Senior secondary

# Biology: Revision units

## Scholar study workbook


The Open University


**Keeping Girls in School scholarship programme**
**Funded by UKaid from the UK government**

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# ‘Keeping Girls in School’ Scholarship Programme

## MSCE Resources: 2014–15

# Contents

# Revision B1: Locomotion

## B1 Diagrams to learn

*Learn the diagrams as sketches. You do not have to be an artist. Make them as clear as possible and a good size. Try to learn as many labels as possible.*

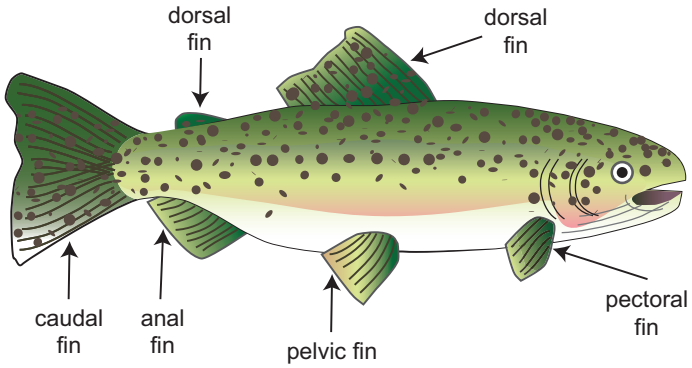


Figure 1: A fish and its fins

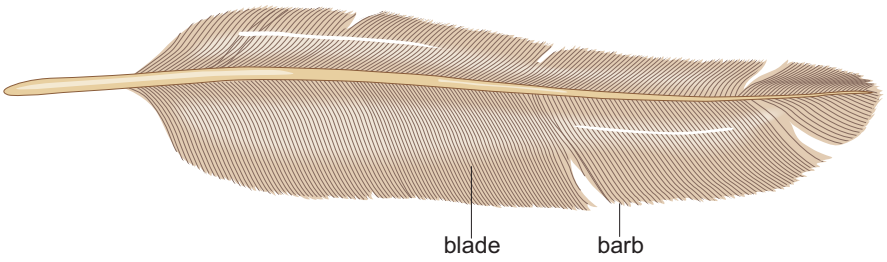


Figure 2: A quill (flight) feather

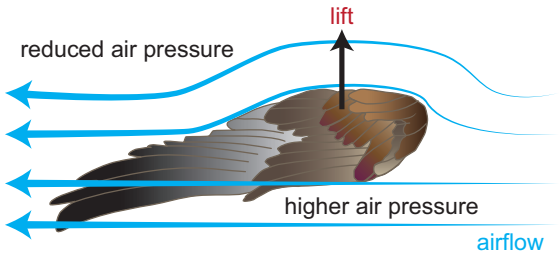


Figure 3: The bird's wing is an aerofoil shape

## B1 Key facts to revise

### Locomotion in fish

- Fish have **streamlined bodies** which reduce friction and allow them to move quickly through water.
- Their bodies are covered with backward pointing **scales** and oil. These help reduce friction and allow the fish to move faster.
- **Side-to-side movement** of the muscular tail and the tail fin enables the fish to move forwards.

- The paired **pectoral and pelvic fins** allow the fish to change direction, control pitching (up-and-down) movement and help control its speed.
- The **median fins** prevent yawing (side-to-side) movement and aid stability.
- Some fish have a **swim bladder**. This enables them to adjust the depth at which they swim.

## Locomotion in birds

- Birds are adapted for flight by having **wings** and **feathers**.
- Wings are skin stretched over bones which are equivalent to human arm bones. The wings are moved by powerful **pectoral muscles** attached to the bones.
- The skin is covered with feathers. There are two **types of feather**.
  (a) **Flight or quill feathers** which are large. They cover the wings. They help provide the forward push force and the lift force in flight. They have **barbs** and **barbules**. The barbules interlock when the wing is flapped downwards to increase the forward and upward pushing force. They unlock when the wing is flapped up.
  (b) **Down feathers** which are smaller and cover the whole body of the bird. They trap a layer of air close to the body. This acts as an insulator to keep the bird warm and to help regulate its temperature.
- The two forces that a bird must overcome in order to fly are **gravity** and **drag**. The two forces that a bird generates to overcome these forces are: **lift**, to push it up, and **thrust**, to push it forward.
- There are two types of flight: **flapping** and **gliding**.
- During flapping flight, a lift force is produced during both the **down stroke** and the **up stroke**.
- In flapping flight the wings move up and down. The **major pectoral muscle** contracts to pull the wing down and into the body (down stroke). The **minor pectoral muscle** contracts to move the wing up again (up stroke).
- The major and minor pectoral muscles act as an **antagonistic pair of muscles**. They pull the wing in opposite directions. When one contracts, the other is relaxed and vice versa.
- In gliding flight, the wings and tail are spread out and the movement of air over the wings produces a lift force due to the **aerofoil shape** of the wings.
- The tail and wing tips control steering.
- The bones of birds are hollow to reduce their weight and make it easier to overcome gravity.
- Birds have air sacs to increase the surface area for gas exchange as they fly.

## Locomotion in humans

Although you did not study human locomotion in detail in unit B1, you may like to read up on it in your text book if you have time, paying special attention to the following points.

- The bending and straightening movement of the human forearm at the elbow happens by **antagonistic pairs of muscles**. Contraction of the muscle on the top of your upper arm makes the arm bend upwards. Contraction of the muscle on the underneath of your upper arm (together with relaxation of the upper muscle) makes the arm straighten out.
- A joint is a place where bones meet. The joint between the bone of the upper arm and the bones of the lower arm is called a **hinge joint**. The joint between the upper arm and the shoulder is a **ball and socket joint**.
- The ends of the bones at these joints are covered with **smooth cartilage**. The bones do not touch each other, and they are separated by a **fluid** (synovial fluid). This prevents the wearing away of the ends of the bones by friction.

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# Revision B2: Respiration

## B2 Diagrams to learn

*Learn the diagrams as sketches. You do not have to be an artist. Make them as clear as possible and a good size. Try to learn as many labels as possible.*

