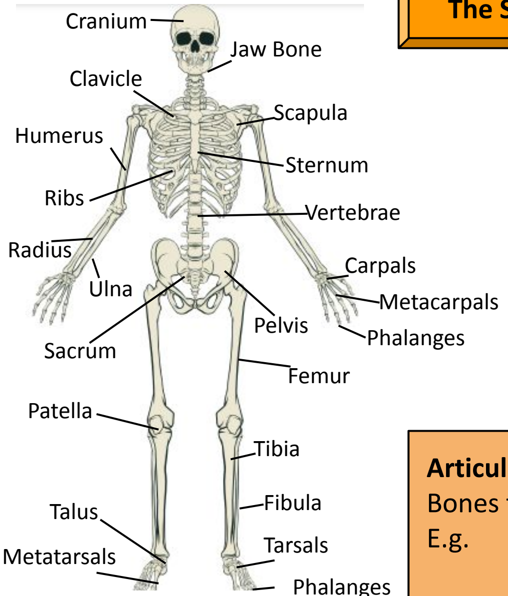
Paper 1

Anatomy & Physiology

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

Structure of the Skeleton



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

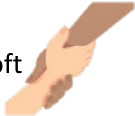
Articulating Bones:

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.

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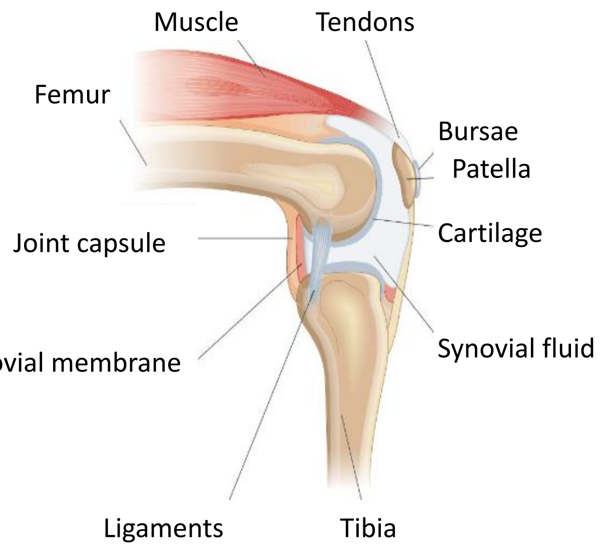
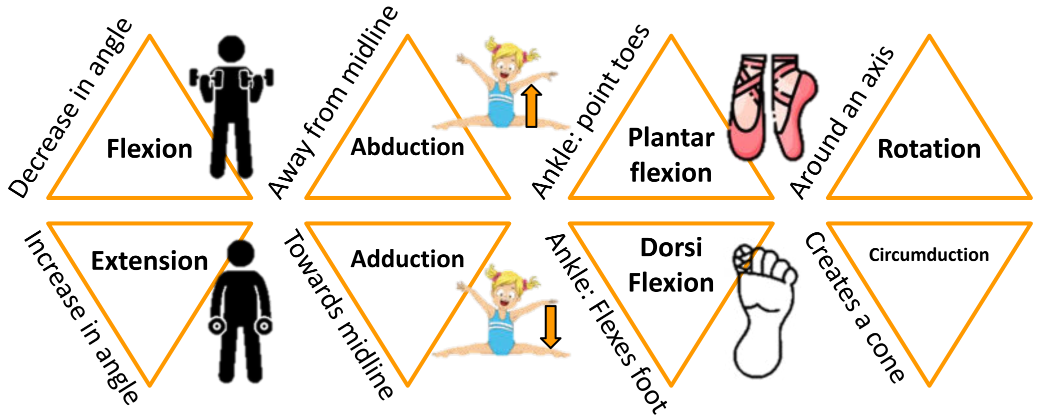
Synovial Joints

