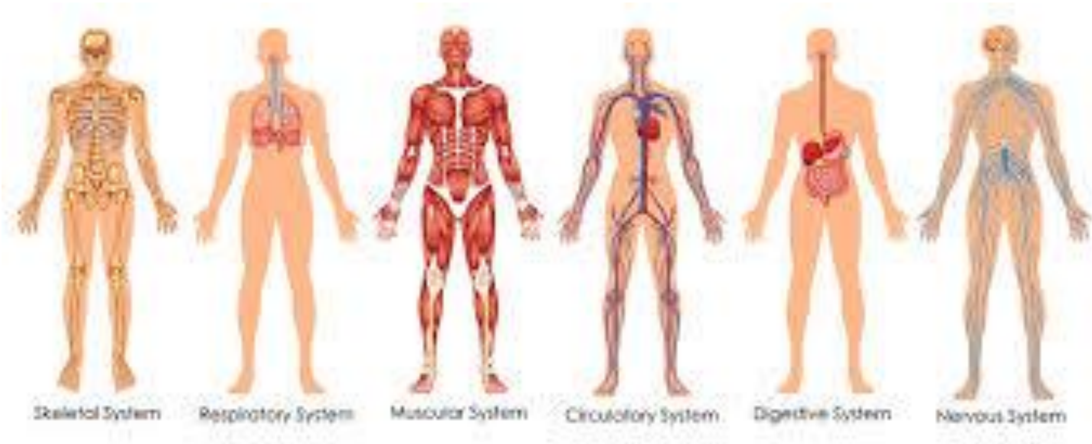
Organisation



Name ______________________________

Class ______________________________

Teacher ______________________________

L1 Growth

Growth in Animals & Plants

Growth is described as a **permanent increase in size or mass**. The growth process is slightly different in plants compared to animals, **both plants and animals** grow via two key processes:

- **Cell division** - mitosis
- **Cell differentiation** - development of specialised features creating specialised cells
- **Plants** also grow through a **unique process** called **cell elongation**

This is where **hormones**, such as **auxin**, cause cells to grow longer in response to certain **stimuli** e.g. sunlight

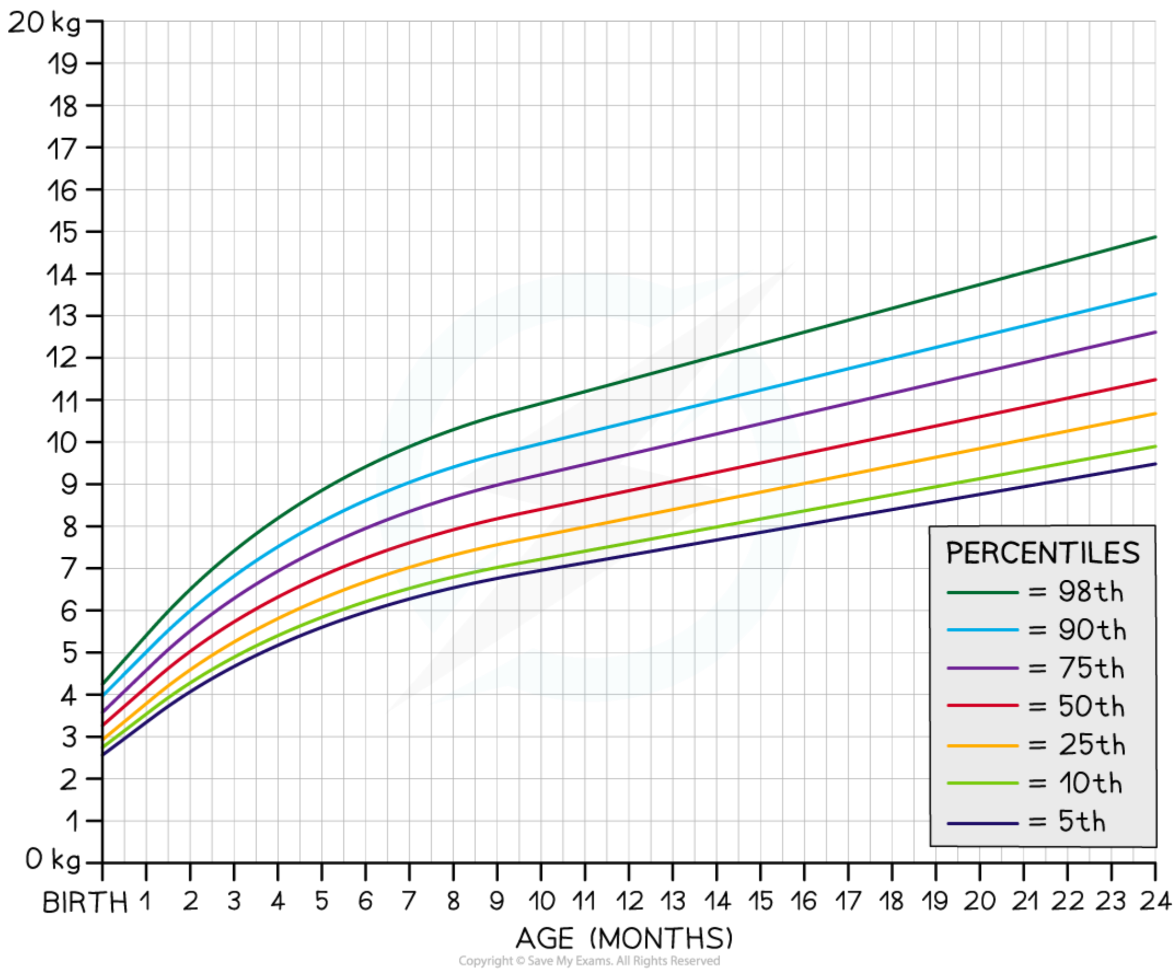
Monitoring Growth

Growth charts can be used to monitor the growth of an organism by comparing its growth to the usual trends for that particular organism

In humans, the growth of a baby is monitored using indicator measurements such as **mass, length and head circumference**. These measurements are then **compared with historical data** collected from other children of the same age

Any potential **issues can then be highlighted** and assessed if necessary. These issues might include:

1. Malnutrition
2. Obesity
3. Inconsistencies across different measurements e.g. a large baby with a small head
4. Sudden changes in trend (which may indicate expression of a new health problem)



The growth of an infant can be monitored using a growth chart that compares their mass, length or head circumference to historical data

