Harlaw Academy

Biology Department







National 5
Summary notes

Multicellular Organisms Unit

Multicellular Organisms

Key Area 1: Producing New Cells

Level	Learning Outcome	☹	😐	☺
N5	I can describe the sequence of events in mitosis.			
N5	I can state that chromatids are a single strand which is part of a chromosome when the chromosome has two strands after replication.			
N5	I can state the role of the equator and spindle fibres in mitosis.			
N5	I can explain that mitosis provides new cells for growth and repair of damaged cells and maintains the diploid chromosome complement.			
N5	I can explain that diploid cells have two matching sets of chromosomes, which are replicated during mitosis.			
N5	I can state that stem cells in animals are unspecialised cells which can divide in order to self-renew.			
N5	I can explain that stem cells have the potential to become different types of cell.			
N5	I can state that stem cells can be obtained from the embryo at a very early stage. In addition, tissue stem cells can be found in the body throughout life.			
N5	I can state that specialisation of cells leads to formation of a variety of cells, tissues and organs.			
N5	I can state that multicellular organisms have more than one cell type and are made up of tissues and organs.			
N5	I can state that organs perform different functions. The cells in organs are specialised for their function and groups of organs which work together form systems.			
N5	I can state that a hierarchy of organisation exists in multicellular organisms: cells, tissues, organs and systems.			

Multicellular Organisms

Key Area 2: Control and Communication

Level	Learning Outcome	☹	😐	☺
N5	I can explain that a response to a stimulus can be a rapid action from a muscle or a slower response from a gland.			
N5	I can state that the nervous system consists of central nervous system (CNS) and other nerves.			
N5	I can state that the CNS consists of brain and spinal cord.			
N5	I can identify the cerebrum, cerebellum and medulla from a diagram of the brain.			
N5	I can state that the cerebrum controls conscious responses; the cerebellum controls balance and movement and the medulla controls heart and breathing rate and peristalsis.			
N5	I can state that there are three types of neurons: sensory, inter and motor.			
N5	I can describe the function of each neuron as: sensory neurons pass the information to the CNS; inter neurons operate within the CNS, which processes information from the senses that require a response; motor neurons enable a response to occur at an effector (muscle or gland).			
N5	I can state that receptors detect sensory input/stimuli.			
N5	I can state that electrical impulses carry messages along neurons.			
N5	I can state that chemicals transfer these messages between neurons, at synapses.			
N5	I can explain that reflexes protect the body from harm.			
N5	I can describe the structure and function of a reflex arc.			
N5	I can state that endocrine glands release hormones into the bloodstream.			
N5	I can state that hormones are chemical messengers.			
N5	I can explain that a target tissue has cells with complementary receptor proteins for specific hormones, so only that tissue will be affected by these hormones.			
N5	I can describe the role of insulin, glucagon, glycogen, pancreas and liver in blood glucose regulation.			

Key Area 3: Reproduction

Level	Learning Outcome	☹	😐	☺
N5	I can explain that cells are diploid, except for gametes which are haploid.			
N5	I can state that in animals, the gametes are sperm and egg.			
N5	I can state that sperm is produced in the testes and eggs are produced in the ovaries.			
N5	I can identify the location of the testes and ovaries.			
N5	I can describe the basic structure of egg and sperm cells and how these relate to their function.			
N5	I can state that in plants, the gametes are contained in pollen and ovules.			
N5	I can state that pollen is produced by the anthers and that ovules are found in ovaries.			
N5	I can identify the location of the anthers and the ovaries.			
N5	I can state that fertilisation is the fusion of the nuclei of the two haploid gametes to produce a diploid zygote, which divides to form an embryo.			

Key Area 4: Variation and Inheritance

Level	Learning Outcome	☹	😐	☺
N5	I can compare discrete variation (single gene inheritance) with continuous variation (polygenic inheritance).			
N5	I can explain that combining genes from two parents contributes to variation within a species.			
N5	I can explain that single gene inheritance of characteristics shows discrete variation where measurements fall into distinct groups.			
N5	I can explain that polygenic inheritance of characteristics shows continuous variation where there is a range of values between a minimum and a maximum.			
N5	I can give a definition of the following terms: gene; allele; phenotype; genotype; dominant; recessive; homozygous; heterozygous and P, F_1 and F_2.			
N5	I can interpret family trees and the identification of phenotypes and genotypes from them.			
N5	I can carry out monohybrid crosses from parental generation through to F_2 using punnet squares.			
N5	I can explain the reasons why predicted phenotype ratios among offspring are not always achieved.			

