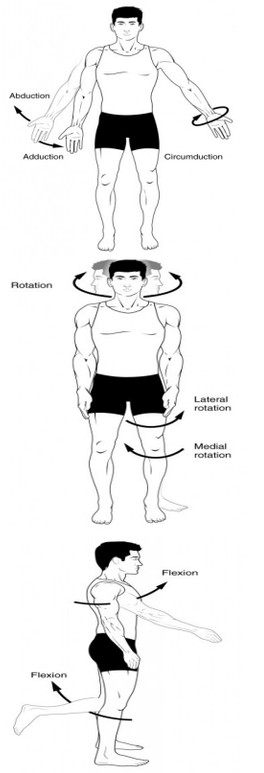
# Applied Anatomy & Physiology

## -Skeletal & Muscular Systems

## Types of Movements

| | |
|---|---|
| **Abduction Adduction** | Movement away from the midline of the body<br>Movement towards the midline of the body |
| **Horizontal Flexion Horizontal Extension** | When a limb is parallel to the ground and moves towards the midline of the body<br>When a limb is parallel to the ground and moves away from the midline of the body |
| **Dorsi Flexion Plantar Flexion** | The foot moves towards the tibia<br>The foot moves away from the tibia |
| **Pronation Supination** | Rotate your palms to face down<br>Rotate your palms to face up |
| **Horizontal Flexion Horizontal Extension** | When a limb is parallel to the ground and moves towards the midline of the body<br>When a limb is parallel to the ground and moves away from the midline of the body |
| **Rotation Medial Rotation Lateral** | When a bone turns about its long axis towards the body<br>When a bone turns about its long axis away from the body |
| **Flexion Extension** | Decreasing the angle at a joint<br>Increasing the angle at a joint |
| **Circumduction** | Movement in a circular motion |



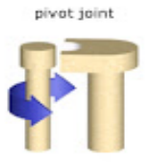

## Synovial Joints

### Pivot Joint

Formed by a ring of bone that fits over one sticking out

**Movement available: Rotation**

Example: Neck

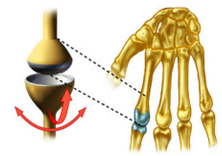



### Condyloid

Have an oval shaped bone end which fits into similar shapes, allowing small movements in all directions

**Movement available: Flexion, Extension, Abduction & Adduction**

Example: Wrist



### Gliding Joints

Occur between the surface of 2 flat bones held together by ligaments

**Movement available: Only a small amount of gliding movement is found**

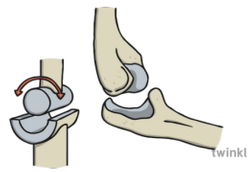
Example: Joints between the Metacarpal and Metatarsal bones


### Hinge Joint

A bone joint in which the articulating surfaces are moulded to each other in such a manner as to permit motion only in one plane

**Movements available: Flexion & Extension**

Example: Elbow & Knee

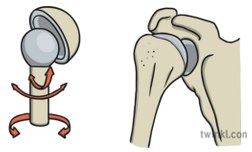



### Ball and Socket

A joint in which the rounded end of one bone fits into a cup like end of the other bone, allowing for relatively free rotary motion

**Movements available: Flexion, Flexion, Horizontal Flexion, Horizontal Extension, Adduction, Abduction, Circumduction, Medial Rotation and Lateral Rotation**

Example: Shoulder & Hip




## Ligament

A tough band of fibrous, slightly elastic connective tissue that attaches bone to bone

### Types of Bones

Flat bone - Sternum
Irregular Bone - Vertebrae
Sesamoid - Patella
Long Bone - Femur
Short Bone - Carpals

### Joint

A place where 2 or more bones articulate to create human movement

### Muscle Fibers

There are 3 types slow oxidative, fast oxidative glycolytic and fast glycolytic

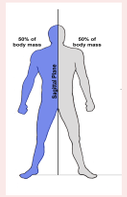
### Articulating Cartilage

Smooth tissue which covers the surface of articulating bones to absorb shock and allow friction-free movement

