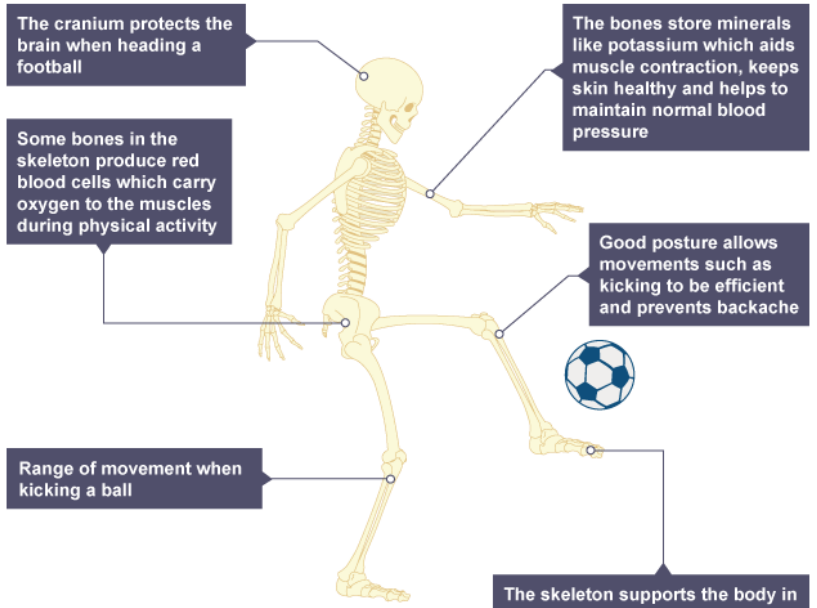
Sport Science

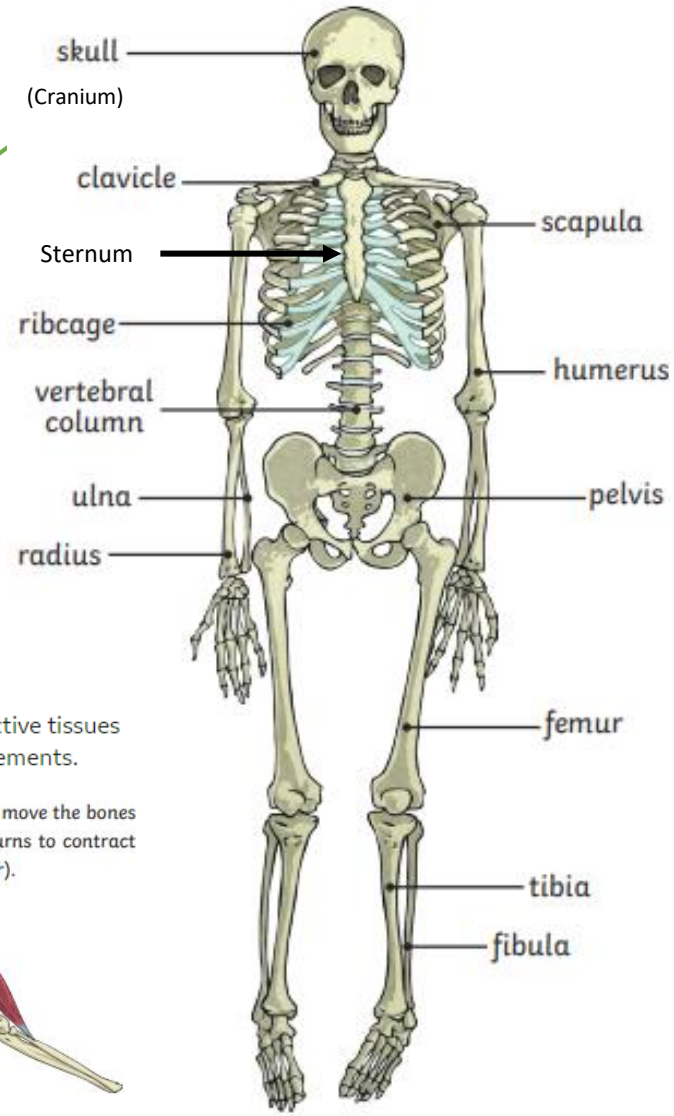
Keywords

Key Vocabulary	
muscles	soft tissues in the body that contract and relax to cause movement
tendons	cords that join muscles to bones
joints	areas where two or more bones are fitted together