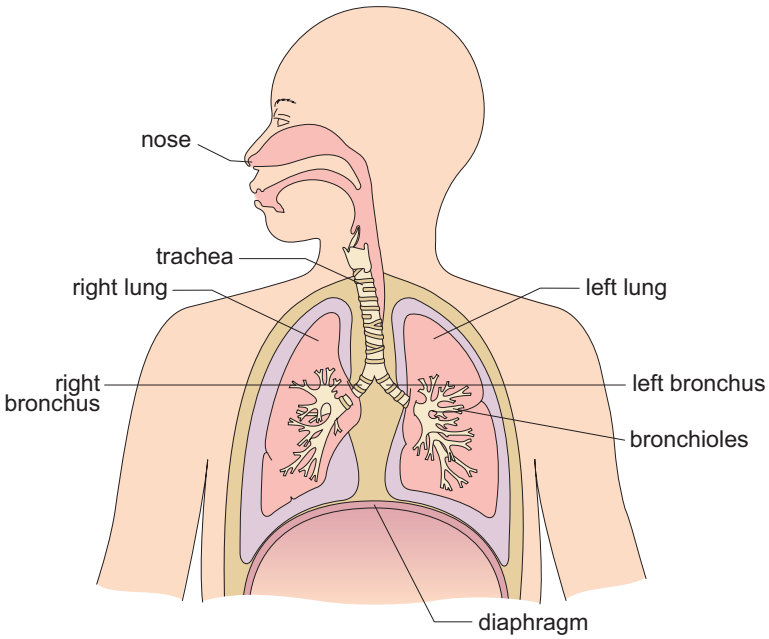


Figure 1: Trachea, lungs and diaphragm in the human body

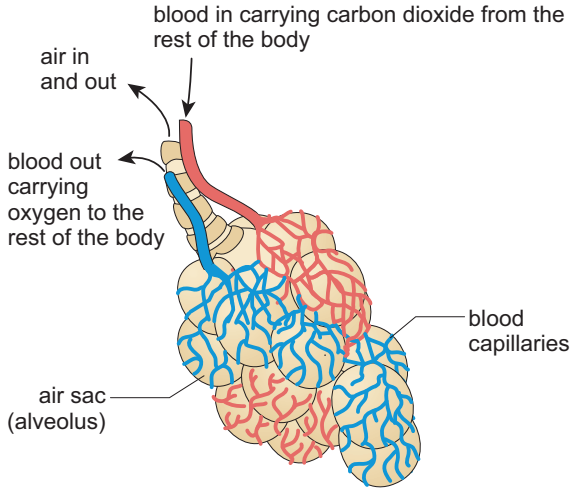


Figure 2: Gaseous exchange in the air sacs in the lungs

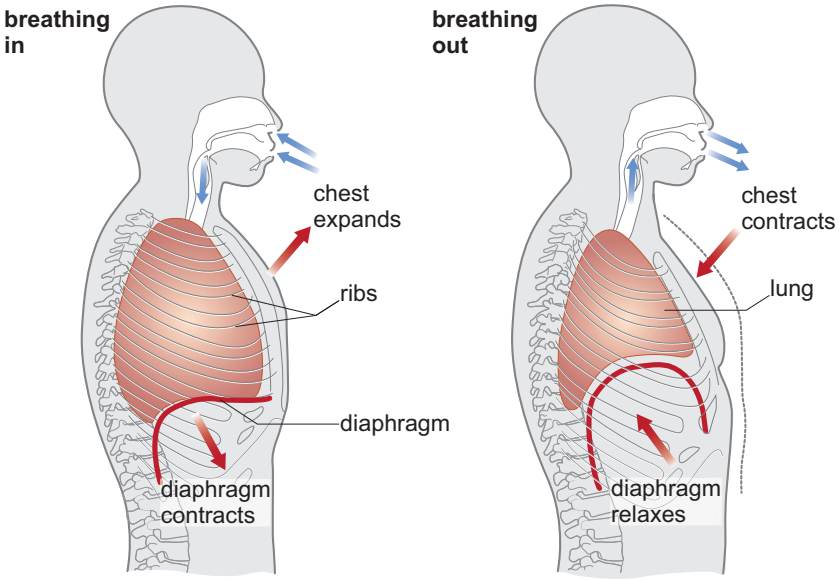


Figure 3: How our ribs and diaphragm move as we take in air and exhale air. Note that these movements are brought about by action of intercostal muscles between the ribs and muscle fibres in the diaphragm. Pay careful attention to the differences between these two diagrams.

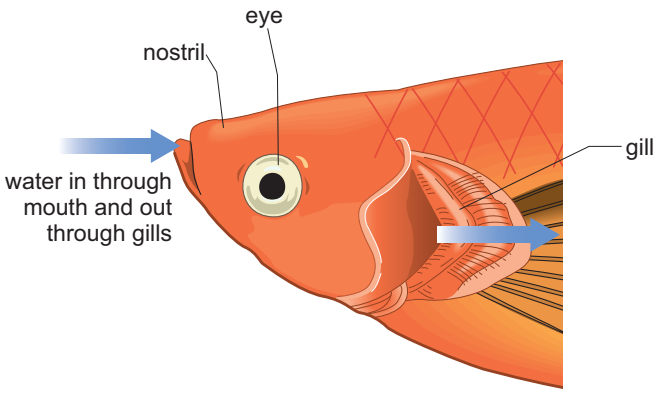


Figure 4: Fish getting dissolved oxygen from water

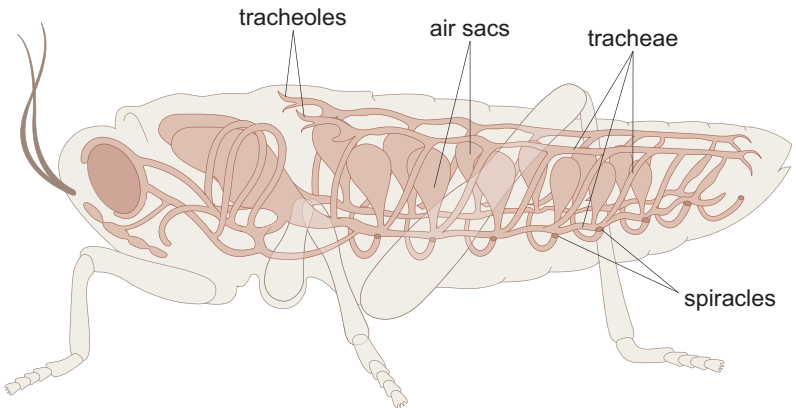


Figure 5: Insects getting oxygen from air through spiracles

# B2 Key facts to revise

## Tissue respiration

- Respiration is the process used by plants and animals to release energy from food for all the activities and processes of the body. Respiration happens inside living cells.
- **Aerobic respiration** needs oxygen. **Anaerobic respiration** happens without oxygen. Aerobic respiration releases much more energy from food than anaerobic respiration.
- Aerobic respiration can be summarised by the following equations:

*Glucose + oxygen → energy + water + carbon dioxide*

$$C_6H_{12}O_6\ (s) + O_2\ (g) \rightarrow H_2O\ (l) + CO_2\ (g)$$

- **Anaerobic respiration** happens in human muscle cells during hard exercise when the body cannot get enough energy by aerobic respiration alone because oxygen cannot get to the muscle cells fast enough.
- In anaerobic respiration glucose is not broken down completely and lactic acid is formed.

Glucose → energy + lactic acid

- **Lactic acid** is poisonous. It causes muscle fatigue, aches and cramp. The body must get rid of it. You continue to breathe rapidly after hard exercise to take in oxygen to break down the lactic acid to carbon dioxide and water. We say you are paying off an **oxygen debt**.

## Breathing in humans

- Breathing is where air travels into (inhalation) and out of (exhalation) the lungs. Air travels between the **mouth** and **nose, windpipe (trachea), bronchi, bronchioles** and **air sacs (alveoli)** in the **lungs**.
- The air sacs are surrounded by many tiny blood vessels (**capillaries**). Oxygen and carbon dioxide are exchanged between the air sacs and the blood in the capillaries. The surface through which this gaseous exchange takes place is called the **respiratory surface**.
- The **intercostal muscles** and the muscles of the **diaphragm** are responsible for breathing movements. They are controlled by the autonomic nervous system.
- Breathing in – ribcage moves up and out (intercostal muscles contract), diaphragm contracts and moves down. Volume of chest is increased. Pressure is decreased, so air is sucked into lungs.
- Breathing out – ribcage moves down and in (intercostal muscles relax), diaphragm relaxes and moves up. Volume of chest is decreased. Pressure is increased, so air is forced out of lungs.
- **Inhaled air** contains more oxygen, less carbon dioxide, less water vapour and is cooler than **exhaled air**.
- Oxygen is carried to all cells in the body in the blood. It is carried by special molecules in the red blood cells called haemoglobin.

## Smoking

- Smoking is very harmful to health. The harmful chemicals in smoke include: **nicotine**, which causes addiction; **tar** which increases the chance of infections and causes cancer; **carbon monoxide** which reduces the ability of red cells to carry oxygen to the cells and which leads to narrowing of the arteries and possible heart attack and even death.
- **Pregnant smokers** supply less oxygen to their babies which may be born prematurely, or be born dead, or show stunted growth.
- Smoke causes bad breath.

## Respiration in fish

- The respiratory surface in fish is the surface of the **gill filaments** down the sides of the body and which contain many blood capillaries.
- Water passes in through the mouth of the fish and out over the gill filaments of the gills.
- Gas exchange occurs across the surface of the gill filaments.
- There is less oxygen in water compared to equivalent amounts of air.

## Respiration in insects

- Insects have paired openings down the sides of their body called **spiracles**. These lead to a network of air-filled tubes, the **tracheal system**, which branch throughout the whole body. The larger tubes are called **tracheae**. The smaller ones are **tracheoles**.
- Oxygen moves in through the tubes and carbon dioxide moves outwards by diffusion.
- Gaseous exchange occurs across the walls of the tracheoles and smaller tracheae.

## Respiratory surfaces

- A respiratory surface is the surface in the body where **gaseous exchange** occurs, i.e. where oxygen diffuses in and carbon dioxide diffuses out.
- The respiratory surface in humans is the air sacs in the lungs. In fish it is the gill filaments. In insects it is the walls of the tracheoles.
- Respiratory surfaces are **thin**, **moist** and have a **large surface area**.
- In mammals e.g. humans and in fish the respiratory surface is associated with a **good blood supply**. This carries oxygen from the respiratory surface to all cells and brings carbon dioxide from the cells to the respiratory surface.

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# Revision B3: The circulatory system and the digestive system

## The circulatory system

### B3 Diagrams to learn

*Learn the diagrams as sketches. You do not have to be an artist. Make them as clear as possible and a good size. Try to learn as many labels as possible.*