## Planes of Movement

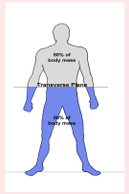
### Sagittal

- Divides the body into anterior (front) and posterior (back)
- Adduction and Abduction
- Cartwheel



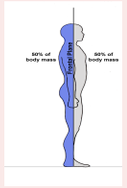

### Transverse

- Divides the body into superior (upper) and inferior (lower)
- Horizontal flexion and extension
- Twisting in a discus throw




### Frontal

- Divides the body into left (medial) and right (lateral)
- Flexion and Extension
- Kicking a football




## Muscle Fibre Types

| Slow Oxidative (type 1) | Fast Oxidative Glycolytic (type 2a) | Fast Glycolytic (type 2b) |
|---|---|---|
| • Structurally designed to store oxygen in myoglobin and process oxygen in the mitochondria<br>• Works aerobically<br>• Produces a small amount of force<br>• Fatigue for a long period of time<br>• 90s recovery<br>• Work to relief ratio<br>• Slow contraction<br>• Long distance runners<br>• Marathon<br>• Triathlon<br>• Cross-country skiing | • Structurally designed to produce a large amount of force quickly<br>• Maximal effort required quickly<br>• Capacity to resist fatigue<br>• Recovery is longer<br>• Fast contraction<br>• High intensity activities<br>• 800-1500m runners<br>• 200m freestyle | • Structurally designed to work anaerobically<br>• Large stores of phosphocreatine for rapid energy production and the largest amount of force<br>• Fatigue quickly<br>• Recover in 4-10 days<br>• Fast contraction<br>• 60-100m sprinters<br>• Javelin<br>• Long jump |

## Role of a Motor Unit

| | |
|---|---|
| 1 | Nerve impulse initiated in the motor neurone cell body |
| 2 | Nerve impulse conducted down the axon of the motor neurone by a nerve action potential to the synaptic cleft |
| 3 | Neurotransmitter called acetylcholine is secreted into the synaptic cleft to conduct the nerve impulse across the gap |
| 4 | If the electrical charge is above a threshold, the muscle fibre will contract |
| 5 | This happens in an 'all-or-none' fashion |

## Slow Oxidative Muscle Fibres

A type of muscle fibre rich in mitochondria, myoglobin ad capillaries which produces a small amount of force over a long period of time

## Fast Glycolytic Muscle Fibres

A type of muscle fibre rich in phosphocreatine which produces a maximal force over a short period of time

Small motor neurone stimulate relatively few small muscle fibres. This creates a motor unit which produces a small and slow amount of force over a long period of time, resisting fatigue well.
Large motor neurone stimulate many large muscle fibres. This creates a motor unit which produces a large amount of force rapidly, but fatigues quickly.

## Motor Units and Skeletal Muscle Contractions

| | |
|---|---|
| **Motor Neuron** | A nerve cell which conducts a nerve impulse to a group of muscle fibres |
| **Motor Unit** | A motor neurone and the muscle fibres stimulated by its axon |
| **Action Potential** | Positive electrical charge inside the nerve and muscle cells which conducts the nerve impulse down the neuron and into the muscle fibre |
| **All-Or-None Law** | Depending on whether the stimulus is above a threshold, all muscle fibres will give a complete contraction or no contraction at all |

## Work:Relief ratio

The volume of relief in relation to the volume of work performed

Aerobic training has a low work to relief ratio as it is 1:1 or 1:0.5

Maximal weight training work-to-relief ratios are very high, 1:3+.
Work then rest for 3-5 mins between sets of 2-6 reps

Slow oxidative muscle fibres will recover very quickly and be available for recruitment in just 90 seconds

