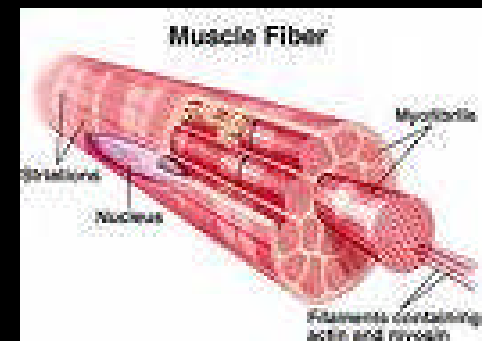


# Muscles and Muscle Actions

## L3Personal Trainer

[www.lesantoine.com](http://www.lesantoine.com)



# Learning Outcomes

- Name anatomical terms
- Name all major muscles and attachments
- Describe the structure of skeletal muscle
- Recognise different types of muscular contractions
- Be aware of muscle actions and group muscle actions
- Work out muscles used - for eight exercises

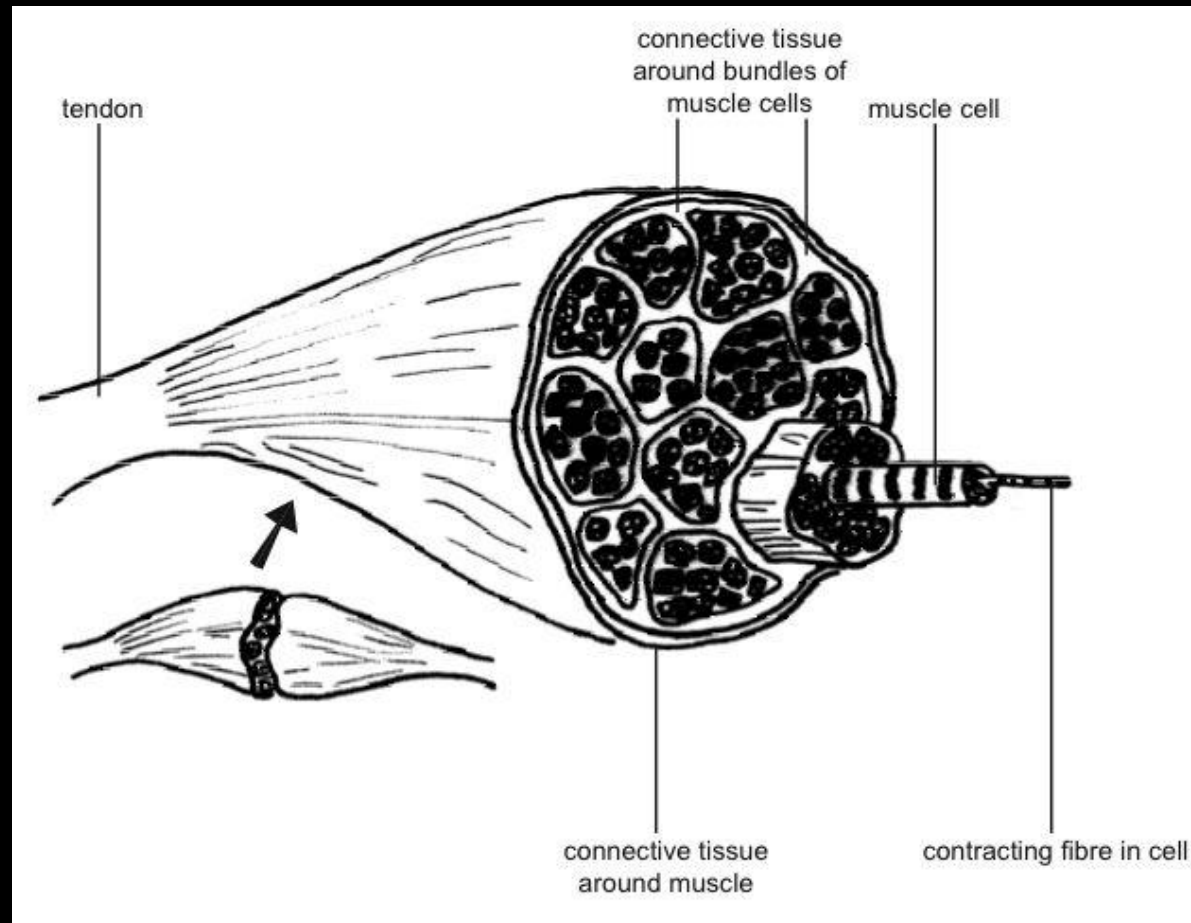
# Types of Muscle

- **Skeletal Muscle (Voluntary)** – brings about movement of the skeleton
- **Smooth Muscle (Involuntary)** – digestive system, blood vessels, respiratory tract
- **Cardiac Muscle (myocardium)** – found in the heart

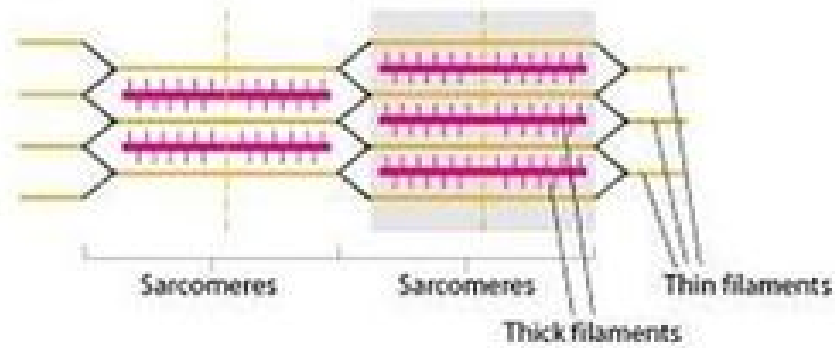
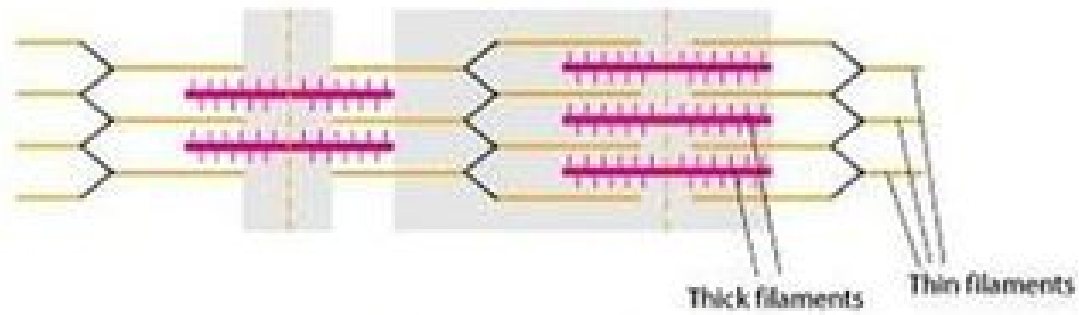
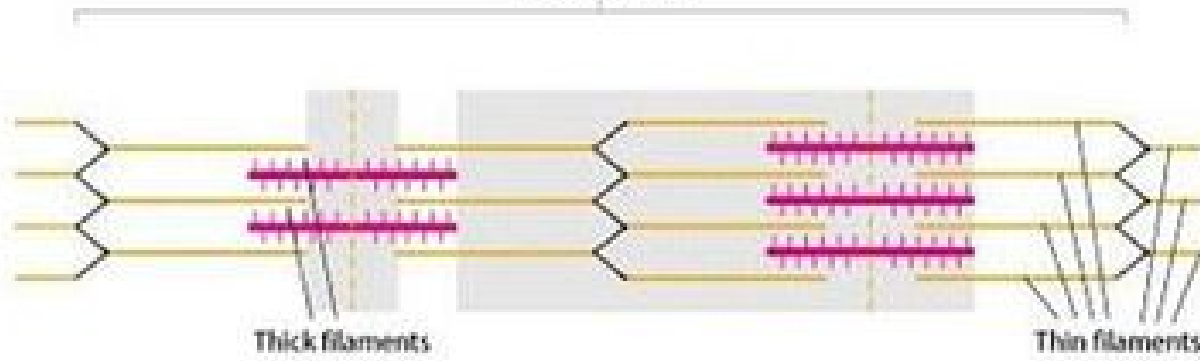
# Structure of Muscle