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

Joint Action and Movements



Structure and Function of the Muscular System

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

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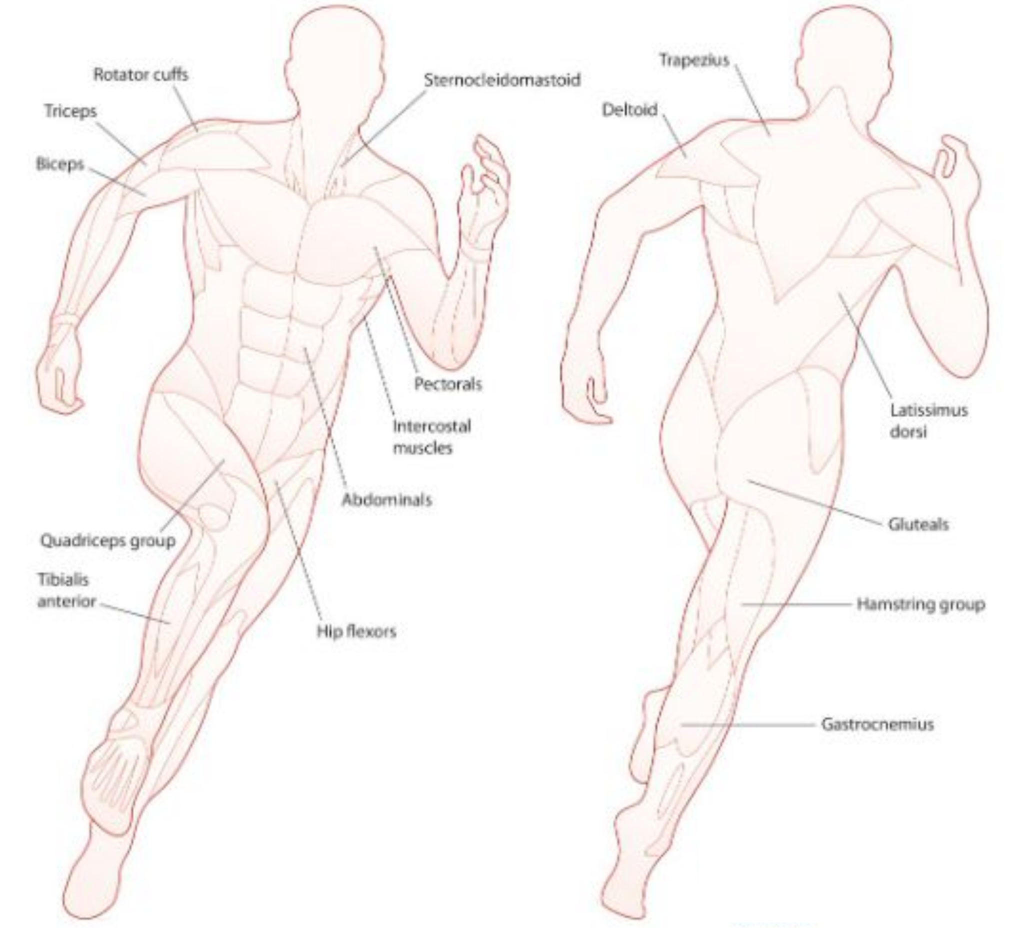
The Muscular System



Muscles and Movement

Prime Mover (Agonist)

Antagonist

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

This is called an **antagonistic muscle pair**

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 stays the same length. No actual movement of either the limb or the joint because the muscles are working to keep the joint stationary

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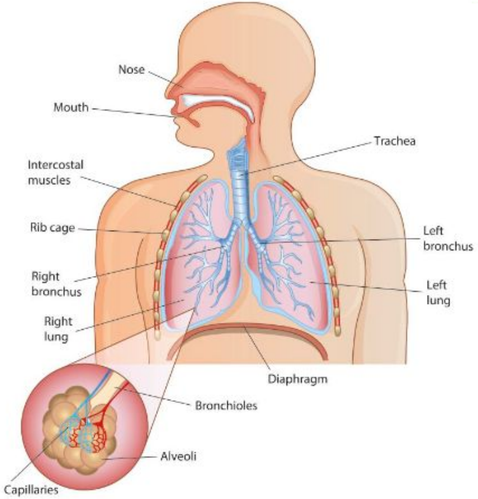
The Structure and Function of the Cardio-respiratory System

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

The Respiratory System



Gaseous Exchange

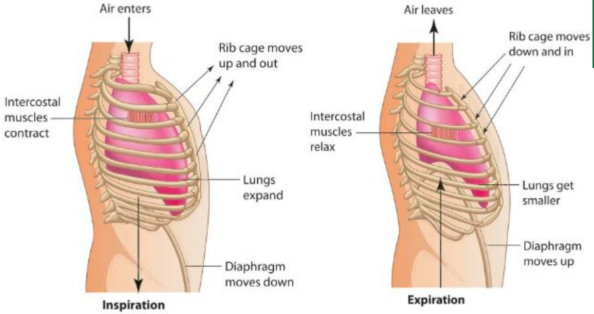
1. Oxygen that has been breathed in passes through the alveoli and into the red blood cells in the capillaries