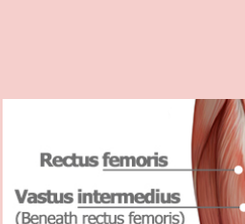
Fast glycolytic muscle fibres are thought to be recruited in the last 2-20 seconds of contraction, they recover 24-48 hours after exercise

When fast glycolytic fibres have been used they take 4-10 days to recover

## Muscular System Key Words

| | |
|---|---|
| **Agonist** | A muscle responsible for creating movement at a joint |
| **Antagonist** | A muscle that opposes the agonist providing a resistance for a coordinated movement |
| **Isotonic** | When a muscle changes length during contraction |
| **Isometric** | When a muscle lengthens during a contraction |
| **Concentric** | When a muscle shortens during a contraction bringing bones closer together |
| **Eccentric** | When a muscle lengthens during a contraction |
| **Insertion** | The point where a muscle attaches to a moveable bone which gets closer to the origin during a muscle contraction |
| **Origin** | The point where a muscle attaches. To s a stationary bone which stays relatively fixed during the contraction |
| **Tendon** | A fibrous connective tissue that attaches muscle to bone |
| **Fixator** | A muscle that stabilises one part of the body while another causes movement |

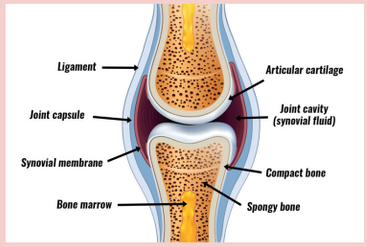
## The Skeleton

| Axial | Appendicular |
|---|---|
| The bones included in the axial skeleton are those that can be found along the body's long axis.<br><br>**These are as follows:**<br>• **Cranium**<br>• **Sternum**<br>• **Rib Cage**<br>• **Vertebral Column**<br>• **Pelvic Girdle** | The bones included in the appendicular skeleton are those make up those found in the limbs of our body.<br><br>**These are as follows:**<br>• **Scapula**<br>• **Humerus**<br>• **Ulna**<br>• **Radius**<br>• **Carpals**<br>• **Femur**<br>• **Tibia**<br>• **Fibula**<br>• **Talus** |
|  |  |

| Shoulder Joints | Movement |
|---|---|
| Middle Deltoid | Abduction |
| Anterior Deltoid | Flexion |
| Pectoralis Major | Horizontal Flexion |
| Trapezius | / |
| Posterior Deltoid | Horizontal Extension |
| Teres Minor | / |
| Subscapulais | / |
| Latissimus Dorsi | Adduction |

| Common Features of a Synovial Joint | Structure | Function |
|---|---|---|
| Ligament | A tough band of slightly elastic connective tissue | Connects bone to bone and stabilises joints during movement |
| Synovial Fluid | Lubricating liquid contained within the joint cavity | Reduces friction and nourishes articulating cartilage |
| Articulating Cartilage | Smooth tissue which covers the surface of articulating bones | Absorbs shock and allows friction-free movement |
| Joint Capsule | A fibrous sac with an inner synovial membrane | Encloses and strengthens the joint secreting synovial fluid |
| Bursa | A closed, fluid-filled sac found where tendons rub over bones | Reduces friction between tendons and bones |