- Bundles of bundles of bundles!
- Endomysium sheath – holds fibres together
- Perimysium sheath – holds bundles of fibres together
- Epimysium – holds the bundles of bundles together to form a big thick muscle!

# Structure of Skeletal Muscle



2 Sarcomeres



# Sliding Filament Theory (Muscle Contraction)

- Actin – thin protein filaments
- Myosin – thick protein filaments
- Myofibril – inside muscle fibre, like lots of tiny little cables (muscle cell)
- Sarcomere – ‘compartment’ where contraction takes place
- Fibres held together by Endomysium

# More Sliding Filament

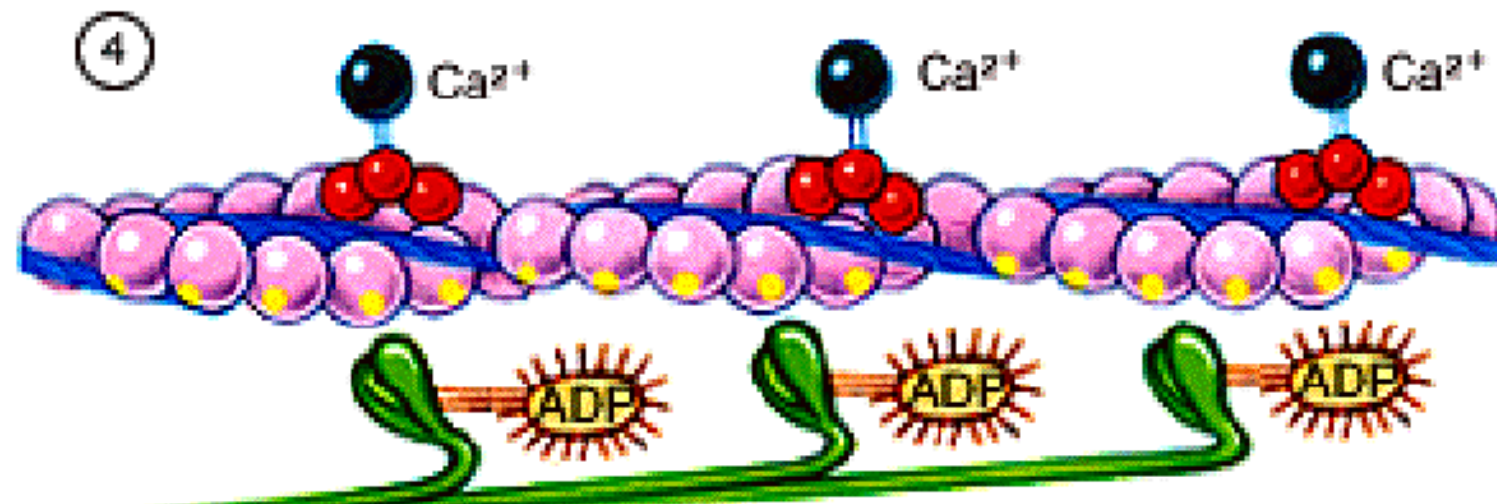
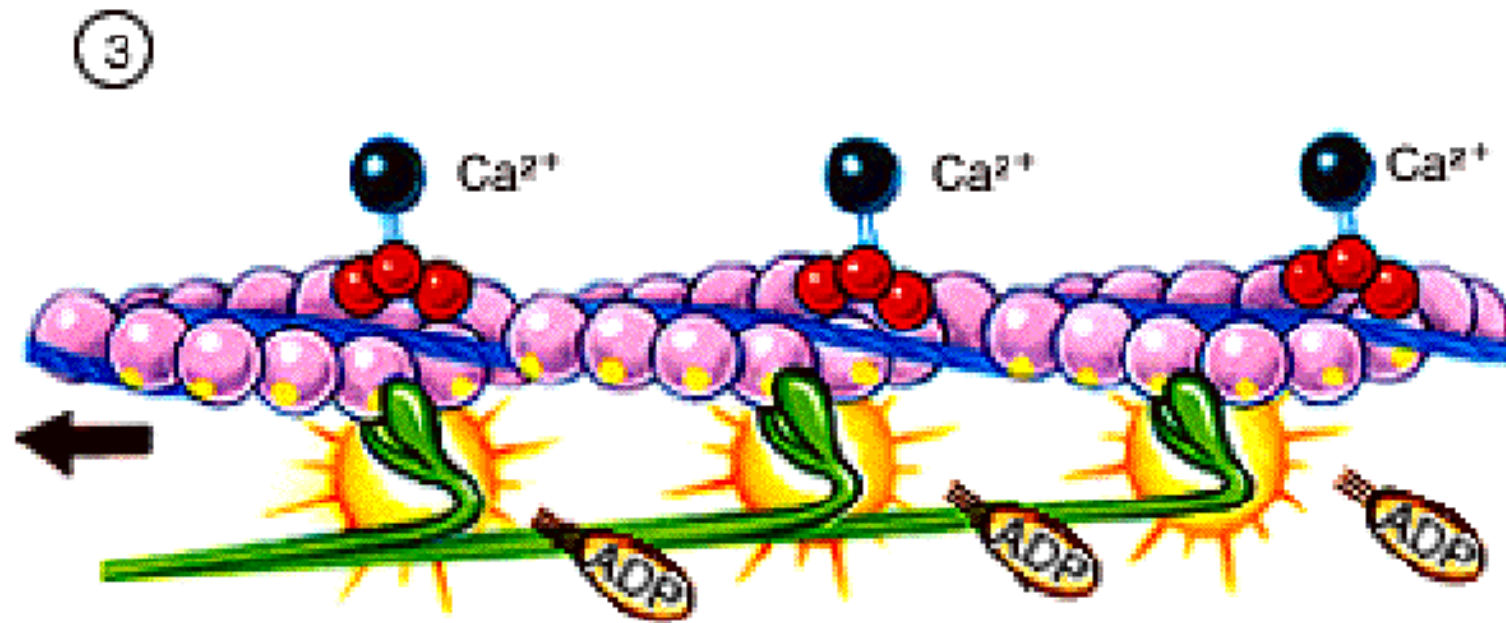
- Sarcomeres surrounded by Sarcolemma
- Sarcolemma contains Sarcoplasm and is electrically conductive
- Sarcoplasm contains Glycogen and Enzymes
- Within Sarcoplasm is a membrane called Sarcoplasmic Reticulum (SR)
- SR contains Transverse Tubules that end in a Lateral Sac at surface of Muscle Cell

# Even more Sliding Filament Theory

- Nervous impulses travels along peripheral fibre to muscle fibre
- At nerve end Acetylcholine (Ach) is released which changes conductivity of sarcolemma (from approximately  $-95\text{mV}$  to  $-50\text{mV}$ )
- This allows Calcium to travel down Transverse Tubules to bind with Troponin
- Troponin is able to bind with tropoMyosin which causes the Myosin to form a bond with Actin and pull towards each other, pulling the ends of the Sarcomere inwards thus shortening the entire muscle fibre

# Sliding Filament info

- Tropomyosin – winds around Actin filaments. When Tropomyosin is relaxed it prevents Actin and Myosin from binding
- Potassium restores conductivity to (-95mV) to close calcium channels in T-Tubules
- Cross Bridges – project from Myosin filaments
- Glycogen – broken down by Enzymes to produce pyruvate, which in turn is broken down to acetyl co enzyme A (acetyl CoA) to make ATP as fuel for muscle contraction

