

Musculoskeletal System Long Bones Short Bones Flat Bones Irregular Bones Articulating Bones Synovial Joints Cartilage Tendons Ligaments
 Freely Moveable Joints Ball and Socket Hinge Flexion Extension Plantar Flexion Dorsi Flexion Rotation Adduction Abduction **Muscular System**
 Prime mover (Agonist) Antagonist Antagonistic Pairs Isotonic Muscle Contraction Isometric Muscle Contractions **Cardio-respiratory System**
 Gaseous Exchange Alveoli Inhale Exhale Diffusion Spirometer Trace Tidal Volume Expiratory Reserve Volume Inspiratory Reserve Volume
 Residual Volume Vital Capacity Cardiovascular System Oxygenated blood Deoxygenated blood Heart rate Arteries Veins Capillaries Diastole
 Systole Cardiac Cycle Blood Pressure Vasoconstriction Vasodilation Stroke Volume Cardiac Output **Aerobic Exercise** **Anaerobic Exercise** **Intensity**
 Lactic Acid Excess Post-exercise Oxygen Consumption (EPOC) Delayed Onset Muscle Soreness (DOMS) Fatigue Hypertrophy

The Structure and Function of the Skeleton

Four types of Bones:

Flat - quite large and protect vital organs
Long - enable gross movements
Short - enable finer, controlled movements
Irregular - specifically shaped to protect

Articulating Bones:

Bones that meet at a joint to allow movement.
 E.g. Shoulder: scapula, clavicle, humerus
 Elbow: humerus, radius, ulna

Functions of the Skeleton

Support

For muscles and vital organs. Without support the body would be a mass of soft tissue that was unable to move

Protection

Of vital organs such as the cranium, a flat bone, protecting the brain. It reduces the chance of injury

Movement

Occurs at the joints when muscles contract

Shape & Structure

Maintaining basic form of our body and providing attachment for our muscles

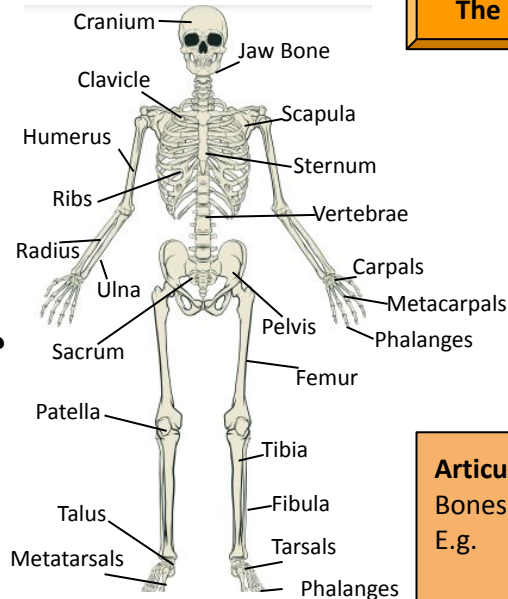
Blood cell production

Takes place in the bone marrow. Red blood cells, white blood cells and platelets

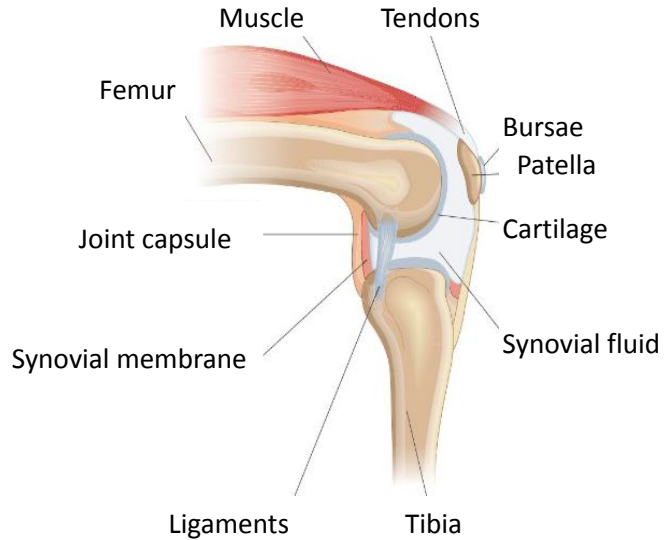
Storage of Minerals

Essential for major body functions. Links to the general health of an athlete.

Structure of the Skeleton



Known as freely moveable joints and are the most common type of joint in the human body. Located at the shoulder, elbow, hip, knee and ankle.