Reading a Growth Chart

To compare the growth of a child using a growth chart:

Find the child's age on the X-axis

Find the child's weight on the Y-axis

Read across and up to the growth chart lines and find where they **intersect** (the correct percentile is the line closest to the intersection)

For example:

If a baby is on the **25th percentile** for mass, it means that they are **lighter than 75%** of children their age and **heavier than 25%** of children their age

Children can fluctuate around a growth trend, this is more obvious in younger children

Girls follow a different growth chart to boys. Specialised growth charts have been produced for children who suffer from specific health issues, such as Down syndrome

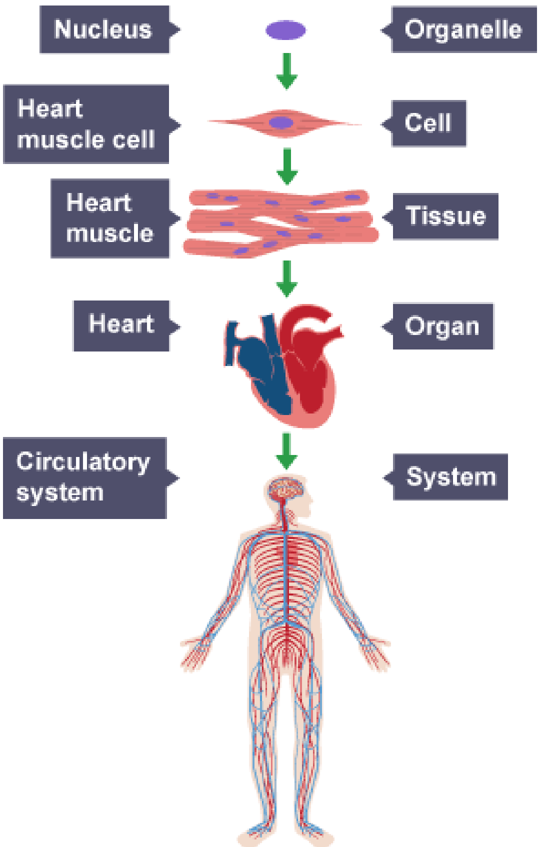
1. Recall What growth means in science
2. Recall what happens in cell division
3. Explain why cell division is important in an organism's life cycle
4. How can growh be monitored?
5. How can you read one of these graphs?
6. Why are there different types of graphs?
7. What factors can effect growth?
8. **Extended writing: explain how mitosis works with regsrd to growth and repair in humans.**

L2 Cells, tissues, organs, organ systems

In order of increasing complexity, *multicellular* organisms are made of:

cells → tissues → organs → organ systems

Structure	Description
Organelle	A specialised unit within a cell which performs a specific function
Cell	The basic building block of all living organisms
Tissue	A group of cells working together to perform a shared function, and often with similar structure
Organ	A structure made up of groups of different tissues, working together to perform specific functions
Organ system	A group of organs with related functions, working together to perform certain functions within the body



1. Describe how collections of cells can perform a specific function
2. Describe how collections of tissues can perform a specific function
3. Describe how collections of organs can perform a specific function.
4. Give the names of four organ systems and their role.
5. What does a collection of organ system create?
6. What is smaller than a cell?
7. What does every cell in the body contain?
8. Extended writing: choose and organ system and describe the organs and tissues it is comprised of.

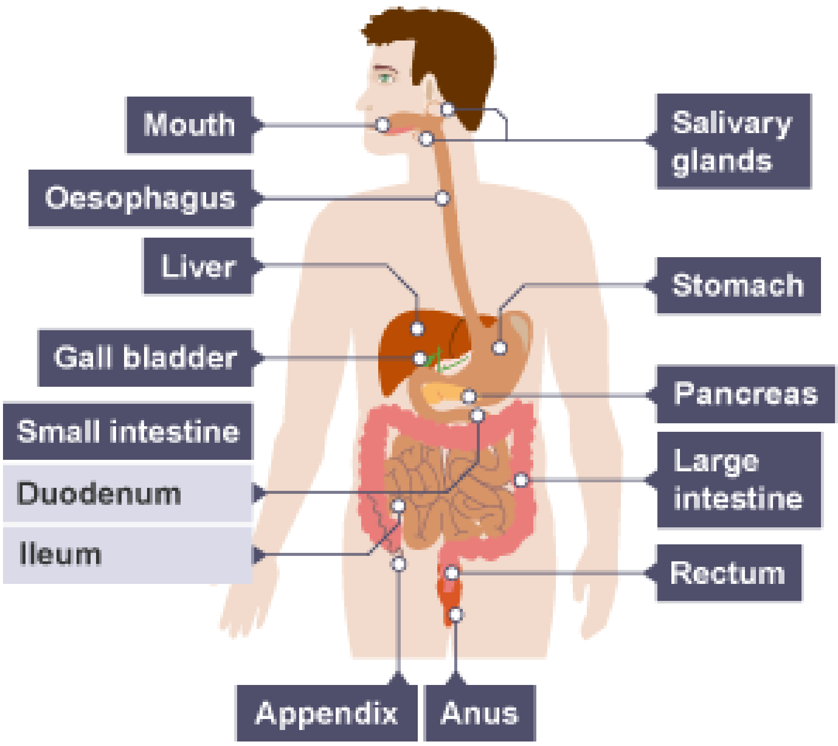
L3 Digestive System

The human *digestive system* has two functions:

- breaks down complex food substances
- provides the very large surface area for maximum absorption of food

The structure of the digestive system

Regions of the digestive system are adapted to the digestion and absorption of food:



Digestion

Region	Function
Mouth	Begins the **digestion** of carbohydrates
Stomach	Begins the **digestion** of protein; small molecules such as alcohol absorbed
Small intestine - duodenum	Continues the **digestion** of carbohydrate and protein; begins the **digestion** of lipids
Small intestine - ileum	Completes the **digestion** of carbohydrates and proteins into single sugars and amino acids; **absorption** of single sugars, amino acids and fatty acids and glycerol