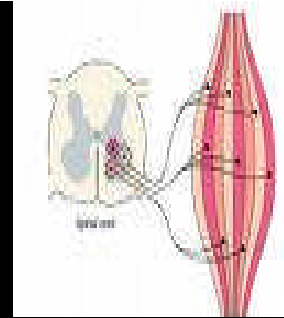


**Breakdown of ATP and Cross-Bridge Movement (Part 2)**

# Motor Unit

- Motor Unit consists of:
  - A Motor Neuron
  - all of the muscle fibres within it
- Motor neurons control all of the muscle fibres/cells in its control

# Muscle Contraction



- Muscle cells contract fully or not at all
- Strength of contraction depends on:
  - 1 Number of cells recruited*
  - 2 Frequency of impulses from nervous system*
- Large muscles have many hundreds of muscle cells controlled by one **MOTOR UNIT**
- More delicate bodily operations will have just a few muscle cells controlled by a single **MOTOR UNIT**

# Nervous Pathways

- Messages from Central Nervous System to Muscles are known as **Efferent** nerves and are carried along **Efferent** Neurons. Consider picking up a box
- Messages from muscles to CNS are known as **Afferent** nerves, and are carried along **Afferent** Neurons. Consider nodding off in a boring lecture!!!!


# Nervous Pathways

- Muscle Spindles – involved in muscular contraction, are found in the belly of the muscle
- Golgi Tendon Organs – involved in relaxing an over-contracted muscle. Found at the 'end' or insertion (tendons) of the muscles. Consider PNF stretching
- *There is a constant balancing act going on controlled by the nervous system to contract and relax muscles depending on what you are doing at that moment in time*

# Muscle Fibre Types

- Type 1 – Slow Twitch – ALL AEROBIC, lots of MITOCHONDRIA, appear Red in colour, lots of capillaries, like to use OXYGEN
- Type 2a – Fast Twitch - Fast Oxidative Glycolytic INBETWEEN AEROBIC AND POWER
- Type 2b – Fast Twitch Fast Glycolytic – ALL POWER. Low in mitochondria, appear White in colour, low in capillaries, can only use GLUCOSE

# Types of Muscle Contractions

- Concentric – muscle shortens **UNDER TENSION**  


Isotonic and Dynamic  
With movement
- Eccentric – muscle lengthens **UNDER TENSION**
- Static Isometric – muscle stays same length **UNDER TENSION**

# Muscle Actions

*(A muscle must cross a joint in order to affect it)*

- **Agonist or Prime Mover** - the **main muscle** responsible for the action
- **Antagonist** – the muscle that has to **relax** in order for movement to take place, the **opposing** muscle sometimes opposite in position, e.g. front and back of thigh
- **Synergist (helper)** – helps the Agonist to perform the action involved
- **Fixator (stabiliser)** – helps keep a joint or a body in place whilst an action takes place

# Joint Actions (Anatomical Terms)

- Flexion and Extension
- Protraction and Retraction
- Hyper Extension
- Adduction and Abduction
- Elevation and Depression
- Plantar Flexion and Dorsi Flexion
- Horizontal Flexion and Horizontal Extension
- Lateral Flexion and Lateral Extension
- Circumduction
- Rotation