## Synovial Joint



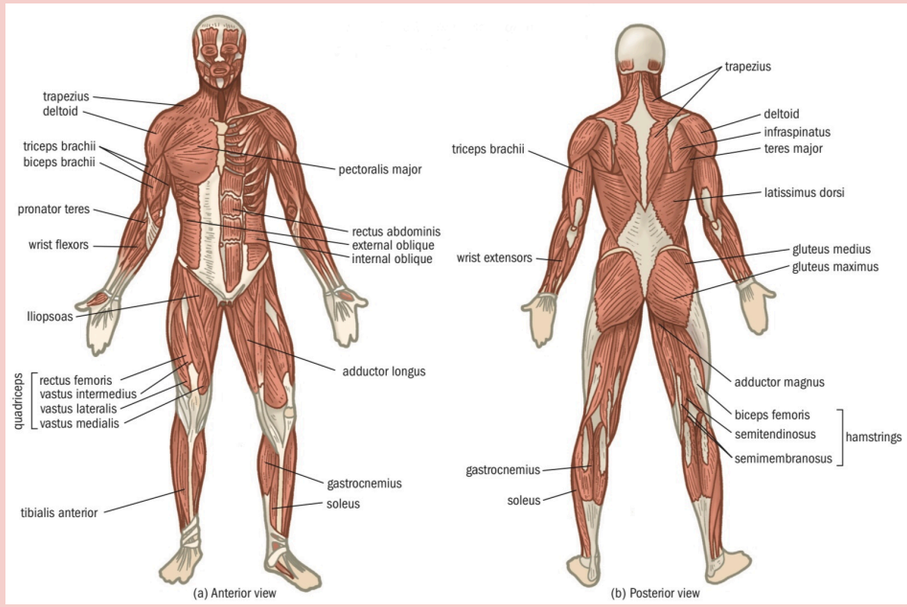

## Movement Analysis

To analyse different movements you need to include:

- **Joint Type**
- **Articulating Bones**
- **Movement Pattern**
- **Agonist Muscle**
- **Antagonist Muscle**
- **Contraction Types**

| Hip | Movement |
|---|---|
| Lliopsoas | Flexion |
| Adductor Brevis | Adduction |
| Adductor Longus | Adduction |
| Adductor Magnus | Adduction |
| Gluteus Medius | Abduction |
| Gluteus Minimus | Abduction |
| Gluteus Maximus | Extension |

## Major Skeletal Muscles




| Movement | Agonist | Antagonist |
|---|---|---|
| Flexion (Wrist) | Wrist flexors | Wrist extensors |
| Flexion (Elbow) | Biceps brachii | Triceps brachii |
| Flexion (Shoulder) | Anterior deltoid | Posterior deltoid |
| Flexion (Hip) | Ilipsoas | Gluteus maximus |
| Flexion (Knee) | Biceps femoris (hamstring group) | Rectus femoris (quadriceps group) |
| Dorsi-Flexion (Ankle) | Tibialis anterior | Gastrocnemius and soleus |

| Elbow | Movement |
|---|---|
| Biceps Brachii | Flexion |
| Triceps Brachii | Extension |

| Wrist | Movement |
|---|---|
| Wrist Flexors | Flexion |
| Wrist Extensors | Extension |

## Quadricep Group




**Extension**

| Ankle | Movement |
|---|---|
| Tibialis Anterior | Dorsi-Flexion |
| Gastrocnemius | Plantar-Flexion |
| Soleus | Plantar Flexion |

### Isotonic Contraction

#### Concentric Contraction

- Concentric contraction in the biceps brachii during upward phase of exercise
- The biceps brachii produces tension and shortens
- It pulls the forearm upwards to cause flexion of the elbow

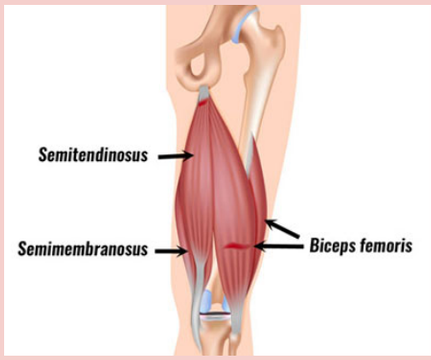
#### Eccentric Contraction

- Eccentric contraction occurs in the biceps brachii during the downward phase of the exercise
- The biceps brachii produces tension and lengthens
- It slows the lowering of the forearm and controls extension of the elbow

### Isometric Contraction

- Isometric contraction occurs in the biceps brachii when the muscle is holding the weight still
- The biceps brachii develops tension and stays the same length
- It stops flexion and extension of the elbow

## Hamstring Group




**Flexion**