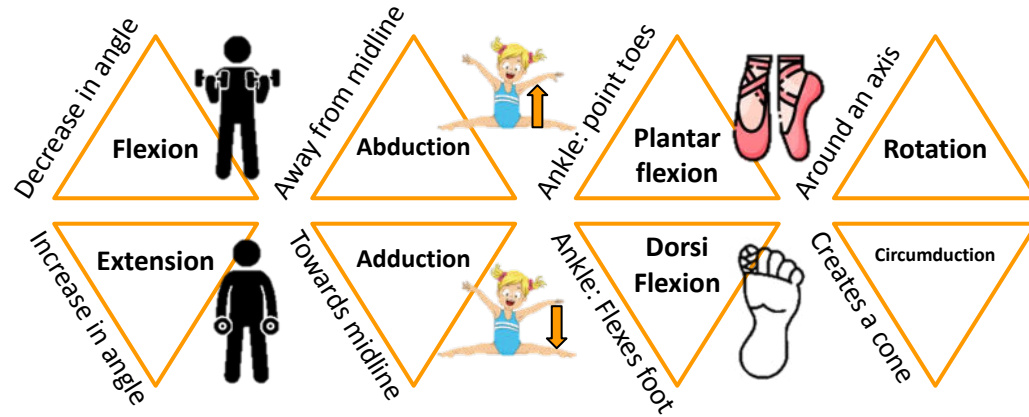
Different types of freely moveable joints allow different types of movement.

Ball and Socket: Shoulder and hip. Can move away and towards the body and rotate. The most moveable joint.

Hinge: Elbow, knee and ankle. Only move in one direction, towards and away from each other

Structure and Function of the Muscular System

Joint Action and Movements



The Muscular System

Major Muscle Groups that operate at the following joints:

Shoulder: Deltoid, trapezius, pectorals, latissimus dorsi, biceps, triceps, rotator cuff

Elbow: Biceps, triceps

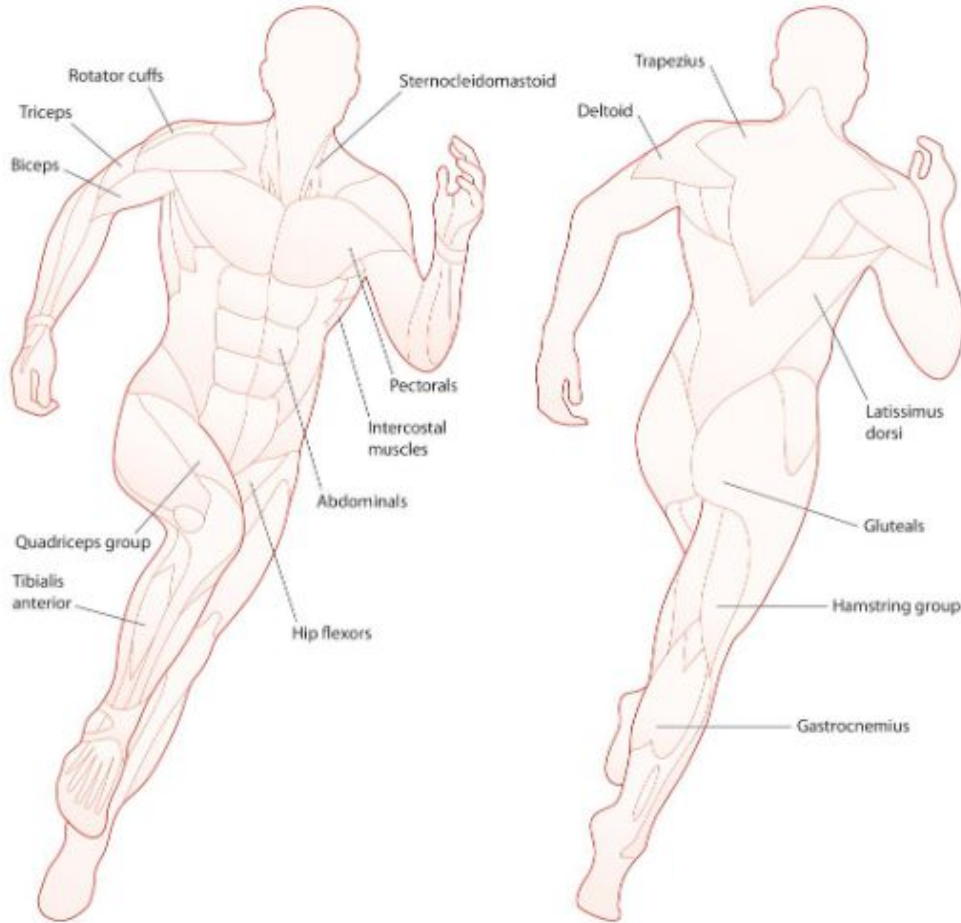
Hip: Gluteals, hip flexors

Knee: Quadriceps group, hamstring group

Ankle: Tibialis anterior, gastrocnemius



The Muscular System



Muscles and Movement

Prime Mover (Agonist)