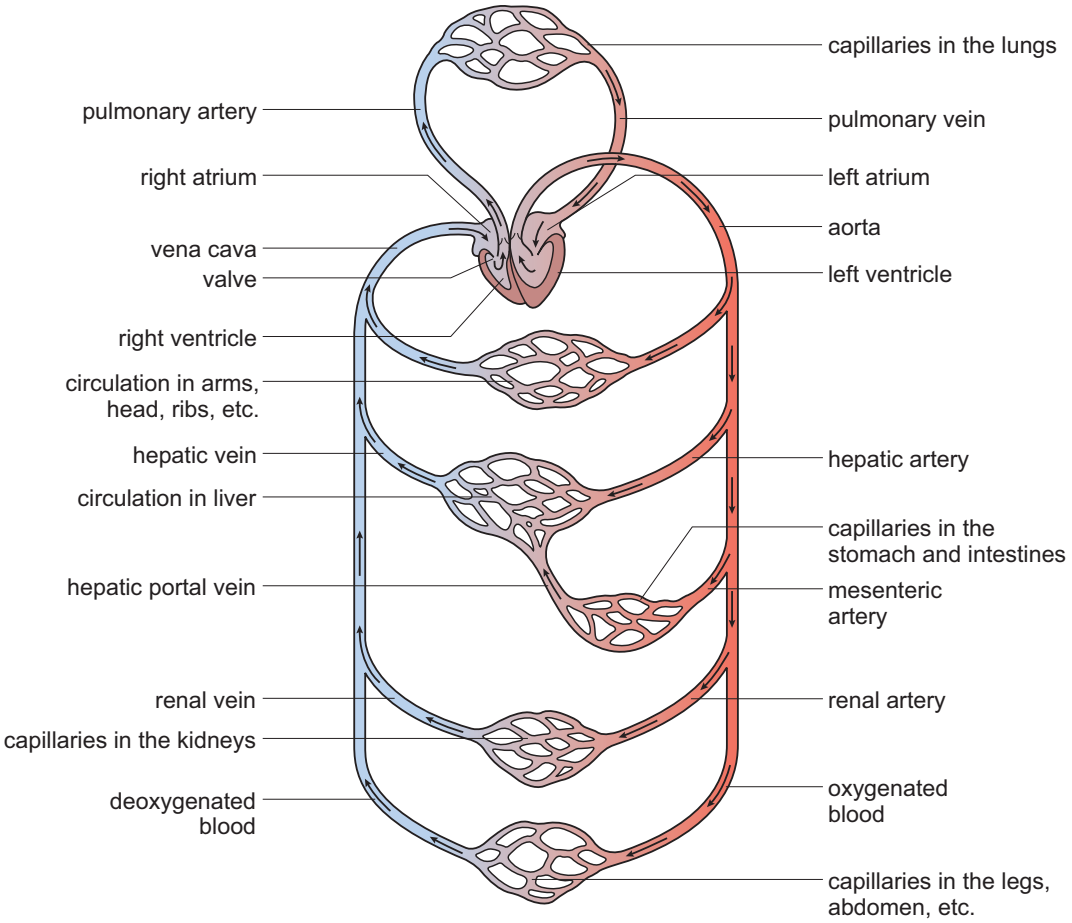


Figure 1: The human circulatory system

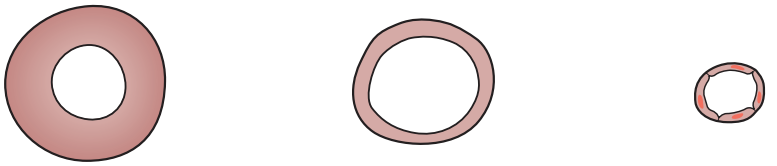


Figure 2: Sketch of a section through an artery, a vein and a capillary.

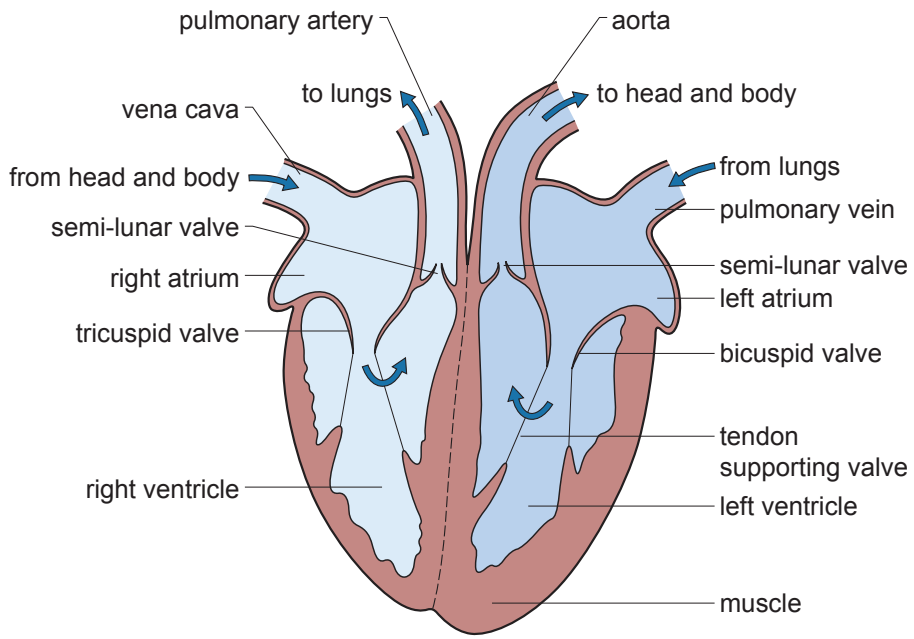


Figure 3: The human heart cut through to show the inside

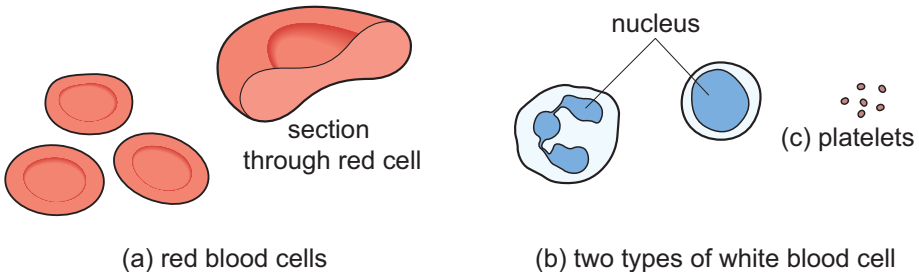


Figure 4: Types of blood cells

## B3 Key facts to revise

### Structure and function of the circulatory system

- The blood is made up of a fluid, the **plasma**, which contains specialised cells: **red blood cells**, **white blood cells** and **platelets**.
- The job of the circulatory system is to carry substances and heat from one part of the body to another. Substances carried include: products of digestion such as glucose, amino acids, fatty acids and glycerol; waste substances such as urea; oxygen; carbon dioxide; hormones. The circulatory system also helps to protect the body against disease.
- The blood moves round the body in blood vessels. It is pumped round by the muscular heart.

### Blood vessels

- **Arteries** carry blood away from the heart to the rest of the body. **Veins** carry blood towards the heart. Blood capillaries form a mass of tiny, thin-walled vessels which connect the arteries to the veins. Substances move in and out of the blood through the walls of the **capillaries**.

- Arteries have thicker walls than veins and a smaller lumen. They have more muscle and elastic tissue in their walls than veins. Blood pressure is higher in arteries than in veins. Arteries carry oxygenated blood, except for the pulmonary artery.
- Some veins contain valves to prevent back flow of blood. All veins carry deoxygenated blood, except for the pulmonary vein.

## The heart

- The heart is a hollow organ made of four chambers: the **left and right atria** and the **left and right ventricles**. Its walls are made of muscle which can contract and squeeze the blood inside and push it onwards. Blood cannot pass directly from the left to the right side or vice versa.
- For one complete circuit of the body, the blood passes through the heart twice: once to go to the lungs to pick up oxygen and get rid of carbon dioxide and once to go to the rest of the body taking oxygen to the cells and picking up carbon dioxide from the cells.
- The main vein which brings blood from the body to the right atrium is the **vena cava**. The **pulmonary vein** brings blood from the lungs to the left atrium.
- The **aorta** is the main artery which carries blood from the left ventricle to the rest of the body. The **pulmonary artery** carries blood from the right ventricle to the lungs.
- Valves in the heart make sure the blood always flows in the correct direction. **Parachute-like valves** between the atrium and ventricle on each side ensure blood always flows from the atrium to the ventricle; these are the **tricuspid valve** between the right atrium and right ventricle and the **bicuspid valve** between the left atrium and left ventricle. **Half-moon shaped valves** at the base of the aorta and the pulmonary artery ensure blood always flows from the ventricle into the artery.

## Blood cells

- **Red blood cells** are shaped as bi-concave discs. They have no nucleus when mature. They contain the red pigment **haemoglobin**, which carries oxygen. The haemoglobin molecule contains iron and protein.
- **White blood cells** are larger than red blood cells. There are fewer white blood cells than red blood cells. Most white blood cells are **phagocytic** cells. This means they can surround, engulf and destroy disease-causing bacteria. The remaining white blood cells are **lymphocytes**, (see Unit B6.)
- **Blood platelets** enable the blood to clot. This stops the body losing blood at sites of wounds and stops germs entering the body.
- The blood-clotting process requires calcium and vitamin K. Exposure of red blood cells to air causes a chain of reaction in the blood, during which the protein fibrinogen is converted to fibrin. Fibrin is insoluble and plugs the wound.

### Circulatory problems

- The **coronary artery** supplies blood to the heart muscle. If fatty deposits build up inside these vessels they become narrower. Platelets may stick onto the deposits and cause a clot. This blocks the artery, stops the heart working properly and leads to heart failure and a **heart attack**.
- The risk of heart attack can be reduced by not overeating, not smoking, not eating too much saturated fat and by taking regular exercise.
- **High blood pressure** (hypertension) puts excess pressure on artery walls. It may lead to heart failure. If it happens in the brain, it can cause a **stroke**. High blood pressure is often associated with overeating, drinking too much alcohol, smoking, stress and lack of exercise.