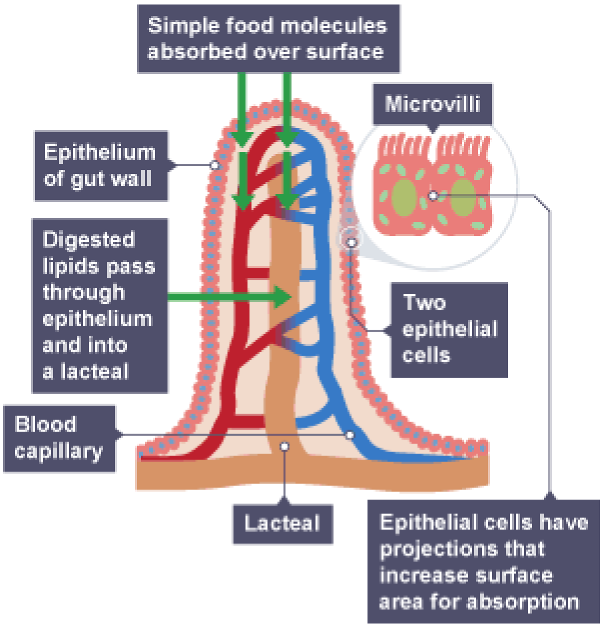
Region	Function
Large intestine	**Absorption** of water; **egestion** of undigested food

Digestive *enzymes* are used to break down food in the *gut* into small, *soluble* molecules that can be absorbed through the gut wall.

Absorption

The surface of the small intestine wall is folded, and has projections called *villi*. Villi is the plural of villus.

The *epithelial cells* that cover each villus themselves have projections called *microvilli*.



These all increase the surface area over which digested food – now simple molecules – is absorbed.

Most of the digested food passes through the epithelial cells of the gut wall and is carried by blood to the liver.

Digested lipids pass through the gut wall and enter the lacteals.

The lacteals in each villus join together into larger vessels. Then all the digested lipids pass through a duct into the bloodstream.

Independent Practice

1. what is meant by the word digestion?
2. Why is digestion needed in the body?
3. Which organs are involved in the digestive system?
4. Which parts of the digestive system mechanically digest food?
5. Which parts of the digestive system chemically digest food?
6. Where are the nutrients absorbed into the bloodstream?
7. How is this part of the body adapted for absorption?
8. What is the purpose of stomach acid?
9. **Extended writing: Produce a cartoon strip describing the journey of a cheese sandwich (other food stuffs are appropriate)**
10. **Explain how each part of the digestive system works in sequence, including adaptations of the small intestine for its function**

L4 Enzymes

Most of the food we eat is complex *carbohydrates*, *proteins* and *lipids*. These must be broken down to be absorbed into the body.

The chemical reactions required to break them down would be too slow without *enzymes*.

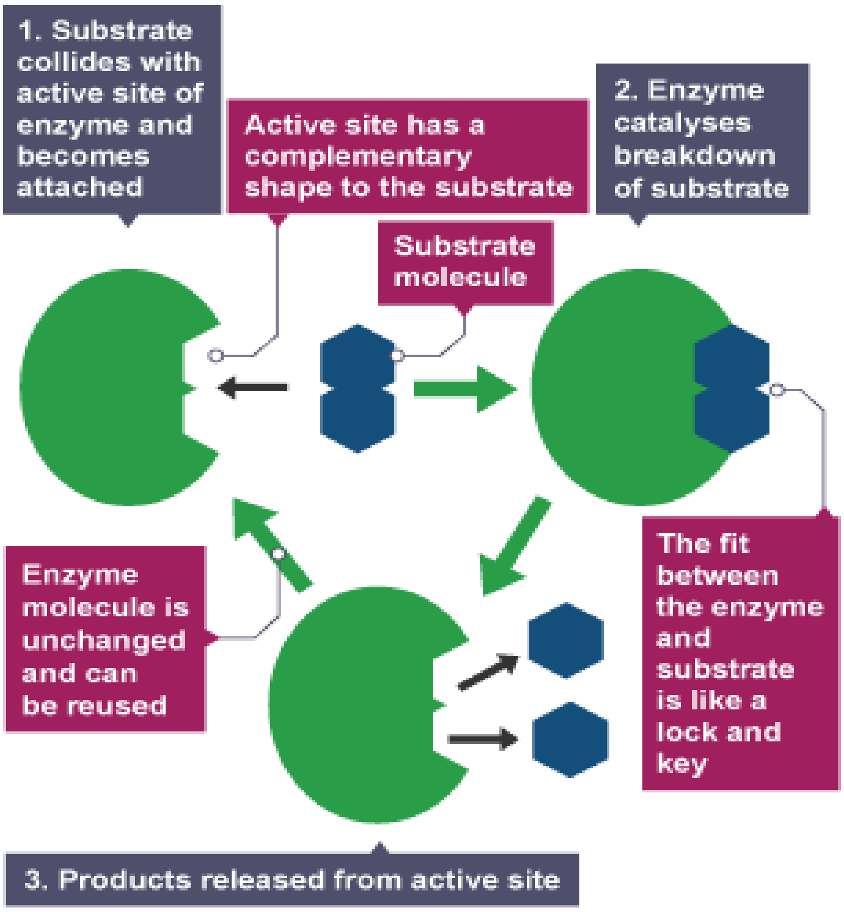
Enzymes are biological *catalysts* – they speed up chemical reactions.

Enzymes are required for most of the chemical reactions that occur in *organisms*. These reactions occur in the breakdown of chemical molecules, which we see in the *digestive system*.

Enzymes are also involved in the building up of chemical molecules elsewhere in the body.

Enzymes are proteins that have a complex 3D shape. Each enzyme has a region called an *active site*.

The *substrate* – the molecule or molecules taking part in the chemical reaction – fits into the active site. Once bound to the active site, the chemical reaction takes place .



In an organism, the active site of each enzyme is a different shape. It is a perfect match to the shape of the substrate molecule, or molecules. This is essential to the enzyme being able to work. One enzyme is therefore specific to one substrate's chemical reaction, or type of chemical reaction.

The groups of *enzymes* involved in the breakdown of food are:

Carbohydrases break down *carbohydrates*:

$carbohydrate \rightarrow carbohydrase simple\ sugars$

Starch is a type of carbohydrate. The carbohydrase that breaks down starch is *amylase*: $starch \rightarrow amylase glucose$

Proteases break down *proteins*: $protein \rightarrow protease amino\ acids$

Lipases break down *lipids:* $lipid \rightarrow lipase fatty acids + glycerol$

<u>Carbohydrases</u>

Carbohydrases break down carbohydrates in several regions of the digestive system.

Most of the carbohydrate we eat is starch, so this will be the main *substrate* in the early part of digestion for enzyme action. Digestion by carbohydrase enzymes breaks down very large starch molecules to small *glucose* molecules.