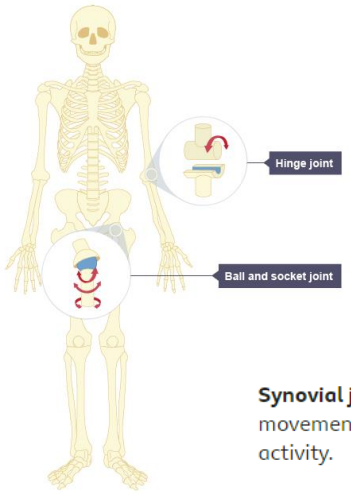
Purpose



Skeleton



Joints



Synovial joints (freely movable joints) allow us the free movement to perform skills and techniques during physical activity.

Type of joint	Body location	Types of movement
Ball and socket	Hip, shoulder	Flexion/extension, rotation, abduction, adduction, circumduction
Hinge	Knee, elbow	Flexion/extension

Muscles

Ligaments and tendons are two main types of connective tissues that help the muscular-skeletal system produce movements.

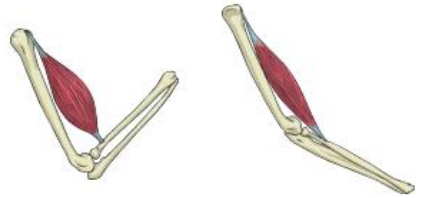
Ligaments:

- attach bone to bone
- act to give stability to joints
- are tough, white and flexible

Tendons:

- attach muscle to bone
- carry the force from muscle contraction to the bone
- are tough, greyish and flexible

Skeletal muscles work in pairs to move the bones they are attached to by taking turns to contract (get shorter) and relax (get longer).



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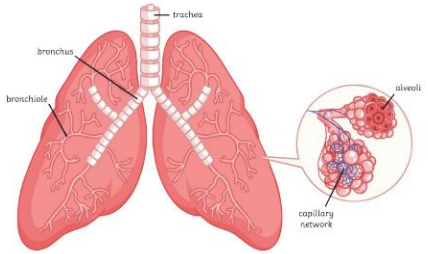
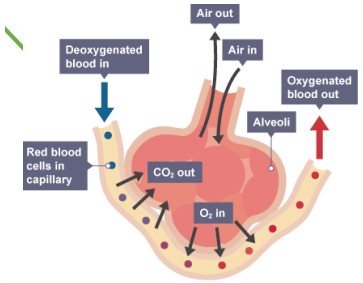
Lungs





When air is **inhaled**, oxygen diffuses from the alveoli into the blood to be used for respiration by the body's cells.

Carbon dioxide is a waste product made by the body's cells during **respiration**.

It **diffuses** from the blood into the alveoli and is **exhaled**.

Adaptations of the alveoli:

- **Large surface area** - many alveoli are present in the lungs with a shape that further increases surface area.
- **Thin walls** - alveolar walls are one cell thick providing gases with a short diffusion distance.
- **Moist walls** - gases dissolve in the moisture helping them to pass across the gas exchange surface.
- **Permeable walls** - allow gases to pass through.
- **Extensive blood supply** - ensuring oxygen rich blood is taken away from the lungs and carbon dioxide rich blood is taken to the lungs.
- **A large diffusion gradient** - breathing ensures that the oxygen concentration in the alveoli is higher than in the capillaries so oxygen moves from the alveoli to the blood. Carbon dioxide diffuses in the opposite direction.