# Shoulder Joint/Girdle Main Muscles

## **Trapezius**

**Origin - back of skull, C7, thoracic vertebrae**  
**Insert – Spine of scapula, lateral edge of clavicle**

## **Rhomboids**

**Origin – C7 and T1-T5**  
**Insert – Medial border of scapula**

## **Deltoids**

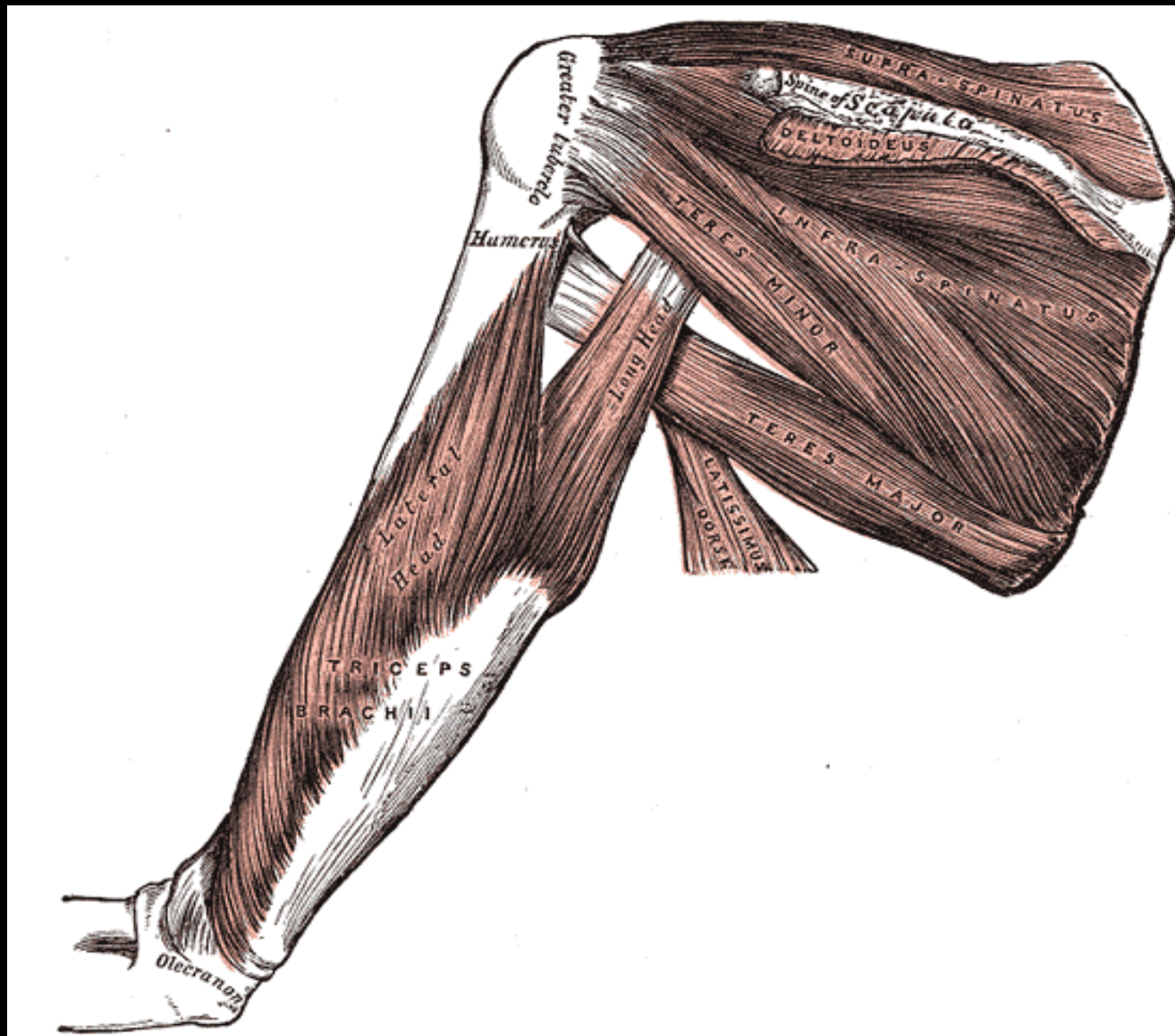
**Origin – spine of scapula, acromion process, clavicle**  
**Insert – laterally on top of humerus**

## **Pectoralis Major**

**Origin – Clavicle, sternum and cartilages of ribs 1-6**  
**Insert – fibres converge and insert into lateral top part of humerus (front of arm pit)**

## **Latissimus Dorsi (Lats)**

**Origin – Lots! Thoracic and lumbar vertebrae, iliac crest, lower ribs, inferior edge of scapula**  
**Insert – Top part of humerus (back of arm pit)**