Muscles can only pull, not push. Arranged in pairs on either side of the joints. One muscle contracts whilst the other relaxes. The muscle that contracts is the agonist, the one that relaxes is the antagonist.

This is called an **antagonistic muscle pair**

Antagonist

Obvious pairs include:

Biceps and triceps
 Hip flexors and gluteals
 Hamstring group and quadricep group
 Tibialis anterior and gastrocnemius

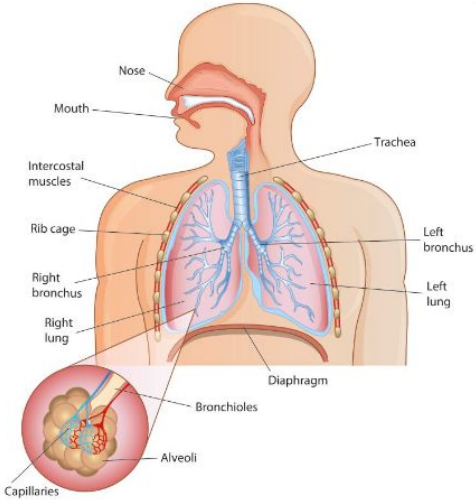
Muscles contract in two different ways: isotonically and isometrically

Isotonic: When the muscle changes length when it contracts, resulting in limb movement. Concentric (muscle shortens) or eccentric (muscle lengthens)

Isometric: When the muscles stay the same length. No actual movement of either the limb or the joint because the muscles are working to keep the joint stationary

Anatomy & Physiology

The Structure and Function of the Cardio-respiratory System



The Respiratory System

Made up of the circulatory system (heart, blood vessels and blood) and the respiratory system (the lungs and airways)

1.

Oxygen that has been breathed in passes through the alveoli and into the red blood cells in the capillaries

Gaseous Exchange

2.

In the capillaries, the oxygen combines with **haemoglobin** to form **oxyhaemoglobin**

4.

The carbon dioxide in the capillaries passes through the alveoli and is breathed out

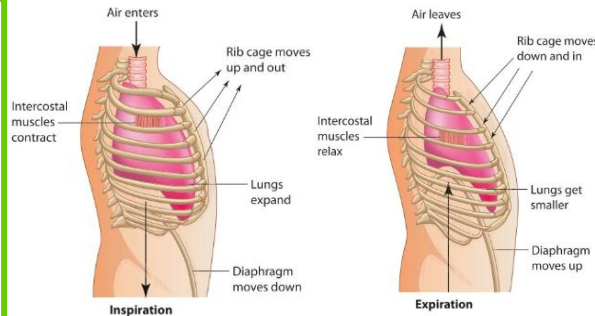
3.

At the same time haemoglobin carries carbon dioxide from the body to the capillaries

The Mechanics of Breathing

Inhalation:

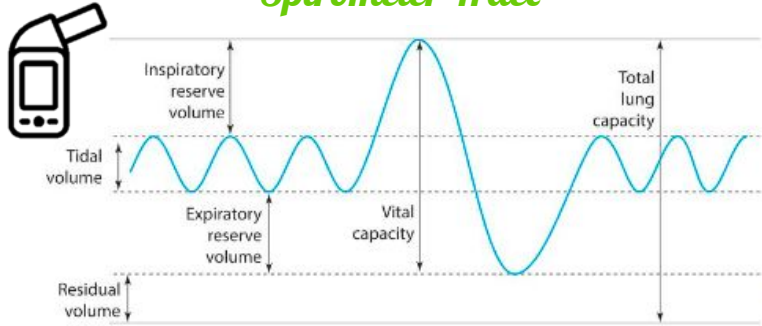
- Chest cavity changes shape and size
- Diaphragm flattens and moves downwards
- Intercostal muscles contract, raising the ribs up and pushing out the sternum
- Chest cavity is then larger
- Reduces air pressure, causing air to be sucked in