Region of digestive system	**Enzyme**	**Where produced**	**Substrate**	**Broken down into**
Mouth	Salivary amylase	Salivary glands	Starch	Maltose
Small intestine - duodenum	Pancreatic amylase	Pancreas	Starch	Maltose
Small intestine - ileum	Amylase	Wall of ileum	Maltose	Glucose

<u>Proteases</u>

Proteases break down proteins in several regions of the digestive system.

Digestion by protease enzymes breaks down proteins to *amino acids*. Cells use amino acids to make new proteins. The liver breaks down unwanted amino acids to *urea*, which is then carried by the blood to the kidneys. The kidneys excrete urea in solution as urine.

Region of digestive system	Enzyme	Where produced	Substrate	Broken down into
Stomach	Protease - pepsin	Gastric glands in stomach	Proteins	Begins the breakdown into amino acids
Small intestine - duodenum	Protease - trypsin	Pancreas	Proteins	Continues the breakdown into amino acids
Small intestine - ileum	Protease - peptidase	Wall of ileum	Peptides	Completes the breakdown into amino acids

Lipases

Lipases break down lipids in one region of the digestive system.

Digestion by lipase enzymes breaks down lipids to *glycerol* and fatty acids. Cells reform fats from the fatty acids and glycerol molecules.

Region of digestive system	Enzyme	Where produced	Substrate	Broken down into
Small intestine - duodenum	Lipase	Pancreas	Lipids	Fatty acids and glycerol

Independent Practice

1. What are enzymes?
2. What is the lock and key mechanism?
3. Why is it described as specific?
4. Where on the enzyme does the substrate bind?
5. What three types of enzymes are involved in the digestive system?
6. What molecules do these enzymes break down?
7. What enzyme is found in the small intestine?
8. What other chemical is present in the small intestine and what is its role?
9. **Extended writing: give a detailed account of the lock and key mechanism. Use the example of amylase in the saliva.**

L5 Circulatory System

Vessel	Direction of blood flow	Lumen diameter	Wall thickness	Blood pressure	Valves present?
Artery	Away from the heart	Small	Thick	High	No
Vein	Towards the heart	Large	Thin	Low	Yes
Capillary	From artery to vein	Small	Very thin – 1 cell thick	Low	No

Arteries

- Usually carry *oxygenated* blood from the heart to the rest of the body
- Pulmonary artery is the exception as it carries *deoxygenated* blood from the heart to the lungs.
- Thick walls (with muscle and elastic fibres) to withstand high pressure.
- Muscle and elastic fibres within the walls also allow the artery to expand and recoil with each surge of blood.

Veins

- Usually carry deoxygenated blood from the body back to the heart.
- The *lumen* is large and reduces friction as the blood moves through.
- The *pulmonary vein* is the exception as it carries oxygenated blood from the lungs to the heart.
- Blood is moving at a low pressure so the walls are thin.
- Very few muscle and elastic fibres because blood does not surge through veins.
- *Valves* are present to prevent the backflow of blood.

Capillaries

Allow the *diffusion* of substances (e.g. oxygen, carbon dioxide, dissolved food and urea) between the blood and the body's cells or vice versa.

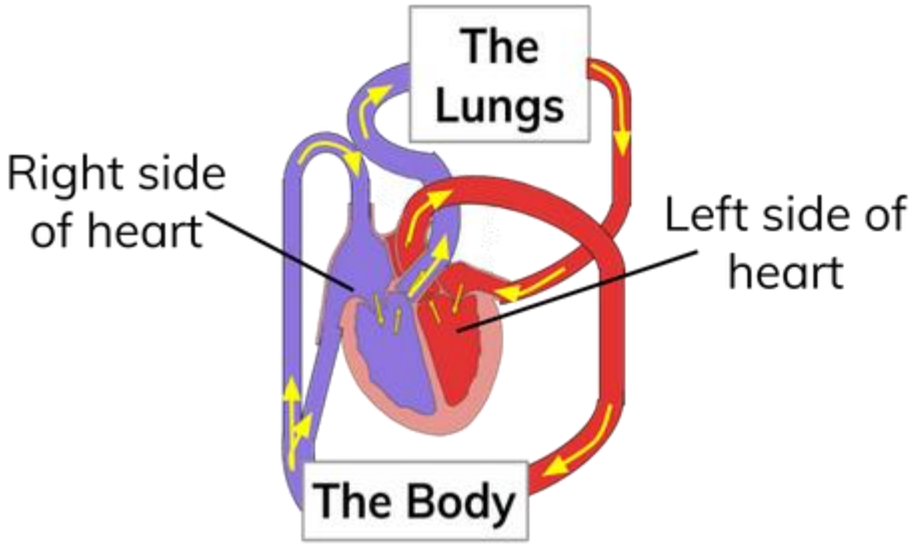
Walls are 1 cell thick providing a thin, permeable surface for diffusion.

The human circulatory system has three key components: blood vessels, blood and the heart. It is called a double circulatory system because blood passes through the heart twice per circuit.

The **right pump** sends deoxygenated blood to the lungs where it becomes oxygenated and returns back to the heart.

The **left pump** sends the newly oxygenated blood around the body. By the time this blood returns to the heart, it has returned to a deoxygenated state.

Circulatory System Diagram



Blood Passes Through The Heart Twice Per Circuit

Blood enters the heart

Deoxygenated blood from the body enters into the right atrium of the heart.

Blood pumped to lungs

This deoxygenated blood is pumped out of the heart and towards the lungs by the right ventricle.

Lungs oxygenate the blood

At the lungs, the deoxygenated blood exchanges carbon dioxide for oxygen. This is how it becomes oxygenated (contains oxygen).

Blood returns to the heart

Oxygenated blood returns to the left atrium of the heart.

Blood pumped to the body

This oxygenated blood is pumped out of the heart and to the body by the left ventricle.

Blood returns to the heart

The oxygenated blood gives its oxygen to body cells in exchange for carbon dioxide. The blood becomes deoxygenated and returns to the heart.