# The digestive system

## B3 Diagrams to learn

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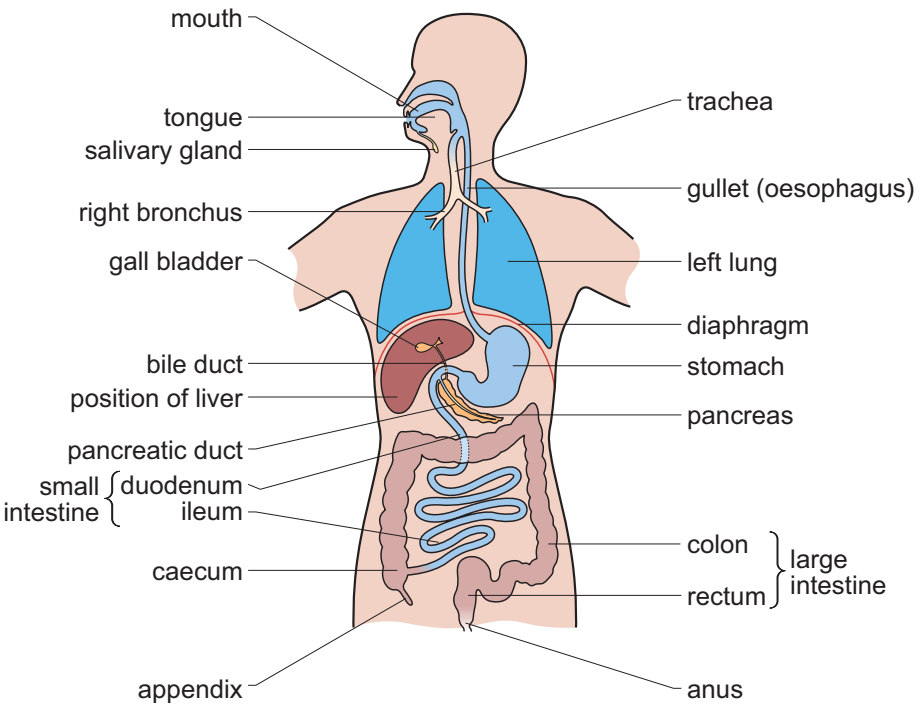


Figure 1: The human alimentary canal

## B3 Key facts to revise

### The alimentary canal

- The food tube goes from the mouth, where food is taken in, to the anus, where undigested food is got rid of from the body. Its walls contain muscle which contracts to push the food along in waves called **peristalsis**. It is over seven metres long and must be coiled up to fit into the body.

- Digestion happens in the mouth, stomach and small intestine. Digested food is absorbed into the blood through the walls of the small intestine. Water is absorbed through the walls of the large intestine (colon).
- The main parts of the alimentary canal and its associated glands are: **mouth, salivary glands, oesophagus, stomach, small intestine (duodenum and ileum), pancreas, gall bladder, large intestine (colon and rectum), anus**.

## Digestion

- Digestion is the process of breaking down food from large, insoluble, complex molecules into small, soluble simple molecules.
- Physical digestion is the breaking down of food into small pieces mainly by the teeth and jaws. Chemical digestion is the breakdown of large molecules in food into smaller molecules. This is done by enzymes. Physical breakdown of food is important because it increases surface area of food on which enzymes work.

## Enzymes

- Enzymes are special kinds of proteins which act as catalysts. They speed up chemical reactions. There are different enzymes for different reactions. They work best at certain temperatures and pH.
- **Starch** is first digested by the enzyme **amylase**. The product is further digested by the enzyme **maltase**. The final product is **glucose**. Amylase is made in the saliva and works in the mouth and oesophagus. It is also made in the pancreas and passes into the small intestine where it does its work. Maltase is made in the intestinal walls.
- **Protein** is digested by **proteases** into **amino acids**. Proteases are made in the stomach, the pancreas and the intestinal walls.
- **Fats** are digested into **fatty acids** and **glycerol** by the enzyme **lipase**. Lipase is made in the pancreas and passes into the small intestine where it does its work.

## Absorption and assimilation

- Digested food is absorbed through the walls of the ileum. The inside of the ileum wall is covered with many finger-like projections called **villi**. This increases the surface area so more food can be absorbed. Glucose and amino acids are absorbed directly into the blood in capillaries in the ileum wall. Most of the fatty acids and glycerol are absorbed into lacteals (part of the lymphatic system) in the ileum wall.
- When digested food reaches body cells, it is used for energy, growth and repair (assimilation).

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# Revision B4: Excretion and coordination

## Excretion

### B4 Diagrams to learn

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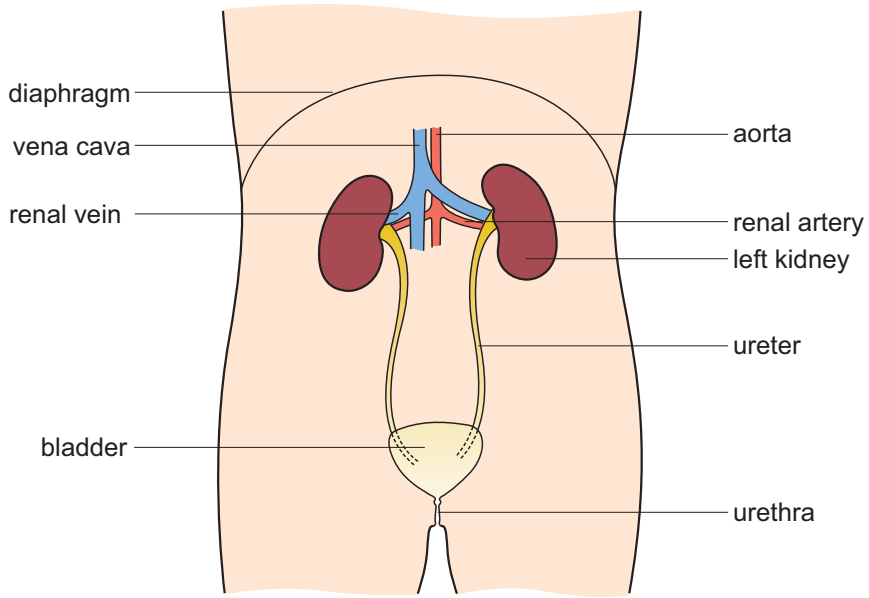


Figure 1: The position of the kidneys in the human body

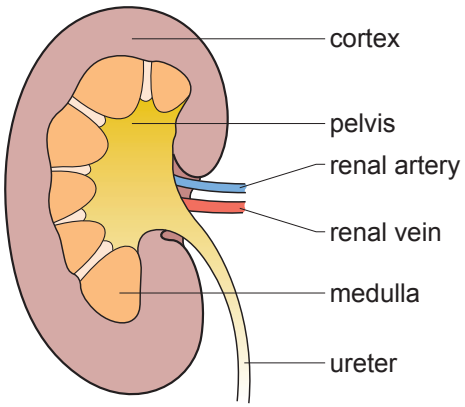


Figure 2: A human kidney cut in half

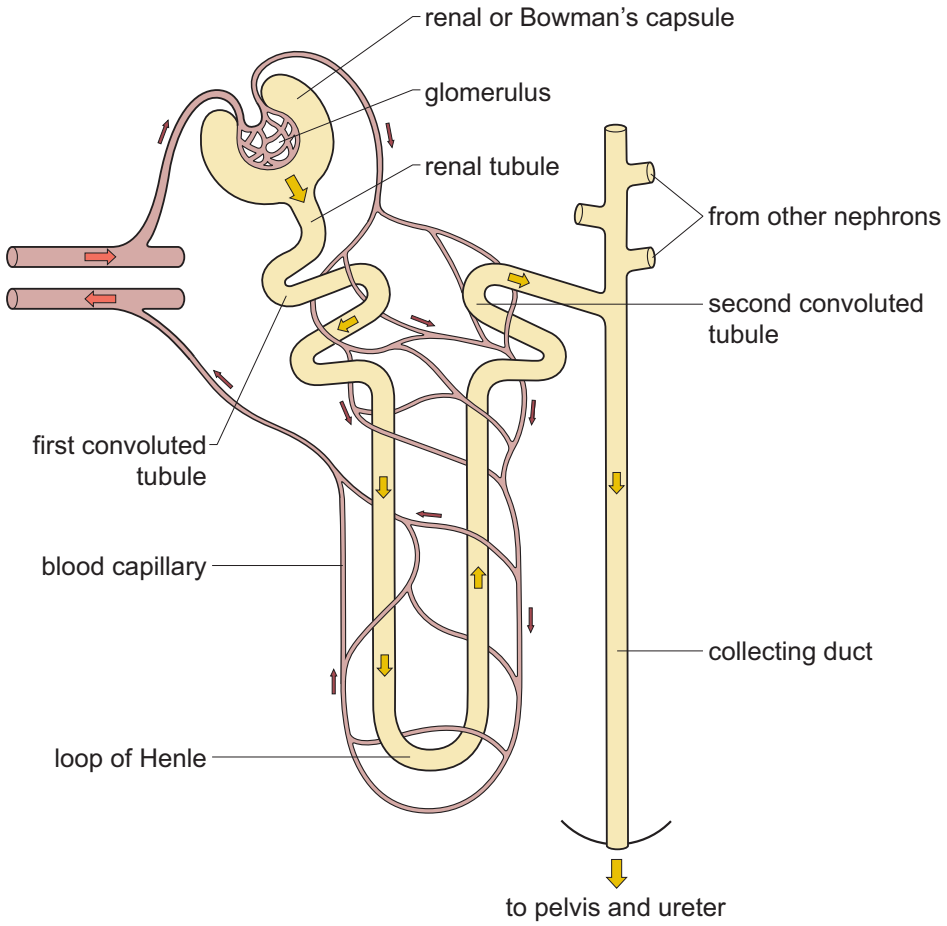


Figure 3: A kidney tubule or nephron

# B4 Key facts to revise

## Waste products

- Excretion is the removal of waste products of metabolism from the body. These would become poisonous if allowed to build up. The main excretory substances are: **urea**, carbon dioxide, excess mineral salts, toxic substances and water. Urea is a nitrogen-containing waste product formed from the breakdown of excess amino acids.
- Waste substances are collected by the blood as it flows round the body. As the blood flows through the kidneys the waste substances are filtered out and pass out of the body in a solution called **urine**. Cleaned blood flows away from the kidneys in the renal veins. (Carbon dioxide waste is removed via the lungs).

