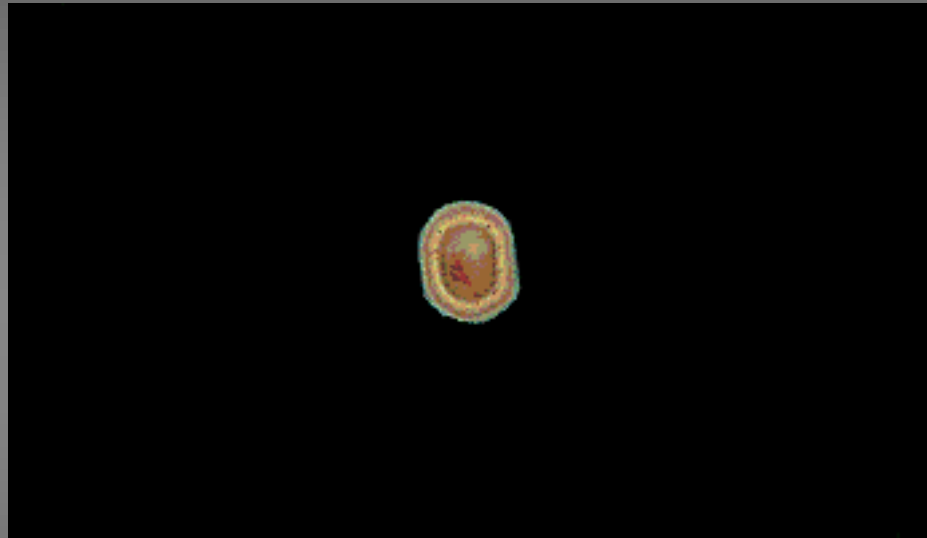
**Front  
(Anterior)**

# The Sagittal Plane

**Right Side**



# The Transverse Plane

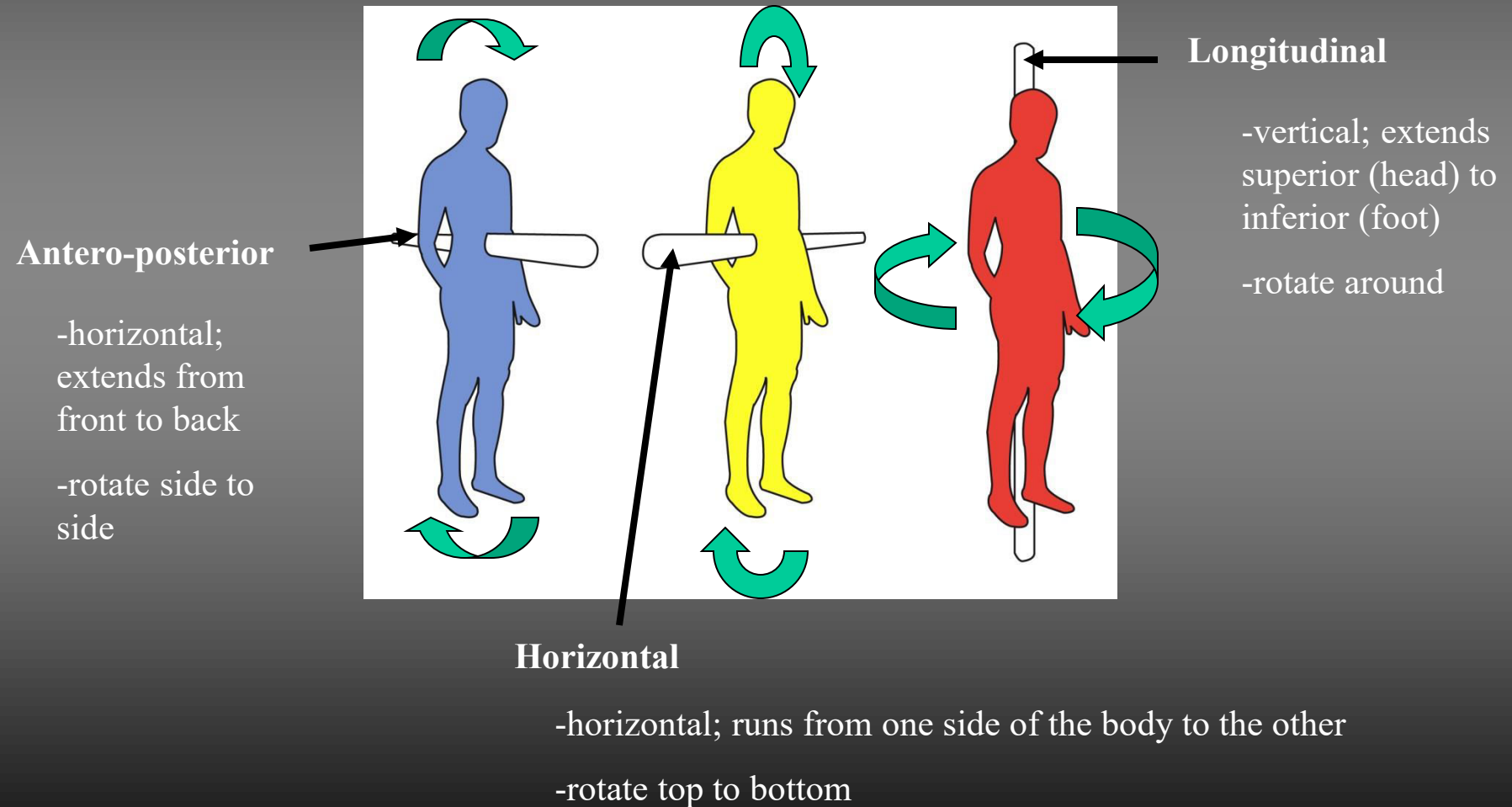




# Anatomical Axes

-a lot of our movement occurs via our joints

-axes are used to describe the direction of movement at joints



# Body Position Terminology

- The following terms will become like a second language for you. These terms are used to describe position of the body and will be used extensively when we talk about muscles and bones