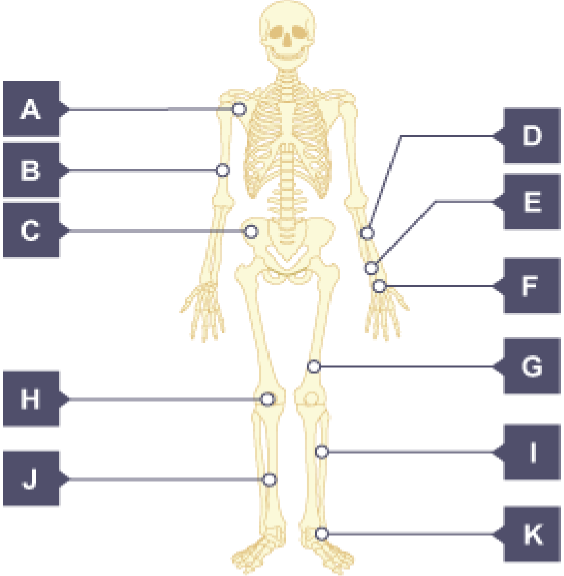
Independent practice

1. What are the names of the three types of blood vessels?
2. List the names in order of size smallest to biggest.
3. What do the word oxygenates and de-oxygenated mean?
4. Which colour is used to represent deoxygenated?
5. Which two places does the blood need to travel to?
6. How many times does it go through the heart?
7. What does the blood pick up at the lungs and what does it drop off?
8. What does the blood pick up around the body and what does it drop off?
9. What is the function of heart valves?

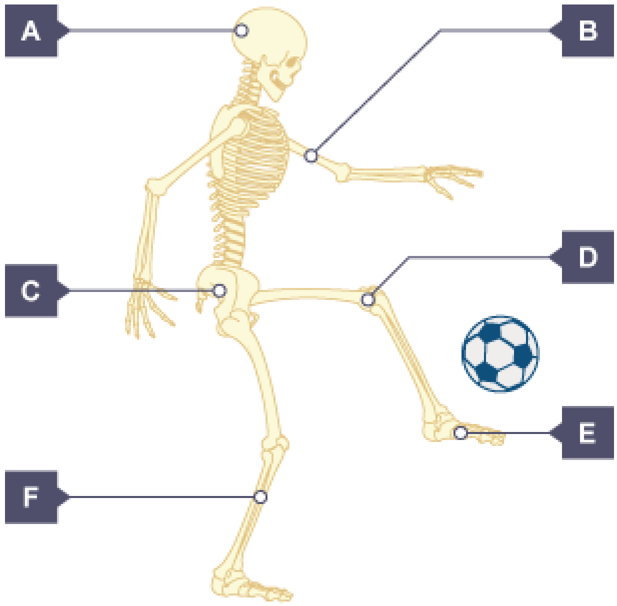
Extended writing: describe the journey of the blood in the double circulatory system
Extended writing: compare the three types of blood vessels

L6 Skeletal System

The main bones of the skeleton and their location are shown here:



- **A** Scapula
- **B** Humerus
- **C** Pelvis
- **D** Radius
- **E** Ulna
- **F** Carpals
- **G** Femur
- **H** Patella
- **I** Fibula
- **J** Tibia
- **K** Talus



- **A** The cranium protects the brain when heading a football
- **B** The bones store minerals like potassium which aids muscle contraction, keeps skin healthy and helps to maintain normal blood pressure
- **C** Some bones in the skeleton produce red blood cells which carry oxygen to the muscles during physical activity
- **D** Good posture allows movements such as kicking to be efficient and prevents backache
- **E** The skeleton supports the body in whatever position we create, such as a balanced crouch when defending
- **F** Range of movement when kicking a ball

Within the skeleton there are different kinds of bone. The type of bone determines the amount of movement.

Type of bone	Example in body	Description
Long	Femur	Cylindrical in shape and found in the limbs. Their main function is to act as a lever.
Short	Carpals	Small and compact, often equal in length and width. These types of bone are designed for strength and weight bearing.

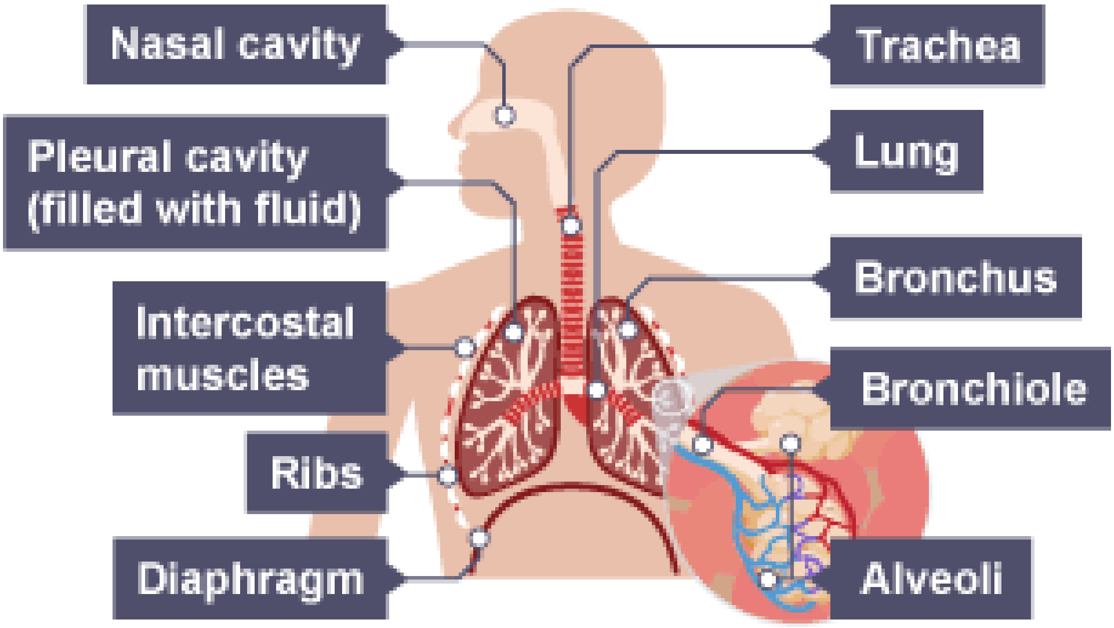
The skeleton has six main functions:

1. **Movement** – the skeleton allows movement of the body as a whole and its individual parts. The bones act as levers and also form joints that allow muscles to pull on them and produce joint movements.
2. **Support** – the skeleton keeps the body upright and provides a framework for muscle and tissue attachment.
3. **Protection** – the bones of the skeleton protect the internal organs and reduce the risk of injury on impact. For example, the cranium protects the brain, the ribs offer protection to the heart and lungs, the vertebrae protect the spinal cord and the pelvis offers protection to the sensitive reproductive organs.
4. **Production of blood cells** – certain bones in the skeleton contain red bone marrow and the bone marrow produces red blood cells, white blood cells and platelets. Examples of bones that contain marrow are the pelvis, sternum, vertebrae and clavicle.
5. **Mineral storage** – the bones themselves are made of minerals and act as a mineral store for calcium and phosphorous, which can be given up if the body requires the minerals for other functions.
6. **Stuctural shape** – the skeleton provides the human shape and determines the height of a person.