## Structures of the excretory system

- The two bean-shaped kidneys are the main excretory organs. Urine is carried away from the kidneys in the **ureters**. These lead to the **bladder** where urine can be stored temporarily. The **urethra** carries urine out of the body.
- Each kidney is made up of about one million tiny tubes called **kidney tubules** or **nephrons**.
- A kidney tubule has a cup-shaped end (**renal or Bowman's capsule**), followed by a long tubule. The tubules join together into collecting ducts which pass to the ureter.

- Each kidney tubule is closely associated with blood capillaries. This includes a bunch of capillaries (**glomerulus**) inside the cup-shaped end of the kidney tubule, as well as more capillaries branching over the rest of the tubule.

## The function of the kidney tubule

- As blood flows through the glomerulus, high blood pressure forces fluid to filter into the Bowman's capsule (**ultra-filtration**). The filtered fluid contains glucose, urea, amino acids, salts, toxic substances and water.
- As the filtrate passes along the rest of the tubule, substances that are useful to the body – including glucose, amino acids, some salts and some water – are reabsorbed or absorbed back into the blood capillaries. This is **selective reabsorption**.
- The remaining solution at the end of the kidney tubule is now called **urine**. It contains water, urea, excess salts and other unwanted substances.

## Osmoregulation

- Body fluids such as blood and tissue fluids must maintain a constant osmotic pressure. This is necessary to prevent cells gaining or losing too much water by osmosis, which would stop them functioning correctly.
- The process of keeping the amount of water in the body balanced is called osmoregulation. This happens in the kidney tubules. When receptors in the **hypothalamus** in the brain detect that water in the blood is low, they instruct the **pituitary gland** to make **ADH (anti-diuretic hormone)**.
- ADH causes more water to be reabsorbed from the kidney tubules. Urine produced is more concentrated and water is conserved. ADH secretion is reduced if there is a lot of water in the body or when the blood is dilute.

## Regulation of salts

- The concentration of sodium, potassium and chloride ions in the blood is regulated by selective reabsorption of these ions in the kidney tubule.

## Homeostasis

- Homeostasis means **staying the same**. It involves regulation of the concentration of salt and sugar in the body, maintaining the correct pH in body fluids and keeping the body temperature constant.
- The kidneys are important in maintaining the correct balance of water, salts and sugars. They also keep the blood pH constant. The liver, lungs and skin are also involved in homeostasis.

## Kidney failure and the dialysis machine

- A dialysis machine can be used by patients whose kidneys have failed. The dialysis machine cleans the blood in a similar way to the kidney.
- Blood is drawn from a blood vessel in the patient's arm and passed through the machine. Inside the machine, waste substances diffuse from the blood which flows along special tubing and out into surrounding dialysis fluid. The cleaned blood is returned to the patient's blood vessel.

# Coordination

## B4 Diagrams to learn

*Learn the diagrams as sketches. You do not have to be an artist. Make them as clear as possible and a good size. Try to learn as many labels as possible.*