Multicellular Organisms

Key Area 5: Transport Systems- Plants

Level	Learning Outcome	☹	😐	☺
N5	I can state that plant organs include roots, stems and leaves.			
N5	I can label a leaf structure diagram to show upper epidermis, palisade mesophyll, spongy mesophyll, vein (consisting of xylem and phloem), lower epidermis, guard cells and stomata.			
N5	I can explain that water and minerals enter the plant through the root hairs and are transported in dead xylem vessels.			
N5	I can describe the structure of xylem vessels.			
N5	I can explain that xylem cells are lignified to withstand the pressure changes as water moves through the plant.			
N5	I can state that transpiration is the process of water moving through a plant and its evaporation through the stomata.			
N5	I can name and describe the structures and processes involved as water moves through the plant from the soil to the air.			
N5	I can explain how the rate of transpiration is affected by wind speed, humidity, temperature and surface area.			
N5	I can explain that sugar is transported up and down the plant in living phloem.			
N5	I can describe the structure of phloem tissue.			
N5	I can state that phloem cells have sieve plates and associated companion cells.			

Multicellular Organisms

Key Area 6: Transport Systems- Animals

Level	Learning Outcome	☹	😐	☺
N5	I can state that in mammals, blood contains plasma, red blood cells and white blood cells.			
N5	I can state that blood transports nutrients, oxygen and carbon dioxide.			
N5	I can explain that red blood cells are specialised by being biconcave in shape, having no nucleus and containing haemoglobin. This allows them to transport oxygen efficiently in the form of oxyhaemoglobin.			
N5	I can explain that white blood cells are part of the immune system and are involved in destroying pathogens.			
N5	I can state that there are two types of white blood cells: phagocytes and lymphocytes.			
N5	I can explain that phagocytes carry out phagocytosis by engulfing pathogens.			
N5	I can explain that some lymphocytes produce antibodies which destroy pathogens.			
N5	I can explain that each antibody is specific to a particular protein.			
N5	I can describe the pathway of oxygenated and deoxygenated blood through heart, lungs and body.			
N5	I can label a diagram of the heart to show right and left atria, ventricles, location of four valves and location of associated blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries).			
N5	I can explain the function of the right and left atria, ventricles, valves and associated blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries).			
N5	I can state that arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure away from the heart.			
N5	I can state that veins have thinner walls, a wider channel and carry blood under low pressure back towards the heart. Veins contain valves to prevent backflow of blood.			
N5	I can state that capillaries are thin walled and have a large surface area, forming networks at tissues and organs to allow efficient exchange of materials.			
N5	Using this information, I can compare the structure of blood vessels in terms of thickness of walls, muscularity of walls, width of central channel and presence of valves.			

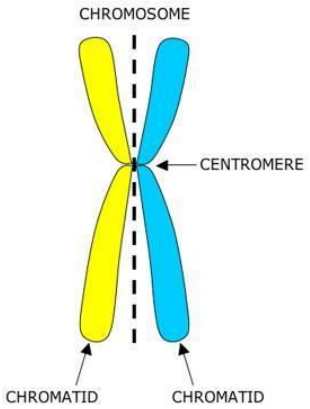
Multicellular Organisms

Key Area 7: Absorption of Materials

Level	Learning Outcome	☹	😐	☺
N5	I can explain that oxygen and nutrients from food must be absorbed into the bloodstream to be delivered to cells for respiration.			
N5	I can explain that waste materials, such as carbon dioxide, must be removed from cells into the bloodstream.			
N5	I can state that tissues contain capillary networks to allow the exchange of materials at cellular level.			
N5	I can explain that surfaces involved in the absorption of materials have certain features in common: large surface area, thin walls, and extensive blood supply. These increase the efficiency of absorption.			
N5	I can state that lungs are gas exchange organs.			
N5	I can state that lungs have a large number of alveoli providing a large surface area.			
N5	I can explain that oxygen and carbon dioxide are absorbed through the thin alveolar walls to or from the many blood capillaries.			
N5	I can state that nutrients from food are absorbed into the villi in the small intestine.			
N5	I can explain that the large number of thin walled villi provides a large surface area.			
N5	I can explain that each villus contains a network of capillaries to absorb glucose and amino acids and a lacteal to absorb fatty acids and glycerol.			