Independent practice

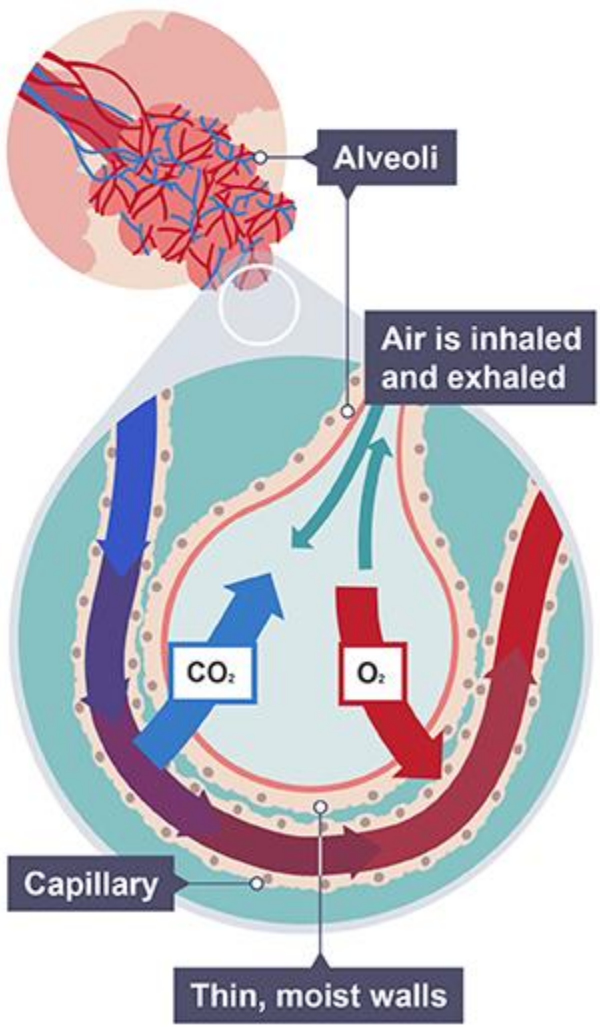
1. Which major organ does the cranium protect?
   which bone is represented by letter K
2. which bone is represented by letter H
3. which bone is represented by letter A
4. which bone is represented by letter G
5. What type of cell does the bone make?
6. Recall the major bones in the human skeletal system
7. Recall the functions of the bones in the skeletal system
8. Describe the structure of bone and explain its adaptations
9. Describe and explain the joints in the human skeletal system

L7Respiratory System



Structure	Function
Nasal cavity	Air is warmed and filtered as it enters the body.
Trachea	Brings air into the lungs. Supported by rings of cartilage that prevent it collapsing.
Bronchus	Branches off the trachea to bring air into the lungs. Also supported by rings of cartilage.
Bronchiole	Branch off the bronchi.
Alveoli	Small air sacs that are the site of gas exchange.
Lung	Organ where gas exchange occurs.
Ribs	Protect internal organs of the thorax.
Thorax	Part of the body between the neck and abdomen.
Intercostal muscles	Muscles between the ribs that aid breathing.
Diaphragm	Sheet of muscle below the ribs that aids breathing.

Structure	Function
Pleural membranes	Thin layers that reduce friction between the lungs and the inside of the chest wall during breathing.
Pleural fluid	Fluid found in the pleural cavity (between the pleural membrane layers). It further reduces friction during breathing.



Gas exchange occurs in the alveoli which are found in the 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:

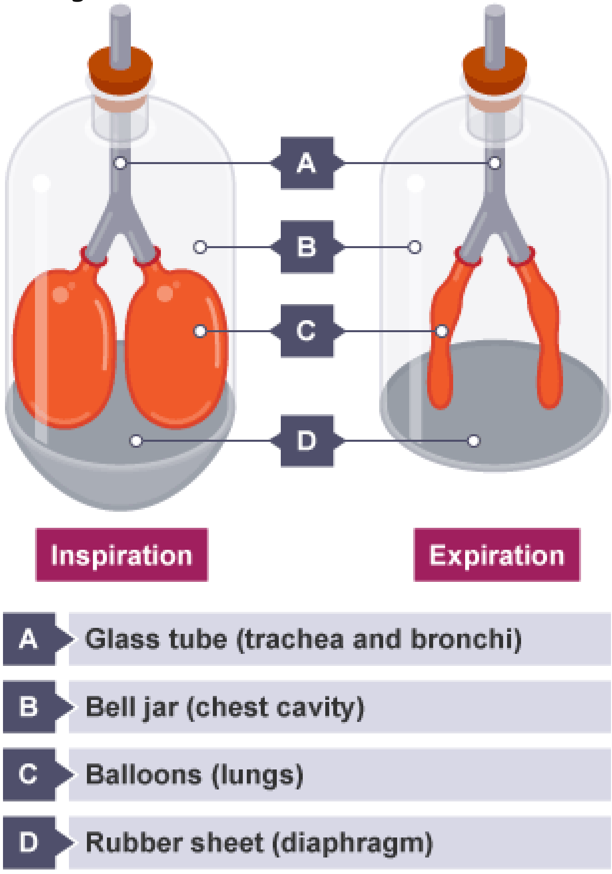
- **Large surface area** - many alveoli are present in the lungs with a shape that further increases surface area.
- **Thin walls** - alveolar walls are one cell thick providing gases with a short diffusion distance.
- **Moist walls** - gases dissolve in the moisture helping them to pass across the gas exchange surface.
- **Permeable walls** - allow gases to pass through.
- **Good 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.

In plants
Gas exchange occurs in the *spongy mesophyll* cells that surround air spaces in the leaves.
Many spongy mesophyll cells are in contact with the air spaces, providing a large surface area for gas exchange to happen.

The spongy mesophyll cell membranes are also thin, moist and permeable, aiding gas exchange further.

Breathing

A lung model can be used to demonstrate the process of breathing.