Exhalation:

- Diaphragm becomes dome shaped
- Intercostal muscles relax, lowering the ribs and dropping the sternum
- Chest cavity is then smaller
- Increases air pressure, causing air to be pushed out

Spirometer Trace



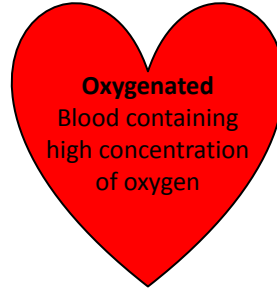
Tidal Volume: The normal amount of air inhaled or exhaled per breath. Tidal volume increases with exercise

Expiratory Reserve Volume: The amount of air that can be forced out after TV. ERV decreases during exercise

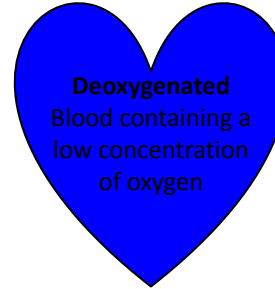
Inspiratory Reserve Volume: The amount of air that can be forced in after TV. IRV decreases during exercise

Residual Volume: The amount of air that remains in the lungs after maximal expiration. There is no change during exercise

Vital Capacity: The largest volume of air that can be forcibly expired after the deepest possible inspiration



Oxygenated
Blood containing a high concentration of oxygen



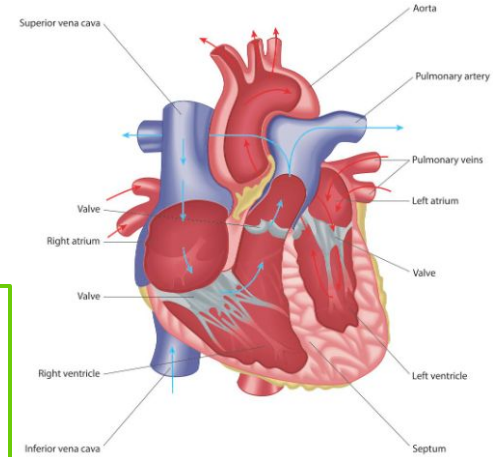
Deoxygenated
Blood containing a low concentration of oxygen

Blood Vessels

Arteries - Thick, muscular walls. Carry oxygenated blood away from the heart quickly and under pressure (except the pulmonary artery - deoxygenated blood to the lungs)

Veins - Thinner walls but larger internal diameter. Lower pressure of blood. Carry deoxygenated blood to the heart (except pulmonary vein - oxygenated blood to the heart)

Capillaries - Microscopic blood vessels that link arteries to veins. One cell thick to allow gaseous exchange to occur



The pathway of blood is shown with the arrows

Cardiac Cycle

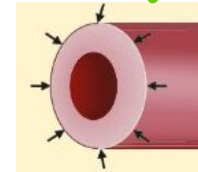
Diastole - Chambers of the heart relax and fill with blood

Systole - Chambers contract and empty and blood is ejected from the heart

Redistribution of Blood during Exercise

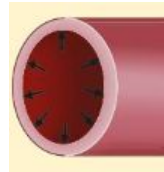
Vasoconstriction

The narrowing of the internal diameter of a blood vessel to restrict the volume of blood travelling through it



Vasodilation

The widening of the internal diameter of a blood vessel to increase the volume of blood travelling through it



$$\text{Cardiac Output (Q)} = \text{Stroke Volume (SV)} \times \text{Heart Rate (HR)}$$

Cardiac Output

The volume of blood ejected from the heart in one minute

Stroke Volume

The volume of blood pumped out of the heart by each ventricle during one contraction