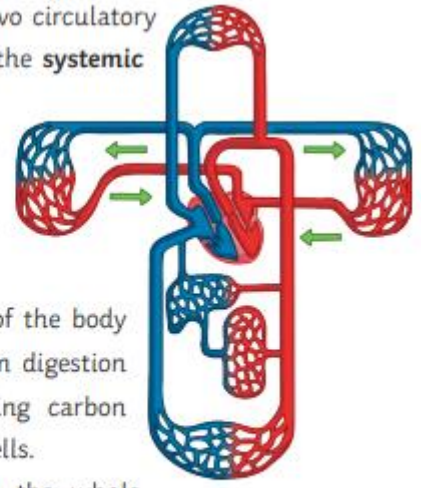
The Heart

The **right atrium** receives deoxygenated blood via the **vena cava**. It is then pumped down through the valves into the right ventricle. From here, it is forced up through the **pulmonary artery** towards the **lungs** where it exchanges carbon dioxide for oxygen. The oxygenated blood then enters the **left atrium** via the **pulmonary vein** and down into the left ventricle. The muscular wall of the **left ventricle** is much thicker so it can pump the blood more forcefully out of the heart and around the entire body, via the **aorta**.

The blood only flows in **one direction**. This is because there are **valves** in the heart which close under pressure and prevent the backward flow of blood.

Double Pump

The heart works as a **double pump** for two circulatory systems; the **pulmonary** circulation and the **systemic** circulation.

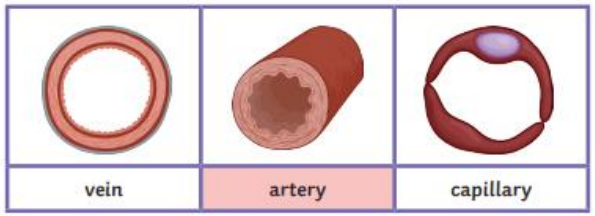


The pulmonary circulation serves the lungs and bring deoxygenated blood to exchange waste carbon dioxide gas for oxygen at the **alveoli**.

The systemic circulation serves the rest of the body and transports oxygen and nutrients from digestion to the cells of the body, whilst carrying carbon dioxide and other waste away from the cells.

The systemic circulation flows through the whole body. This means the blood is flowing at a much higher pressure than in the pulmonary circuit.

Blood Vessels



The three types of blood vessels, shown above, are each adapted to carry out their specific function.

Capillaries are narrow vessels which form networks to closely supply cells and organs between the veins and arteries. The walls of the capillaries are only **one cell thick**, which provides a short **diffusion pathway** to increase the rate at which substances are transferred.

	Artery	Vein
direction of blood flow	away from the heart	towards the heart
oxygenated or deoxygenated blood?	oxygenated (except the pulmonary artery)	deoxygenated (except the pulmonary vein)
pressure	high	low (negative)
wall structure	thick, elastic, muscular, connective tissue for strength	thin, less muscular, less connective tissue
lumen (channel inside the vessel)	narrow	wide (with valves)

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Anaerobic

Respiration:
Respiration is the process by which energy is released from glucose.

Anaerobic respiration

Anaerobic respiration does not need oxygen. It happens when there is not enough oxygen for aerobic respiration. Here is the word equation:

glucose → lactic acid (+ energy)

Aerobic

Aerobic respiration

glucose + oxygen → carbon dioxide + water (+ energy)

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ (+ energy)

Fatigue

Muscle fatigue

During hard exercise when anaerobic respiration occurs with aerobic respiration, an **oxygen debt** builds up. This is because glucose is not broken down completely to form carbon dioxide and water. Some of it is broken down to form lactic acid. Panting after exercise provides oxygen to breakdown lactic acid. The increased heart rate also allows lactic acid to be carried away by the blood to the liver, where it is broken down.

Fitness Test

Fitness testing is a central and essential feature of all fitness **training** and will be used before training begins, during the training programme and again at the end of the training programme.