The balloons represent the lungs, the glass jar represents the *thorax* and a rubber sheet represents the *diaphragm*.

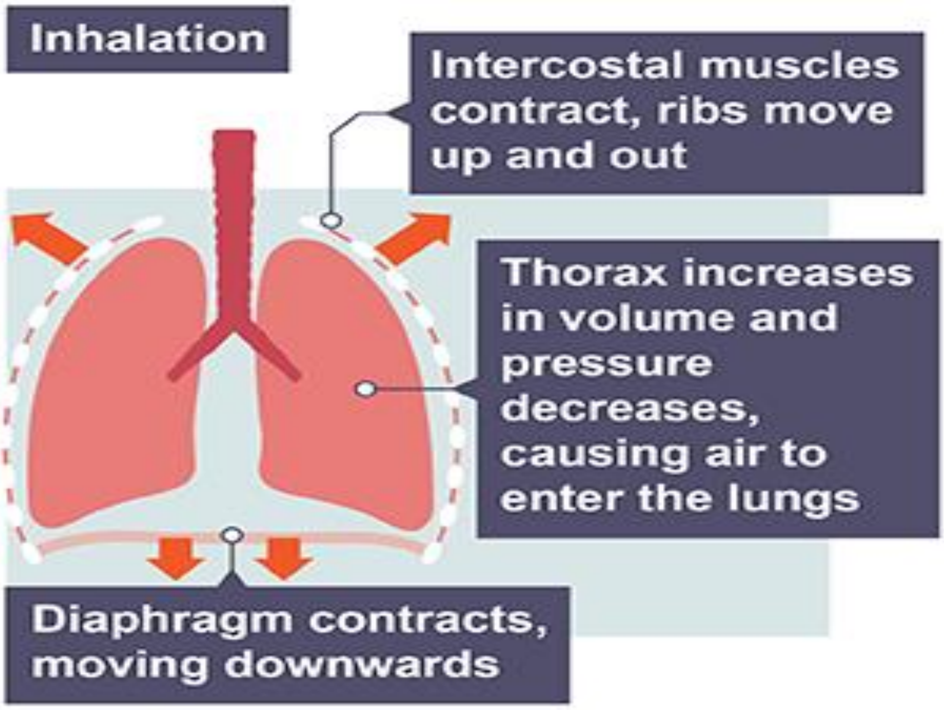
The lung model shows inhalation:

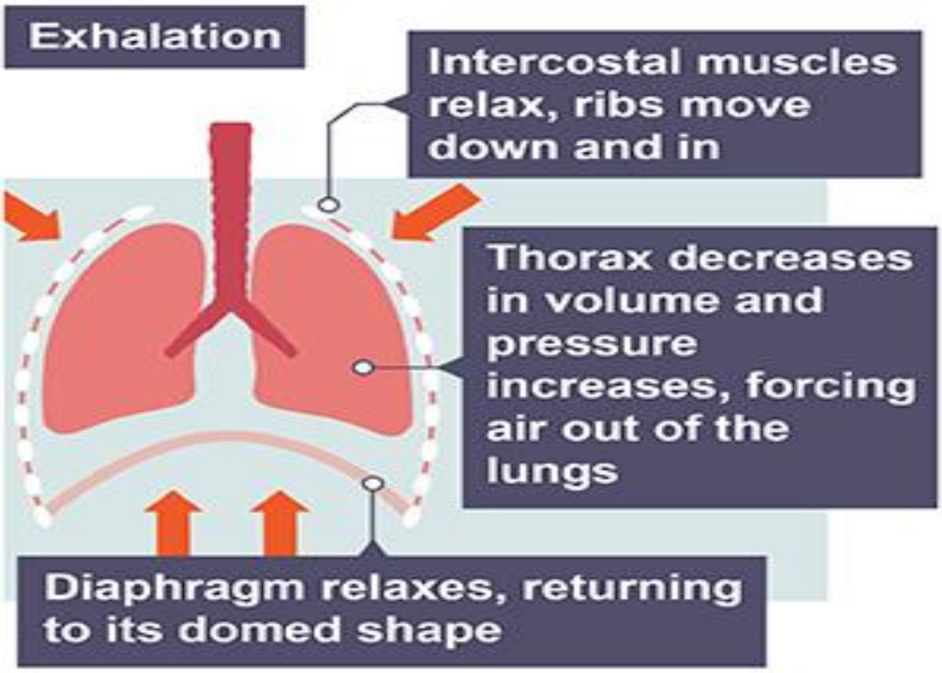
- When the diaphragm (rubber sheet) moves down, the volume inside the glass jar (thorax) increases.
- This increase in volume causes a decrease in pressure.
- The lungs (balloons) *inflate* as air enters until the pressures inside and outside are equal.

The lung model shows exhalation:

- When the diaphragm (rubber sheet) moves up, the volume inside the glass jar (thorax) decreases.
- This decrease in volume causes an increase in pressure.
- The lungs (balloons) *deflate* as air exits until the pressures inside and outside are equal.

There are a few differences between the lung model and the actual process of breathing:

1. 

Inhalation
2. 

Exhalation

- The ribs and *intercostal muscles* are not represented in the model. When breathing in, the intercostal muscles contract, moving the ribs up and out, increasing the volume of the thorax. When breathing out, the intercostal muscles relax, moving the ribs down and in, decreasing the volume of the thorax.

- In reality, the diaphragm is dome-shaped and flattens during *inhalation*. In the model, the rubber sheet is flat and is pulled down to represent inhalation
- The space between the lungs and wall of the thorax is very small but the model shows a large space between the balloons and glass jar.

Effect of exercise on breathing rate and depth
Muscle cells require more energy during exercise. Energy is made during *respiration*. When exercising, cells will need more oxygen and produce more carbon dioxide as a result of increased respiration.

When blood reaches the lungs, a larger volume of air is needed to replace the oxygen used and remove the carbon dioxide produced by this extra respiration.
In order to supply more oxygen to the exercising cells, the body increases the rate and depth of breathing.
The time taken for the breathing rate to return to normal is known as the recovery time.
This can be used as a measure of fitness.