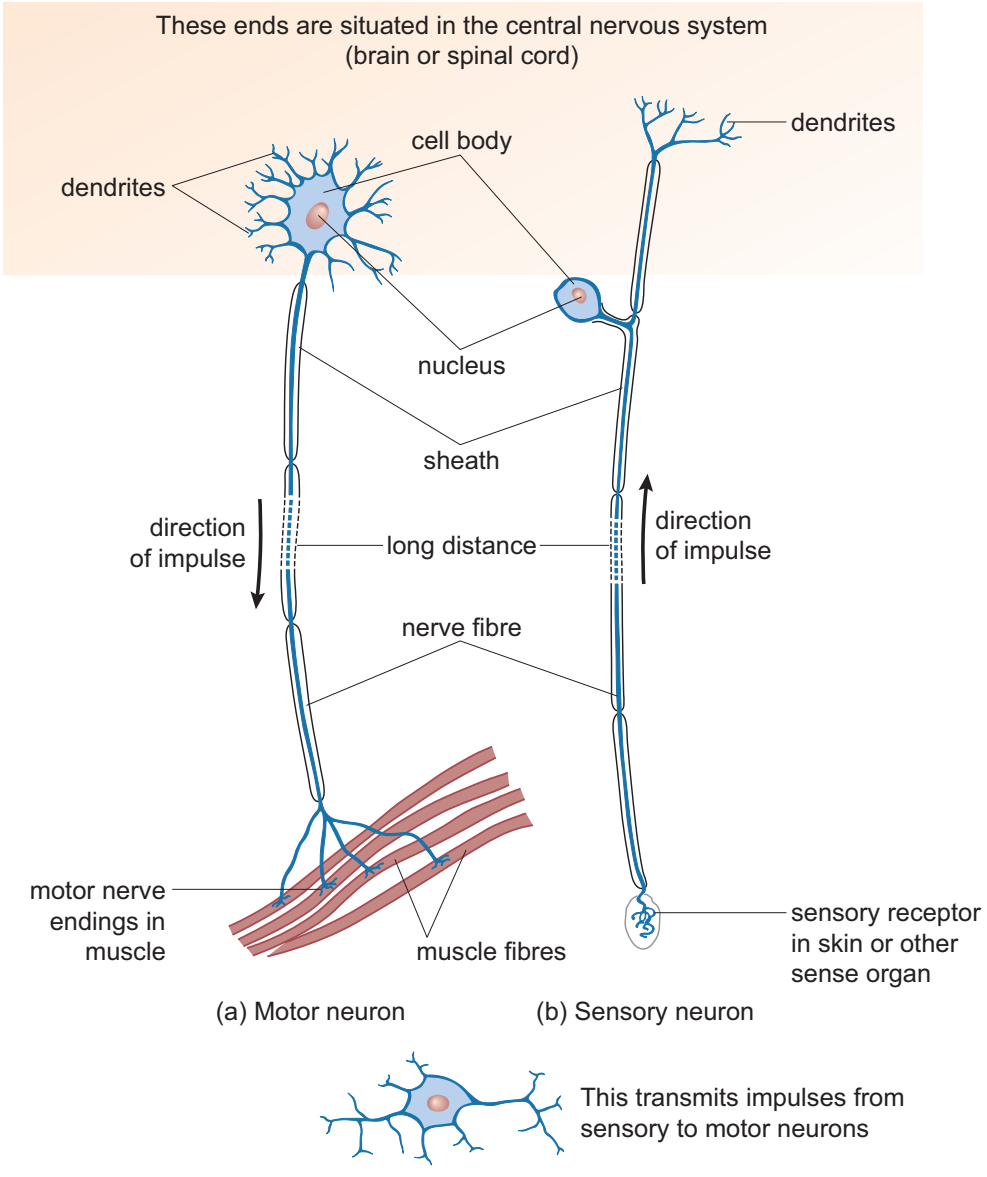


Figure 1: Types of neuron

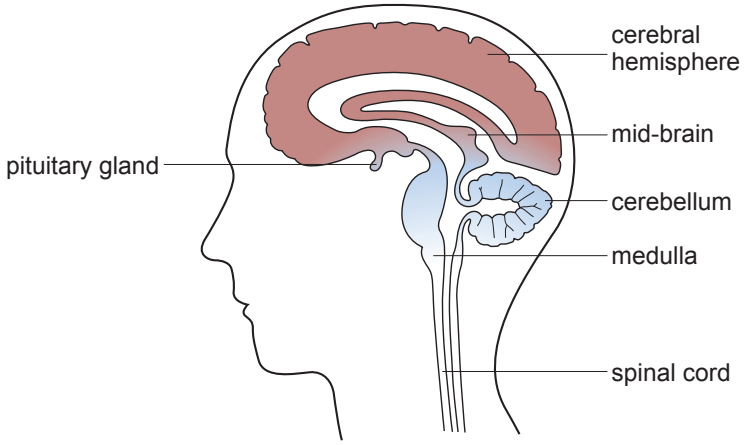


Figure 2: The human brain in section

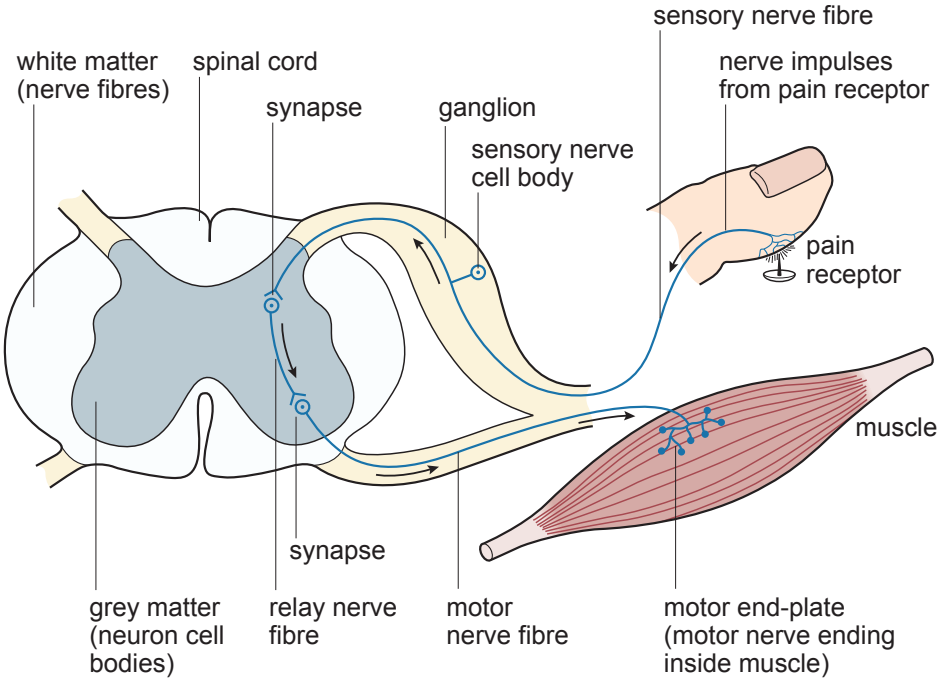


Figure 3: Reflex arc

## B4 Key facts to revise

### Structure and function of the nervous system

- The nervous system plays an important role in ensuring that the different parts and activities of the body work together cooperatively and efficiently. This is known as **coordination**.
- The central nervous system is made up of the brain and spinal cord. The peripheral nervous system is made up of nerves. Nerves are bundles of long nerve fibres. Nerve fibres are extensions from nerve cells.
- Nerve cells or **neurons** are made up of a compact cell body with fibre-like extensions. The long fibres are called **axons**. The shorter fibres are called **dendrites**. The fibres are surrounded by a fatty **myelin sheath**.
- There are three types of neuron: **sensory neurons, motor neurons** and **relay neurons** (also known as intermediate, multi-polar or association neurons).
- Sensory neurons transmit impulses from a sense cell or organ (**receptor**) towards the central nervous system. Motor neurons transmit impulses from the central nervous system towards muscles or glands (effector organs). Relay neurons transmit impulses from sensory to motor neurons and are found in the brain or spinal cord.
- **Nerve impulses** are electrical impulses which pass along the long fibres of neurons. There is a tiny gap where one neuron meets another. This is called a synapse. Packets of chemicals called **neuro-transmitters** are released from the end of one neuron, cross the gap and start an electrical impulse in the next neuron. Neuro-transmitters are only produced at one end of a neuron. This ensures that impulses always pass in one direction.

- Co-ordination involves a **stimulus** (a local change in the internal or external environment), which is received by a **receptor**. This sets up **impulses** which pass via the brain or spinal cord to an **effector** organ, which makes a **response.** Response can be in the form of muscle contraction or production of a hormone.
- The brain is surrounded and protected by the bony skull, the cerebrospinal fluid and three membranes called the meninges. **The cerebral hemispheres** (cerebrum) control intelligence, memory, learning and consciousness and co-ordinate voluntary and some involuntary activities. The **cerebellum** co-ordinates muscle action and balance. The **medulla oblongata** controls involuntary actions. Damage to the medulla can cause death because it controls vital activities of the body.
- The spinal cord is protected by the bony spine or vertebral column. Pairs of spinal nerves come off the spinal cord.
- A **reflex action** is a rapid, automatic response to a stimulus, which you cannot consciously control, e.g. blinking of eyes, withdrawing your hand from a hot object. The path of the nervous impulses along the neurons that make a reflex action happen is called a **reflex arc**.
- A **drug** is a substance which alters the way the body works. **Painkillers**, e.g. aspirin, suppress the part of the brain responsible for pain. **Stimulants**, e.g. cocaine, speed up the action of the brain and make you more alert. **Sedatives**, e.g. alcohol, slow the brain down and make you sleepy. **Hallucinogens**, e.g. cannabis, make you see, feel or hear things that are not really there.

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# Revision B5: New generations

## B5 Diagrams to learn

*Learn the diagrams as sketches. You do not have to be an artist. Make them as clear as possible and a good size. Try to learn as many labels as possible.*