Producing new cells – Mitosis

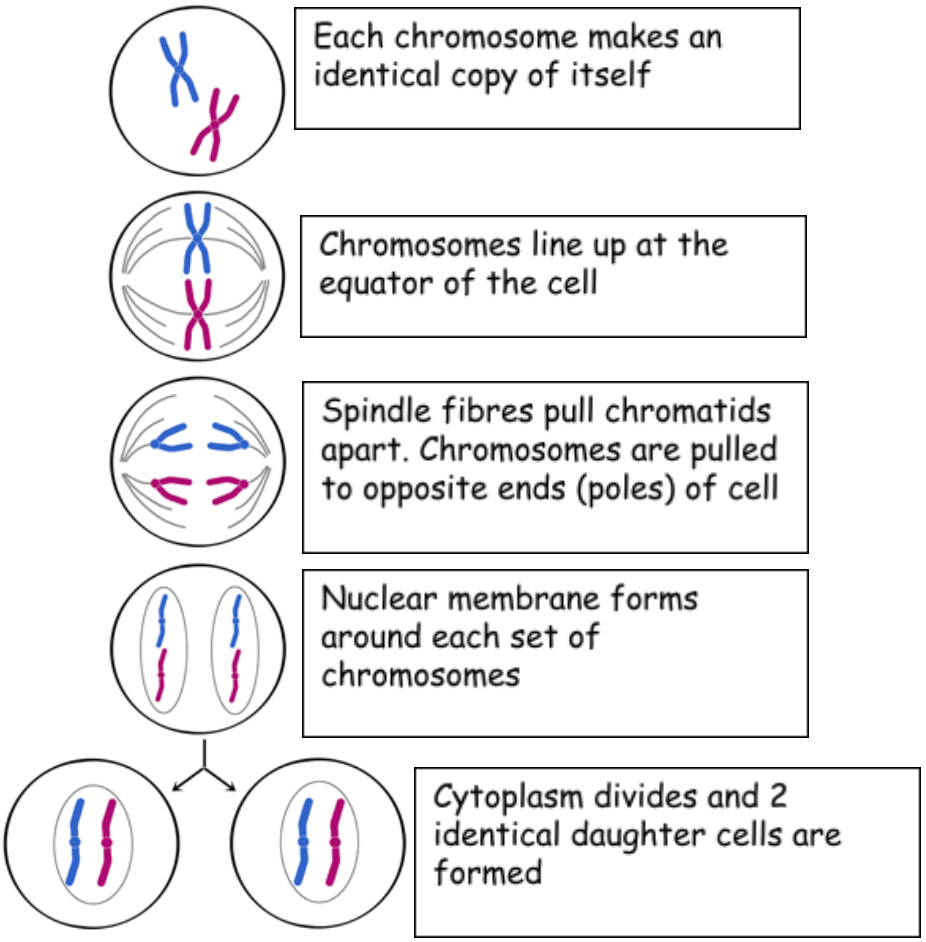
SQA Course specification: Sequence of events of mitosis. Understanding of the terms chromatids, equator and spindle fibres.
Mitosis provides new cells for growth, repair of damaged tissues and replacement of dead or damaged cells. It also maintains the diploid chromosome complement.



In order for growth and repair to take place in multi-cellular organisms cell division is essential.
Cell division is also called Mitosis. Cells produced by mitosis must have exactly the same chromosome structure as the parent cell which divides to produce them. This ensures that no genetic information is lost so that the cell can function correctly.

Most cells are **diploid**, this means that they have 2 copies of each chromosome. Human diploid cells have 46 chromosomes (23 pairs).

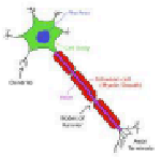
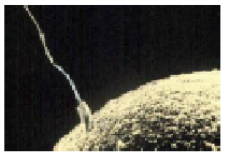
During cell division the following stages take place;



Specialised Cells

SQA Course specification: Specialisation of cells leads to the formation of a variety of cells, tissues and organs. Groups of organs which work together form systems. A hierarchy exists:

Cells □ tissues □ organs □ systems.