<u>Independent practice</u>

1. Where are the lungs located?
2. What protects the lungs?
3. What separates the lungs from the abdomen (lower part of body)?
4. What gas diffuses into the bloodstream?
5. What gas diffuses out of the bloodstream?
6. Name the structure which carries air from the nose/mouth.
7. Name the two structures which branch off from the answer to Q6.
8. Name the structure which branch off from the answer to Q7.
9. What are the small gas exchange structures in the lungs called?
10. **Extended Writing: Describe four adaptations do alveoli have to make them an efficient gas exchange surface.**

12. Name the parts of the gaseous exchange system and state how they are adapted to their function
13. Define the terms: breathing, breathing rate, ventilation, inhalation and exhalation
14. Explain how the adaptations of the parts of the gas exchange system help them to perform their function
15. Explain the similarities and difference between the bell jar model and the breathing system
16. Explain how diffusion occurs in terms of movement of particles.

L8 Muscular System

There are three types of muscle in the body:

1. **smooth muscle** – found in the internal organs and blood vessels - this is involuntary
2. **cardiac muscle** – found only in the heart - this is involuntary
3. **skeletal muscle** – attached to the skeleton - this is voluntary

Involuntary muscles are not under our conscious control which means we can't make them contract when we think about it.
Voluntary muscles are under our conscious control so we can move these muscles when we want to.
Muscles cause movement by contracting across joints. Muscles are attached to the skeleton by tendons in two places:

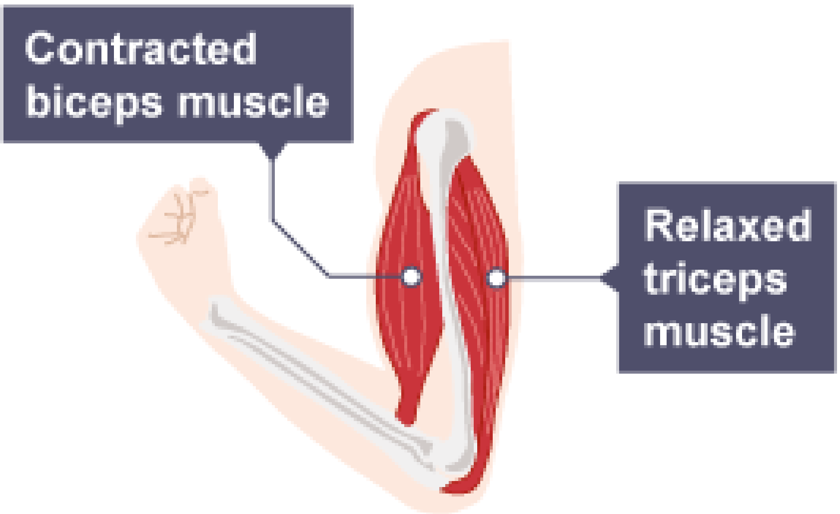
- the origin
- the insertion

The **origin** is the end of a muscle which is attached to a fixed bone. The **insertion** is the other end of the muscle that is attached to the bone which moves.
Muscular contractions are defined as the change in the length of the muscle under contraction. Muscles contract in different ways to produce a range of movements

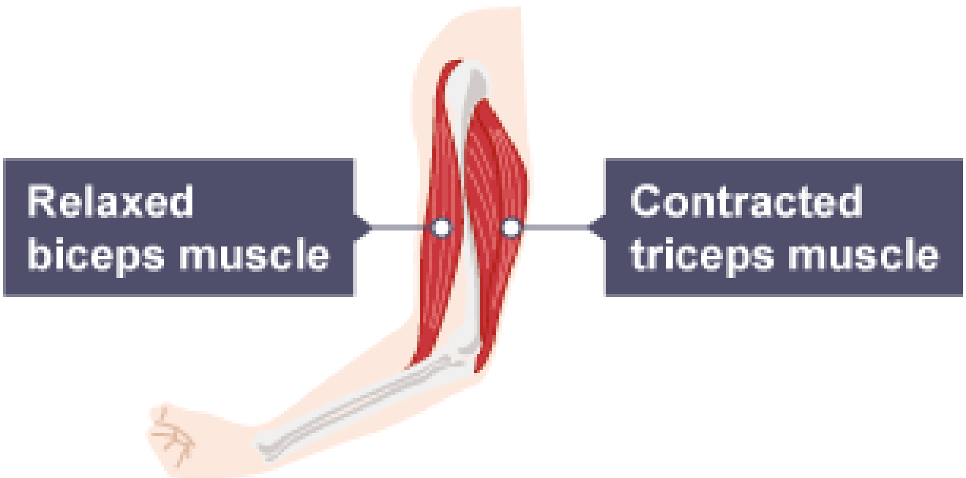
Muscles transfer force to bones through tendons. They move our bones and associated body parts by pulling on them – this process is called muscle contraction.
However, muscle contraction cannot act to push the bone back into its original position, and because of this, muscles work in 'antagonistic muscle pairs'. One muscle of the pair contracts to move the body part, the other muscle in the pair then contracts to return the body part back to the original position. Muscles that work like this are called **antagonistic pairs**.
In an antagonistic muscle pair, as one muscle contracts, the other muscle relaxes or lengthens. The muscle that is contracting is called the **agonist** and the muscle that is relaxing or lengthening is called the **antagonist**.
Key fact

One way to remember which muscle is the agonist – it's the one that's in 'agony' when you are doing the movement as it is the one that is doing all the work.

For example, when you perform a bicep curl, the biceps will be the agonist as it contracts to produce the movement, while the triceps will be the antagonist as it relaxes to allow the movement to occur.



1. The biceps contracts and raises the forearm as the triceps relaxes



2. The triceps contracts and lowers the forearm as the biceps relaxes

Antagonistic muscle pairs

The following groups of muscles are antagonistic pairs:

Biceps	Triceps
Hamstrings	Quadriceps
Gluteals	Hip flexors
Gastrocnemius	Tibialis anterior
Pectorals	Latissimus dorsi

Independent practice

1. Which of these muscle types are found in the heart?
2. Which muscle type is under conscious control?
3. Which muscle fibre types provides the greatest speed and force of contraction?
4. Which type of performers would need the highest proportion of type I muscle fibres?
5. Which muscle group is responsible for flexion at the knee when a footballer prepares to kick a football?
6. Which type of muscle contraction is completed by the triceps during the upwards phase of a press up?
7. Which muscle operates as the antagonistic pair in combination with the hip flexors?
8. Which muscle operates as the antagonistic pair in combination with the ham strings?
9. Which muscle operates as the antagonistic pair in combination with the pectorals?
10. Which structure connects muscle to bone and allows force to be transmitted from the muscle to move the skeleton?

Extended writing: explain how antagonistic pairs create movement around a joint.