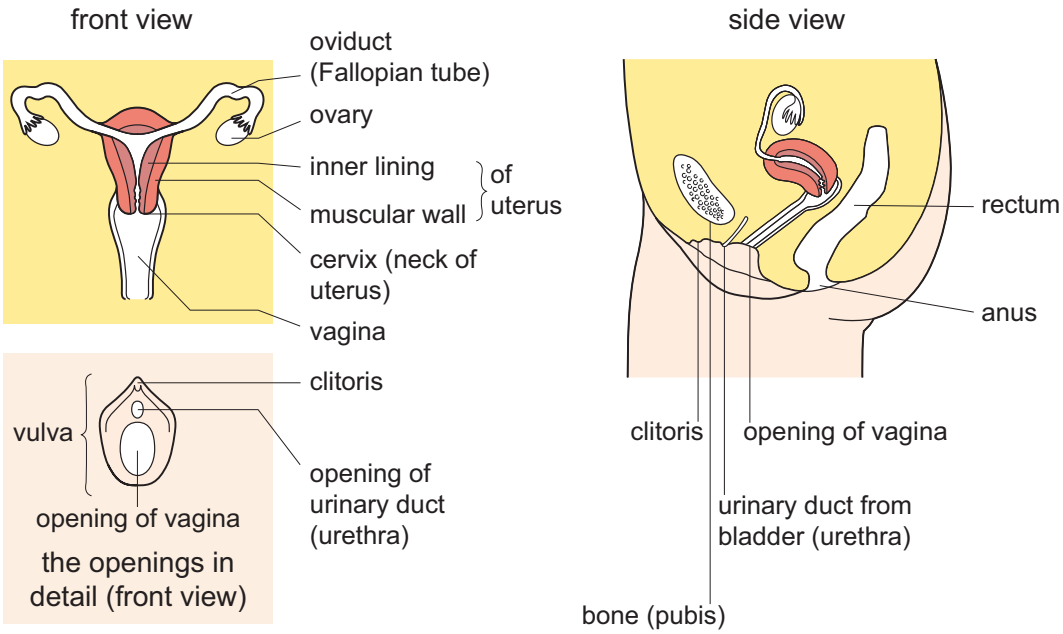


Figure 1: The human female reproductive system

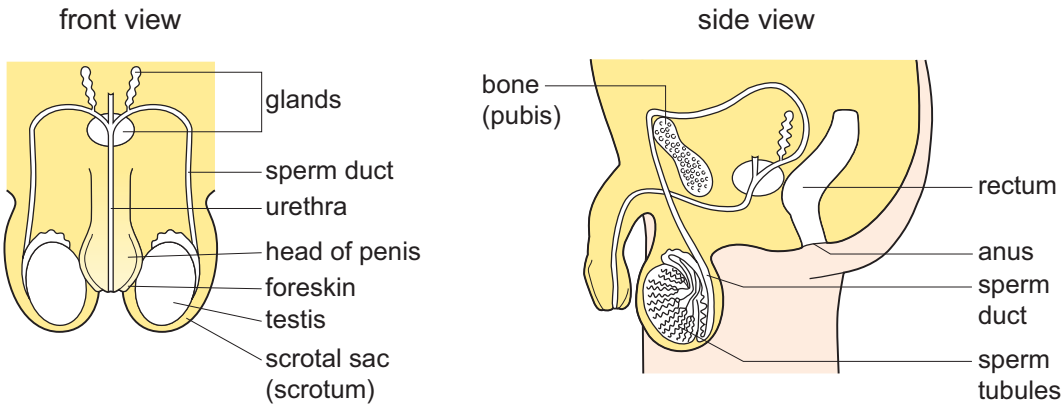


Figure 2: The human male reproductive system

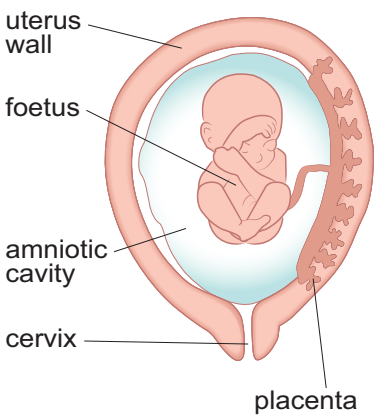


Figure 3: The baby in the uterus

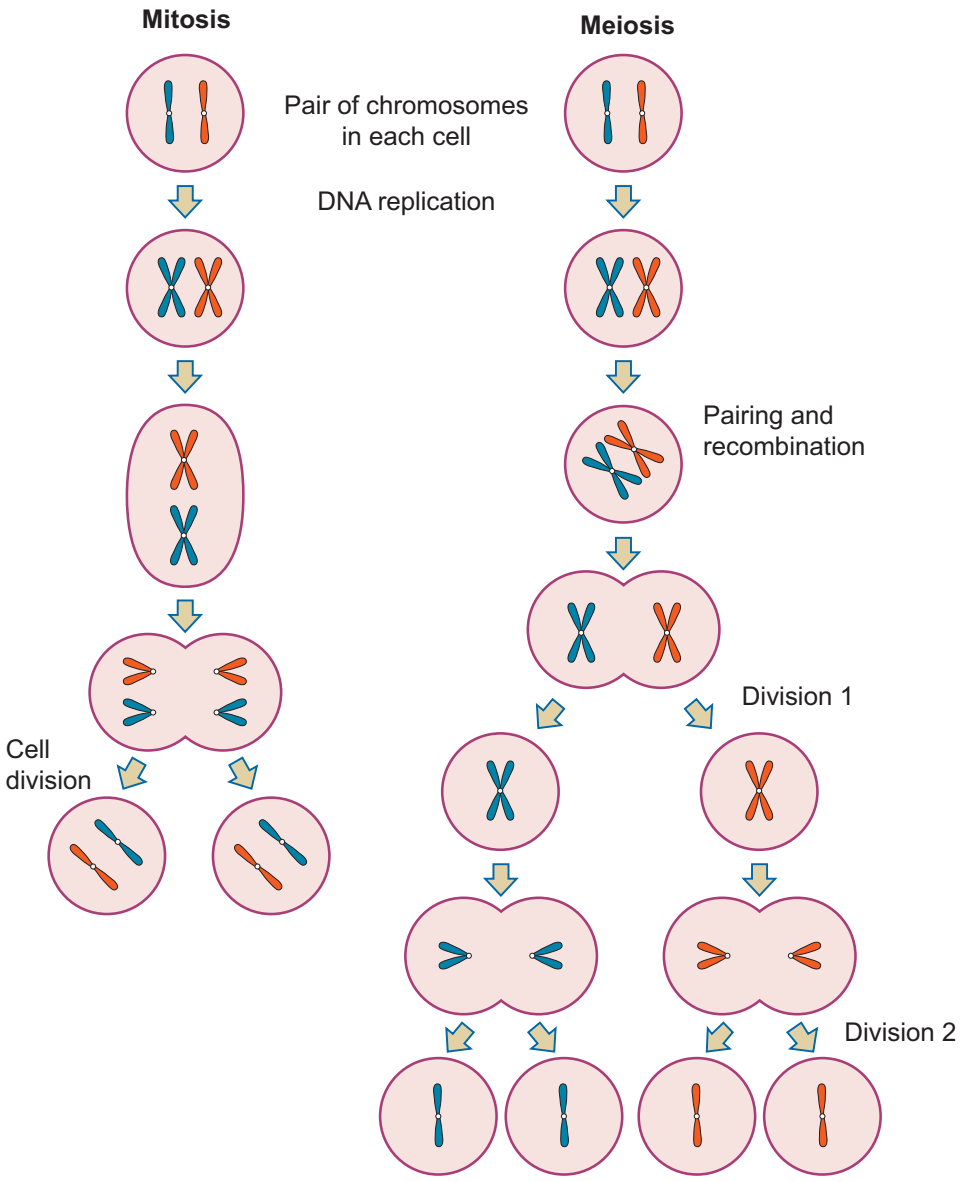


Figure 4: Mitosis and meiosis

## B5 Key facts to revise

### Chromosomes, DNA and genes

- The nucleus of every cell of your body (except egg and sperm cells) contains 23 pairs of chromosomes. These thread-like structures are made of bundled-up molecules of DNA (deoxyribonucleic acid). A gene is a section of DNA.

### Human reproduction

- Humans reproduce by sexual reproduction. **Sex cells** or **gametes** are produced. Women make **egg cells** (female gametes). Men make **sperm** (male gametes). An egg and sperm must join together at **fertilisation**. The resulting cell, the **zygote**, goes on to divide, grow and develop into a new individual.
- The female reproductive organs are the two **ovaries**. Eggs are made here. After puberty, once a month, an egg passes out of an ovary

and moves down the **oviduct** (Fallopian tube) to the **uterus** (womb), **vagina** and out of the body if it does not get fertilised.

- The male reproductive organs are the two **testes**. Sperm are made here. Sperm pass out of each testis along a **sperm duct**. The male has a **penis** which is used to transfer sperm into the vagina of the body of a female during sexual intercourse.
- Ejaculation is a reflex action during which the sperm ducts contract forcing sperm out through the **urethra**. As this happens, glands around the sperm duct pour fluid into the ducts. The resulting fluid plus sperm is called **semen**. Sperm are much smaller than eggs. They are shaped like tadpoles with a tail for swimming.
- Once in the body of a woman, sperm swim through the uterus to the oviduct. If the woman has just ovulated, one sperm may meet an egg and join with it to make a zygote.
- The zygote divides to form a ball of cells which is wafted down to the uterus by hair-like cilia lining the oviduct wall. The ball of cells sinks into the thick spongy lining of the uterus wall. This is **implantation**. From this point in its development the growing ball of cells is called an **embryo**.

## Structure and function of the placenta

- The **placenta** is a flat disc-shaped structure formed partly from embryo tissue and partly from the mother's tissue. The blood vessels of the mother and the blood vessels of the embryo lie very close together in the placenta but do not connect directly. Food and oxygen diffuses from the mother's blood to the embryo's blood. Carbon dioxide and urea diffuse in the opposite direction. The placenta is attached to the embryo by an **umbilical cord**. Blood vessels run through this cord and transfer substances between the placenta and the embryo.
- As the embryo grows and develops, the uterus enlarges around it. A bag filled with fluid develops around the embryo. This is the **water sac** or **amnion**. It protects the baby from bumps and damage. The main organs of the baby are developed by 8-10 weeks. The embryo is now called a **foetus**.

## Human menstrual cycle

- Between the ages of about eleven and 45–55, a woman releases one egg each month from one of her ovaries. At the same time, her uterus lining starts to thicken and develop a richer blood supply in case fertilisation happens and a baby develops inside her.
- If fertilisation does not happen, the egg, together with the extra uterus lining and its blood supply, pass out of the body through the vagina. This is known as **a period**. If fertilisation does happen, the thickened uterus lining is maintained to protect and nourish the developing baby.
- The monthly cycle – or menstrual cycle – is controlled by four hormones. **Oestrogen** and **progesterone** control the development and maintenance of the uterus wall. Progesterone also prevents the release of further eggs while a woman is pregnant. **Follicle stimulating hormone (FSH)** and **luteinising hormone (LH)** cause eggs to mature in the ovary and be released into the oviduct (ovulation).

## Contraception

- Contraception or birth control means preventing a baby developing following sexual intercourse. Some methods are more reliable than others.
- The main methods are: sterilisation; the contraceptive pill; sheaths or condoms; a diaphragm or cap; a coil or loop (intrauterine device or IUD); the "safe period" (avoiding intercourse around ovulation time).

## Division of nucleus and chromosomes

| Mitosis | Meiosis |
|---|---|
| This is a kind of nuclear division. | This is a kind of nuclear division. |
| In mitosis, each chromosome **replicates** itself before nuclear division happens, so it becomes a **double strand**. | In meiosis, each chromosome **replicates** itself before nuclear division happens, so it becomes a double strand. |
| In mitosis, the nucleus divides once. | In meiosis, the nucleus divides twice. |
| In mitosis, the double-stranded chromosomes split once and separate to form two sets of chromosomes. Each set becomes surrounded by a nuclear membrane. | In meiosis, there are two divisions of the nucleus. In the **first meiotic division** the chromosomes do not separate, but one of each pair of chromosomes separates to each end of the cell. Each set of single chromosomes then undergoes a **second meiotic division**. The chromosomes themselves then split into two separate groups. |
| In mitosis, **two new nuclei** are made. | In meiosis, **four new nuclei** are made. |
| Each of the two new nuclei has the **same number of chromosomes** as the parent nucleus. | Each new nucleus has **half the number of chromosomes** that the parent cell had. |
| Each of the two new nuclei is **identical** to the parent nucleus. | The chromosomes in the four new cells will not all be the same. They will have one of each pair of chromosomes, but the genes on the chromosomes will **vary.** |
| Mitosis happens whenever cells divide during growth of an individual. | Meiosis occurs when gametes are produced. Therefore eggs and sperm have half the normal number of chromosomes – the haploid number of chromosomes. Once an egg and sperm fuse together, the full chromosome number is restored. |