**Superior-** towards the top of the body (cranial)

**Inferior-** towards the bottom of the body (caudal)

**Anterior-** towards the front of the body (ventral)

**Posterior-** towards the back of the body (dorsal)

**Medial-** towards the midline(centre) of the body

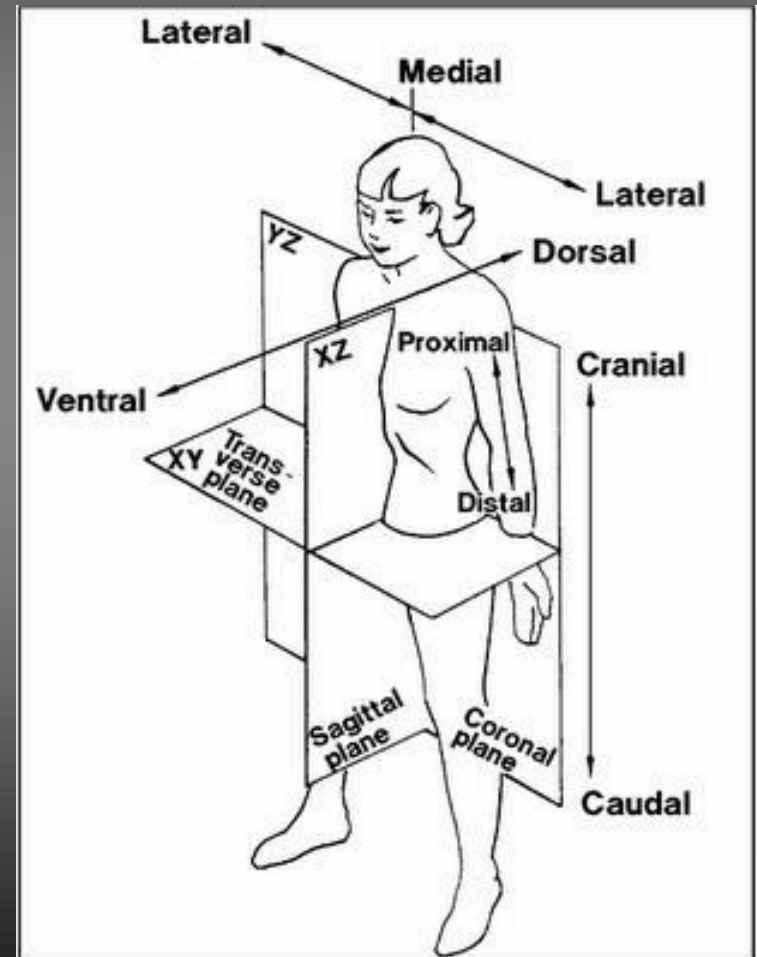
**Lateral-** away from the midline of the body

**Proximal-** situated closest to the point of attachment

**Distal-** situated farthest from the point of attachment

**Superficial-** on or close to the surface of the body

**Deep-** farther away from the surface of the body



# Let's apply our knowledge

1.



2.