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

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

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

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

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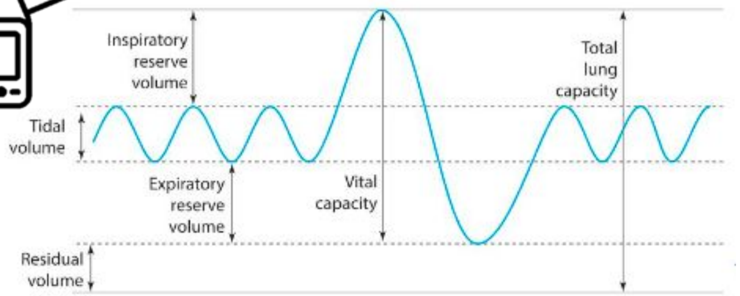
Spirometer Trace



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

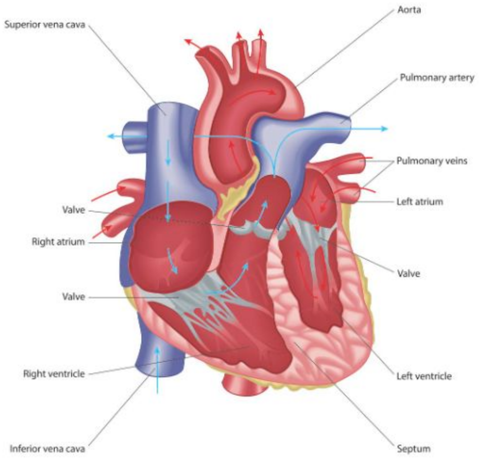
Residual Volume: The amount of air that remains in the lungs after maximal expiration. There is no change during exercise

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

Cardiovascular System

Oxygenated
Blood containing high concentration of oxygen

Deoxygenated
Blood containing a low concentration of oxygen



The pathway of blood is shown with the arrows

Blood Vessels

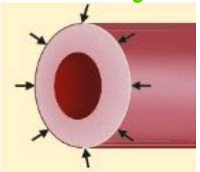
Arteries - Thick, muscular walls. Carry oxygenated blood away from the heart quickly and under pressure (except the pulmonary artery - deoxygenated blood to the lungs)
Veins - Thinner walls but larger internal diameter. Lower pressure of blood. Carry deoxygenated blood to the heart (except pulmonary vein - oxygenated blood to the heart)
Capillaries - Microscopic blood vessels that link arteries to veins. One cell thick to allow gaseous exchange to occur

Cardiac Cycle

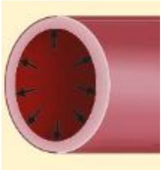
Diastole - Chambers of the heart relax and fill with blood
Systole - Chambers contract and empty and blood is ejected from the heart

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



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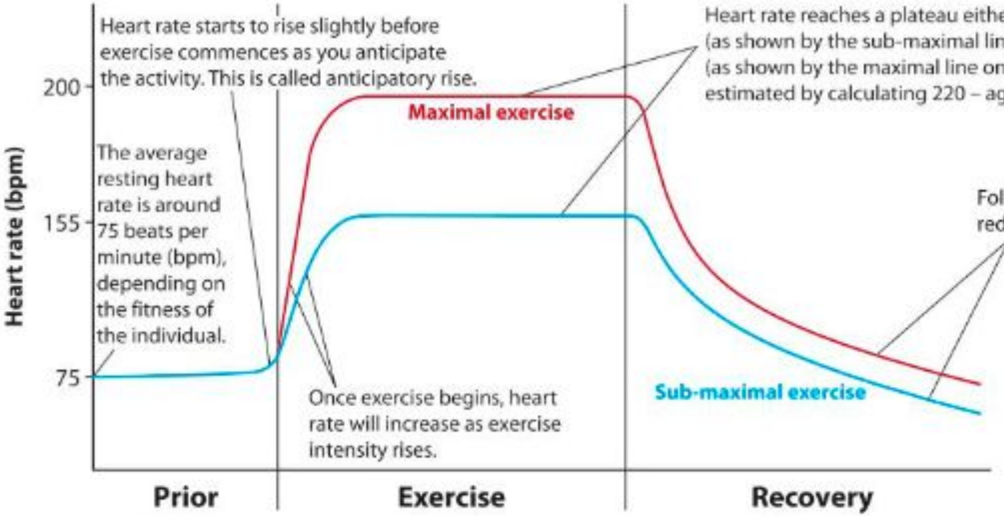
Aerobic and Anaerobic Exercise

Cardiac Output, Stroke Volume and Heart Rate

Cardiac Output (Q) = Stroke Volume (SV) x 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

The effects of exercise on Heart Rate (HR):



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

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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

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The Effects of Exercise

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

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