Prior to training	During the training programme	At the end of the training programme
To assess the baseline fitness of the athlete and to help to set relevant goals	To monitor the ongoing impact of the training	To judge success and to plan for the next stages of training

Long Term effects of exercise

	Long term effects of exercise	Type of training
Cardiovascular system	Cardiac hypertrophy; increased stroke volume (SV); decrease in resting heart rate (HR); increase in maximum cardiac output (Q); capillarisation at the lungs and muscles; increase in number of red blood cells	Aerobic
Respiratory system	Increased number of functioning alveoli; increased strength of the respiratory muscles (intercostals and diaphragm)	Aerobic
Energy system	Increased production of energy from the aerobic energy system; increased tolerance to lactic acid	Aerobic; anaerobic
Muscular system	Muscle hypertrophy; increased strength of tendons; increased strength of ligaments	Resistance
Skeletal system	Increase in bone density	Resistance
Fitness	Increase in strength; increase in flexibility; increase in speed; increase in muscular endurance	Resistance; stretching; interval

Short Term effects of exercise

Tiredness and fatigue.
Light headedness.
Nausea.
Delayed Onset of Muscle Soreness (DOMS) occurs when muscles experience pain for 24-48 hours after intense exercise due to microscopic tears in the muscle fibres. DOMS typically follows a change in training or performance intensity and the muscles need to be rested while in this condition to avoid injury.

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Health

Health is the state of being free from **illness** or **disease**. It refers to **physical** and **mental** wellbeing.

Disease and lifestyle factors, such as diet, stress, smoking, alcohol consumption and the use of illegal drugs, can all impact the health of a person.

Some conditions are associated with certain lifestyle choices:

- Liver conditions are associated with poor **diet** and prolonged excessive **alcohol** consumption.
- Lung cancer is associated with **smoking**.
- Memory loss, poor physical health and hygiene are associated with the use of illegal or recreational **drugs**.
- Obesity and diabetes are associated with poor diet.
- Anxiety and depression are associated with **stress** and prolonged excessive alcohol consumption.

Non-Communicable Disease

Diseases can be non-communicable, which are not transferred between people or other organisms. Something that increases the likelihood of developing a disease is called a **risk factor**.

Non-communicable diseases include:
- cancer
- diabetes
- genetic diseases and conditions
- heart disease
- neurological disorders

Reaction Time Practical

The aim of the investigation is to **investigate out whether reaction times can be reduced with practice.**

Method:

In this experiment you are working with a partner and you are always using the opposite hand to your writing hand.

1. One of the pair sits upright on a chair and places their forearm on the table so that their hand is hanging over the edge of the table.
2. The other partner places a ruler vertically between the person sitting down's thumb and first finger. The thumb and first finger should be as far apart as possible.
3. Ensure the 0cm end of the ruler is pointing downwards.
4. Place the 0cm mark level with the top of the thumb and drop without telling your partner you are going to do it. Do tell them that the aim is for them to catch the ruler as quickly as possible.
5. Reading from the top of the thumb, record how many centimetres it took to catch.
6. Repeat nine more times.
7. Swap roles with your partner.
8. Using the reaction time conversion tables, convert your results from centimetres to reaction times (s).

The **independent variable** is the method for improvement e.g. amount of practice, use of caffeine

The **dependent variable** is the reaction time in seconds (converted from the cm taken to catch the ruler).

Drugs in sport

Some sportspeople try to gain an advantage by using performance-enhancing drugs. This is known as doping. Many performance-enhancing drugs are banned by sports' governing bodies.

Doping class	Effect on performance	Dangerous side-effects
Stimulants	Make athletes more alert and mask fatigue (extreme tiredness caused by physical activity)	Can cause **heart failure**, addictive
Anabolic agents - steroids	Help athletes to train harder and build muscle	Increased **aggression** and **kidney damage**
Diuretics	Remove fluid from the body. Used to make the weight, eg in boxing and to hide other drug use	Causes severe **dehydration**
Narcotic analgesics	Mask pain caused by injury or fatigue which can make the injury worse	Addictive
Peptides and hormones	**EPO** (Erythropoietin) red blood cells - gives more energy and **HGH** (Human Growth Hormone) - build muscle	EPO - risk of stroke or heart problems and HGH - abnormal growth, heart disease, diabetes, arthritis etc