Using what you have learned today, for each of these movements: 1) cartwheel and 2) figure skater spin, describe the motion by which plane and axis each movement occurs

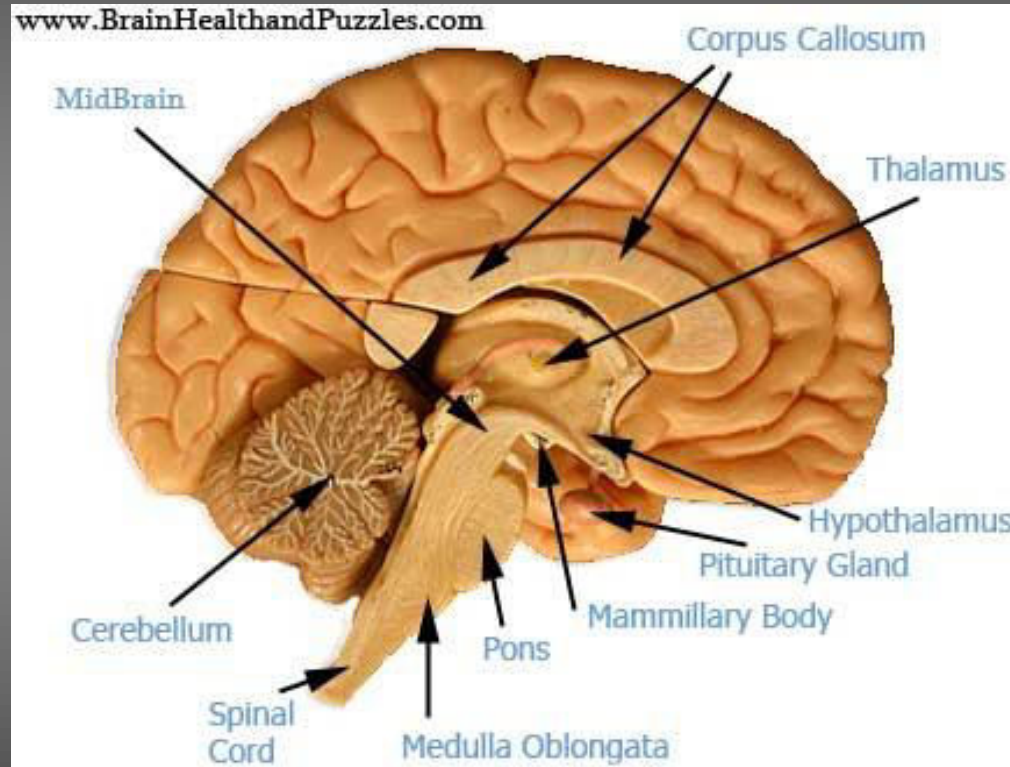
Plane: **Frontal**

Axis: **Anteroposterior**

Plane: **Transverse**

Axis: **Longitudinal**

**Describe the anatomical plane that each of the following pictures is viewed from:**



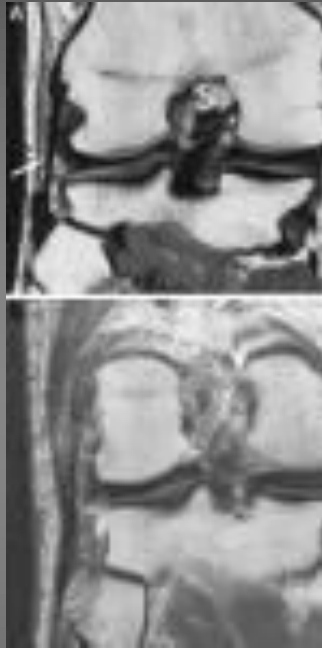
**sagittal**



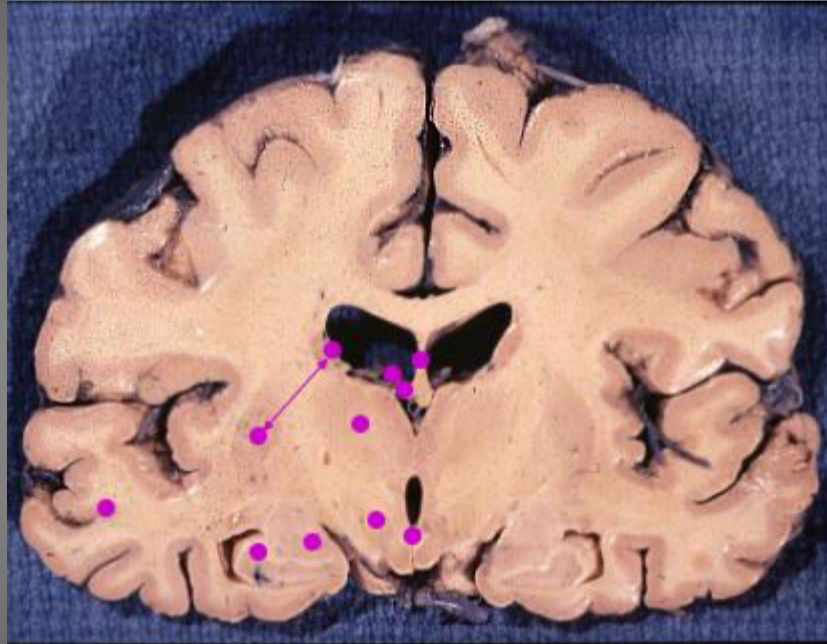
**Transverse**



**sagittal**



**frontal**



**frontal**