# Pelvic Girdle Main Muscles

## Iliopsoas is two muscles Iliacus and Psoas Major

- Origin – Iliacus from front of iliac crest, Psoas Major from lumbar and T12
- Insert – Anterior top of femur

## Sartorius (longest muscle in body!)

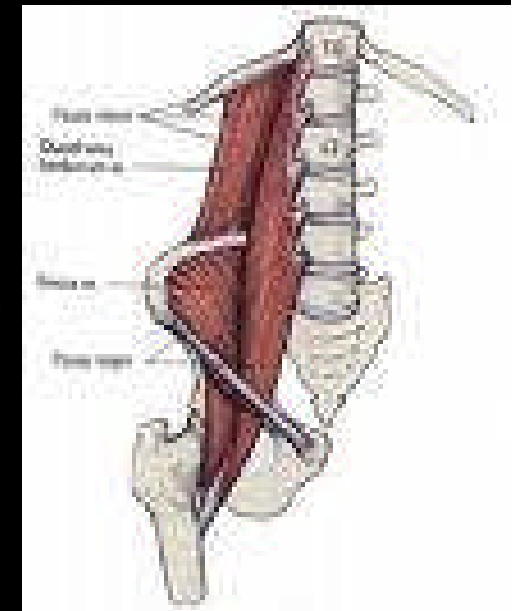
- Origin – anteriorly and laterally on iliac spine
- Insert – winds around inside of knee and inserts medially on tibia

## Gluteus Maximus (butt cheeks!)

- Origin – base of spine(sacrum/coccyx) and back of ilium
- Insert – posteriorly top of femur

## Adductors (groin strain!)

- Origin – anteriorly from base of pelvis – mainly pubic area
- Insert – medial length of femur



# Vertebral Column Muscles

## Erector Spinae (variety of muscles running along the length of the back)

- Origin – iliac crest and processes of vertebrae, outer fibres originate on ribs
- Insert – spine and processes of vertebrae, base of skull