## Inheritance

- Inherited characteristics are controlled by **pairs of genes**. One of each pair of genes comes from your mother and one from your father. Some characteristics are controlled by just one pair of genes. More complex characteristics are controlled by several or many pairs of genes.
- We represent genes by letters of the alphabet. Genes written with a capital letter are **dominant**, e.g. ***R***. Genes written with a small letter are **recessive**, e.g. ***r***. As you have two genes to control each characteristic, you may have ***RR***, ***Rr*** or ***rr***. This is your **genotype**.
- Dominant genes show their effect in the body even if only one of them is present. Recessive genes cannot show their effect if a dominant gene is also present.
- We use the word **phenotype** for the characteristics we see in an individual due to its genes. If ***R*** represents the gene for tongue-rolling and r represents the gene for non tongue-rolling, the phenotype of both ***RR***, and ***Rr*** individuals will be tongue-rollers. The phenotype of rr individuals will be non tongue-roller.
- If the two genes controlling a characteristic in an individual are the same, e.g. ***RR*** or ***rr***, the individual is described as being **homozygous** for that characteristic. If the two genes are different, e.g. ***Rr***, the individual is described as being **heterozygous** for that characteristic.
- Different forms of a gene are called ***alleles***. For example, R and r are alleles of the gene for tongue-rolling.

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# Revision B6: Drugs and disease

## B6 Key facts to revise

### Infectious diseases

- A disease caused by microbes entering the body and growing and reproducing there is called an infectious disease. Microbes that cause disease include: bacteria, viruses, fungi and protozoa.
- **Bacterial diseases** include pneumonia, TB (tuberculosis), cholera and typhoid. **Pneumonia** and **TB** affect the lungs. **Cholera** and **typhoid** affect the small intestine – both cause diarrhoea.
- **Viral diseases** include common cold, flu (influenza), measles, chickenpox and AIDS. The **common cold** virus, the **influenza** virus and the **measles** virus affect the respiratory system. **Chickenpox** affects skin and nerve cells.
- **Fungal diseases** include ringworm, thrush and athlete's foot. **Ringworm** affects the skin. **Thrush** affects the inside of the mouth, the vagina and the head of the penis. **Athlete's foot** affects skin, especially between the toes.
- Human diseases caused by **protozoa** include malaria and sleeping sickness.

### Spread of microbes

- Understanding how microbes are spread is important for planning ways of protection against infectious diseases. There are seven main ways in which they are spread.
    1. By **droplets in the air**: colds, flu, pneumonia, measles, chickenpox and TB.
    2. By **water**: cholera, typhoid and dysentery. Human sewage must be disposed of so it cannot contaminate human drinking water. Treat drinking water to remove bacteria.
    3. By **food** prepared or stored in unhygienic conditions. Typhoid, TB and cholera are spread in this way.
    4. By **vectors**. A vector is an organism that transmits a disease-causing organism from one animal to another, e.g. mosquitoes (malaria and elephantiasis) and tsetse flies (sleeping sickness).
    5. By **direct contact**: chickenpox, measles, athlete's foot and ringworm.
    6. By **infected blood** or other **body fluids**: AIDS.
    7 By **carriers** who have the microbes in their body but do not get the disease themselves, e.g. house flies and cockroaches.

### Drugs and vaccines for treating infectious diseases

- **Antibiotics** are used to treat pneumonia, cholera, and typhoid. They kill bacteria and fungi.
- **Antifungal ointments** are used to treat ringworm, thrush and athlete's foot.

- **Anti-viral drugs** are available for influenza.
- **Anti-retroviral drugs** slow the progress of AIDS. It cannot be cured.
- For some diseases there is no drug cure but drugs may alleviate some of the symptoms, e.g. pain killers and drugs to reduce fever.
- **Vaccines** are available to prevent TB, cholera, typhoid and measles.

## Infectious diseases involving a vector

- **Malaria** is caused by a protozoan parasite, **plasmodium**, which is transmitted by female Anopheles **mosquitoes**. The plasmodium multiplies in the liver and red blood cells. Poisonous waste substances released into the blood cause regular bouts of fever.
- Mosquitoes lay their eggs in stagnant water. The eggs hatch into larvae, which later become pupae. Both larvae and pupae are also found in stagnant water.
- Malaria can be controlled by controlling the mosquitoes, e.g. with insecticides. Mosquito larvae can be controlled by spraying oil on the water and by draining swamps and open water. Mosquito nets and clothing which covers the whole body helps prevent the insects biting individuals.
- Anti-malaria drugs are available to prevent people getting malaria. Other drugs are available to treat the disease once a person has been infected.
- **Sleeping sickness** is caused by a protozoan called a **trypanosome**. It is spread by the tsetse fly. Trypanosomes live in the human blood stream, but later invade the nervous system. Symptoms of sleeping sickness in human are fever, headache, swollen lymph nodes, excessive sleeping and eventual death. It is controlled by controlling the insect. Drugs are available to treat the disease.
- **Elephantiasis** is caused by a tiny nematode worm that lives in and blocks lymph vessels. This leads to swelling in parts of the body, especially the lower parts of the body and legs. The worm is spread by mosquitoes.

## Diseases of the nervous system

- **Polio (poliomyelitis)** is caused by a virus which damages motor neurons. It is present in the faeces of infected people and is spread in contaminated water and food. It can cause paralysis of leg and breathing muscles.
- **Tetanus (lockjaw)** is caused by a type of anaerobic bacterium found in soil. It invades the spinal cord and brain stem and blocks nerve impulses to muscles. It causes uncontrollable contraction of muscles. Vaccinations are available. Tetanus infections can be treated with a solution of antibodies.
- **Meningitis** may be caused by bacteria or viruses. The disease is spread by direct contact and respiratory droplets. The bacteria infect the meninges of the brain. Symptoms include headache, stiff neck and convulsions in children. Meningitis can be treated with antibiotics.

- **Leprosy** is caused by bacteria. It is transmitted by droplets and frequent contact with infected individuals. It can be treated by multi-drug therapy. If untreated, it causes permanent damage to skin, nerves, limbs and eyes. The bacteria affect sensory neurons causing the affected parts to fail to detect stimuli, e.g one may lose sense of pain.

## Barriers in the body which stop microbes getting in

- These include **skin**, which has some antiseptic properties. The **lining of the nose**, **mouth and air passages** are made of cells that make sticky mucus and are covered in tiny hairs (cilia). These trap and sweep microbes away. **Stomach acid** kills microbes, as well as playing a role in digestion. **Earwax** and **tears** have antiseptic properties.

## The lymphatic system

- This is a network of thin-walled vessels. The smallest vessels, **lymph capillaries**, are closed at one end. The other ends join to larger **lymph vessels**, which join the blood in the neck region.
- Lymph capillaries and vessels contain a fluid called **lymph** and cells called **lymphocytes**. There are swellings in the system called **lymph nodes**. The main nodes are in the neck, armpit and groin. Spaces in lymph nodes are filled with **lymphocytes** and macrophages. Macrophages destroy microbes by surrounding, engulfing and digesting them, (**phagocytosis**).

## Antibodies

- Your body recognises foreign microbes by detecting special proteins on their outside called **antigens**. Different microbes have different antigens. B-lymphocytes can make **antibodies** to act against antigens. Different antibodies are made for each type of antigen.
- Antibodies fight infection in several ways, e.g. by killing microbes, making them clump together or by sticking onto their surface to make them harmless. Some make microbes more easily attacked by phagocytes. Some make the poisons produced by microbes harmless.

## Immunity

- When your body makes antibodies against invading microbes, this is called an **immune response.** Once your body has made antibodies against a particular microbe it can make them again quickly if you are re-infected another time. This stops you getting the disease a second time. We say you are 'immune' to that disease. This is **natural acquired immunity**.
- Antibodies can pass from mother to baby in the placenta. They are only effective for a short time, but they are important in protecting the baby before it can make its own antibodies.
- **Vaccines** contain either a changed microbe, a killed microbe or a changed microbe poison. If you are given a vaccine for a particular disease, you will not get the disease but your body will recognise antigens in the vaccine and will make antibodies against the microbes that cause the disease. Vaccines give you **active artificial immunity**.

- For some diseases, in an emergency you can be given an injection containing ready-made antibodies once you have caught the disease. This is called **passive artificial immunity**. This form of immunity is only temporary.

## HIV/AIDS

- **AIDS (acquired immunodeficiency syndrome)** is caused by the **human immunodeficiency virus** or HIV. This virus attacks the immune system. It invades the T-lymphocytes.
- Individuals with HIV are more likely to get diseases that the bodies of uninfected individuals can fight off relatively easily. They may suffer fever, sweating, swollen glands, chills, weakness and weight loss. They often die of pneumonia. Infected mothers can pass the virus to their babies in the uterus. There is no cure or vaccine for HIV/AIDS. Antiretroviral drugs can help delay death and reduce the chance of infection by other pathogens.

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