Heart Rate

The number of times your heart beats in one minute

Aerobic Exercise

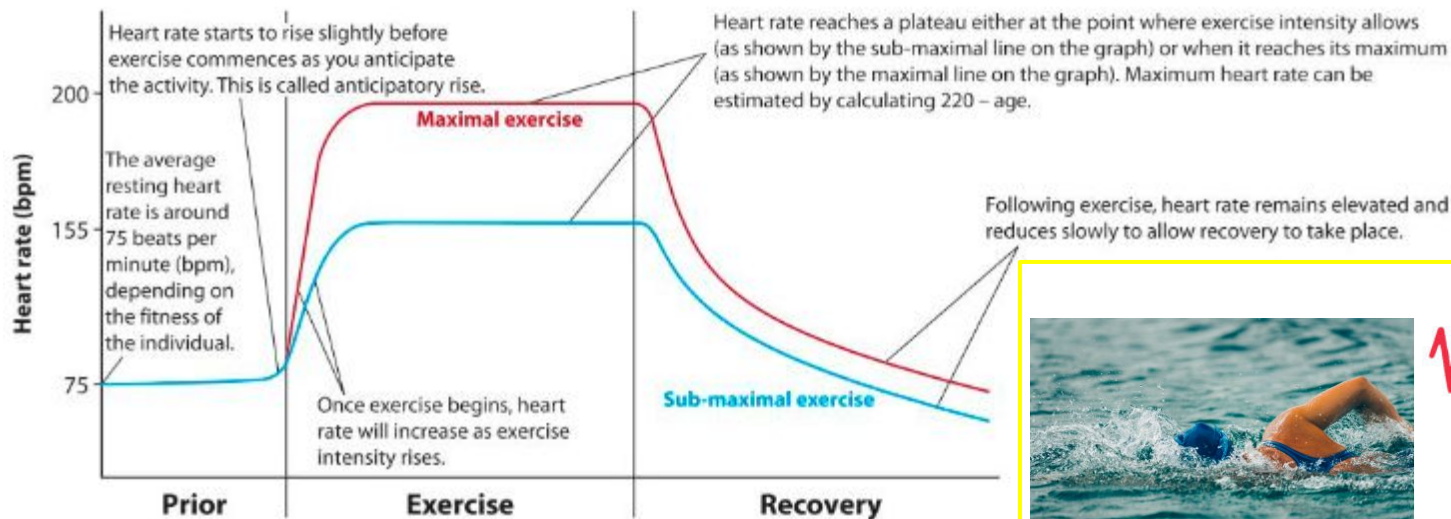
Takes place in the **presence** of oxygen. When exercise is over a long period of time, not too fast and is steady, the heart can supply all the oxygen the working muscles need



Glucose + Oxygen → Energy + Carbon Dioxide + Water

People working aerobically can work for a long period of time at a low to moderate intensity

The effects of exercise on Heart Rate (HR):



Le
de TOUR
de France



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Anaerobic Exercise

Takes place in the **absence** of oxygen. When exercise is short in duration and at high intensity, the heart and lungs cannot supply enough blood and, therefore, oxygen to the working muscles

Glucose → Energy + Lactic Acid

People working anaerobically can work for short periods of time, for a maximum of approximately 60 seconds



EXCESS POST-EXERCISE OXYGEN CONSUMPTION (EPOC)

- The amount of oxygen needed to recover after anaerobic exercise
- Characterised by an increased breathing rate and deeper breathing
- EPOC replenishes the body with oxygen and enables the body to convert the lactic acid produced during anaerobic exercise into glucose, carbon dioxide and water

The Recovery Process

Cool Down

- Instead of just stopping at the end of a physical activity, end the session gradually
- Some light exercise and gentle stretching
- Reduce the intensity of exercise to maintain an elevated breathing rate
- Ensure quick blood flow to the muscles
- Helps convert lactic acid into glucose, carbon dioxide and water



Ice Baths or Massage

- Help prevent Delayed Onset Muscle Soreness (DOMS)
- Massage increases blood flow to the sore area, speeding up the healing process

Manipulation of Diet

- Drinking water to rehydrate and replace lost fluids
- Carbohydrate loading for endurance athletes to boost their performance and limit the length and severity of their recovery period
- Consuming protein after training provides nutrients needed to heal tears quickly



Immediate Effects of Exercise

Heart rate will increase, as your heart works harder to deliver oxygen to the working muscles	Begin to feel hotter as your body temperature increases
Start to sweat and your skin will redden, especially on your face	Breathing will become deeper and more frequent, as your body delivers more oxygen to the working muscles

FURTHER
READING

The Effects of Exercise



Short-term Effects of Exercise

Feel tired, possibly very fatigued	Muscles will ache a little
Feel nauseous	Feel light-headed
May experience DOMS if your exercise was high intensity	May experience muscle cramps



Long-term Effects of Exercise

Body will change shape. Helps keep body weight down	Will see improvements in specific CoF. Exactly which CoF improve will depend on the exercise you do
Your stamina - ability to exercise for longer - will improve	Muscles will increase in size and produce greater strength. This is called hypertrophy
Heart will increase in size. This is called cardiac hypertrophy . Cardiac output increases	Resting heart rate will become lower. Bradycardia is the name given to a slow resting heart rate