## Quadratus Lumborum

- Origin – iliac crest and iliolumbar fascia
- Lumbar vertebrae



# Abdominal Muscles

## Rectus Abdominus

**Origin – Pubis symphysis**

**Insert – cartilages of ribs 5-7 and base of sternum**

## External Obliques

**Origin – outer surface of bottom 8 ribs**

**Insert – mainly linea alba, also iliac crest**

## Internal Obliques

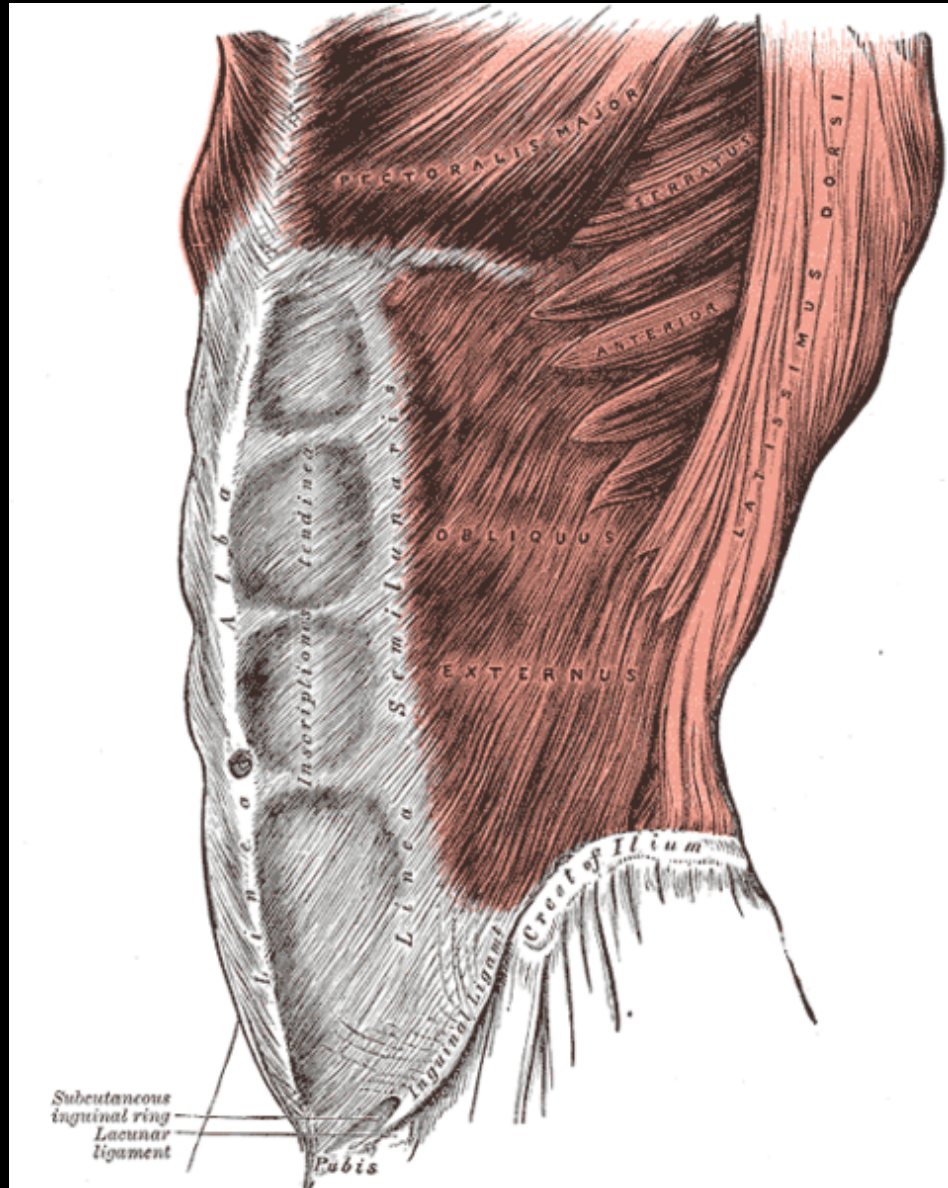
**Origin – Lumbar fascia**

**Insert – Linea alba, bottom 3 ribs**

## Transversus Abdominus

**Origin – lumbar fascia, cartilage of lower ribs, iliac crest**

**Insertion – linea alba**



Credit: Wikipedia

# Upper Limb Muscles

## Biceps

**Origin – Separate points on top of scapula**

**Insert – top of radius, near radioulnar joint (medially on arm)**

## Brachialis

**Origin – front of humerus, about a third of the way up from elbow**

**Insert – top of ulna**

## Triceps

**Origin – long head on scapula just above shoulder joint, other two heads on humerus laterally and posteriorly**

**Insert – Olecranon (point of elbow) of ulna**

# Lower Limb Muscles

## Quadriceps (four muscles)

### **Rectus Femoris, Vastus Medialis, Vastus Intermedius, Vastus Lateralis**

- Origin – (Rectus) iliac spine and top of acetabulum. (Vastii) anteriorly just below neck of femur
- Insert – Front of tibia via patella

*Rectus assists in Hip Flexion*

# Lower Limb Muscles

## Hamstrings (three muscles)

### **Biceps Femoris, Semimembranosus, Semitendinosus**

- Origin – ischial tuberosity (sitting bones), biceps short head arises posteriorly from the femur
- Insert – biceps laterally onto tibia and onto head of fibula, others onto tibial shaft medially

# Lower Leg Muscles

## Tibialis Anterior

- Origin – lateral condyle at proximal head of tibia and interosseus membrane two thirds of its length
- Insert – inferior surface of first metatarsal, medially on the foot

# Calf Muscles

## Gastrocnemius and Soleus

- Origin – Gastroc from medial and lateral condyles of femur just above knee. Soleus from proximal tibia and fibula and interosseus membrane
- Insert – Calcaneus via calcaneal (Achilles) tendon