Type of Cell	Function	How it is adapted to carry out this function
 Red blood cell (RBC)	To carry (transport) oxygen around the body for use in respiration.	RBC contain **haemoglobin** which combines with the oxygen being transported. RBC do not have a nucleus and are biconcave in shape to maximise the area available in the cell to carry oxygen.
 Nerve cells (neurones)	To carry messages around the body in the form of electrical impulses.	They have long extensions to allow them to send information over long distances.
 Egg cell	To fuse with a sperm cell during fertilisation and divide into an embryo.	Egg cells contain a large store of food to provide the energy required to develop in the early stages.
 Sperm cell	Sperm cells swim through the female reproductive system to fertilise an egg in the oviduct.	Sperm cells are streamlined in shape and have a tail to allow them to swim to the egg. They also have lots of mitochondria to provide the energy required to complete this journey.

RBC image from Wikimedia commons, all other cell diagrams from Wikipedia

Tissues and Organs

A **tissue** is a group of **cells** that are specialised to perform a particular function. Tissues can be made up of one type of cell or different types of cell. Muscle cells form muscle tissue.

Organs are a group of tissues working together to perform the same function. The **heart** contains different tissues including **nerve** and **muscle** tissues.

Different organs will work together in organ systems such as the digestive or respiratory systems. All these systems then work together within an **organism**.

Cells □ Tissues □ Organs □ Systems □ Organisms

Stem Cells

SQA Course specification: Stem cells in animals are unspecialised cells which can divide in order to self-renew. They have the potential to become different types of cell. Stem cells are involved in growth and repair.

Stem cells are unspecialised animal cells that are involved in **growth** and **repair**. They are able to reproduce themselves by mitosis without becoming specialised. They can also develop into specialised cells to replace those that have been lost/damaged or that have reached the end of their life.

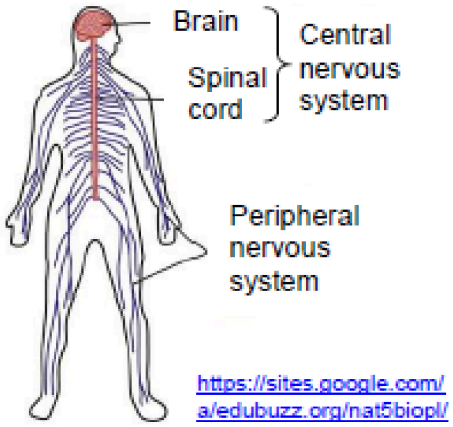
Control and Communication

SQA Course specification: Nervous system consists of central nervous system (CNS) and other nerves. CNS consists of brain and spinal cord.

Nervous Control

In previous topics we have looked at cells and how they come together in tissues and organs. We will now look at how cells, tissues and organs work together in various **systems**. The first system we will consider is the **nervous system** as this is needed to communicate information around the body to ensure that all the systems work effectively.

The nervous system is composed of the three parts:

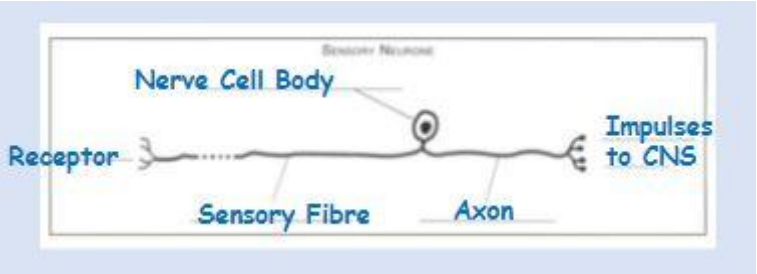


- The brain
- The spinal cord
- Nerves

The **brain** and **spinal cord** make up the central nervous system (CNS)
The **nerves** are part of the peripheral nervous system and they lead to and from all organs and systems.

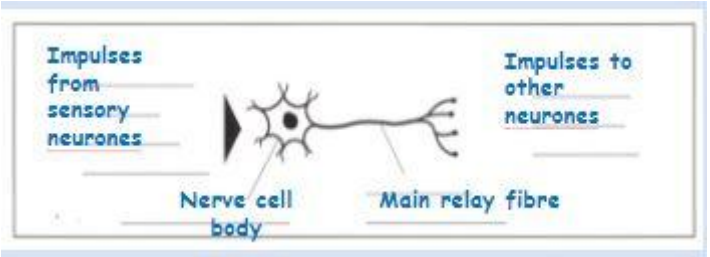
There are three types of neuron; sensory, inter and motor. Each has a specific job.

Sensory neurones are important in transmitting impulses from **sense organs** to the **CNS**.
The **receptors** at the end of the sensory neuron detect a **stimulus** and electrical impulses are sent along the sensory neuron to the CNS.



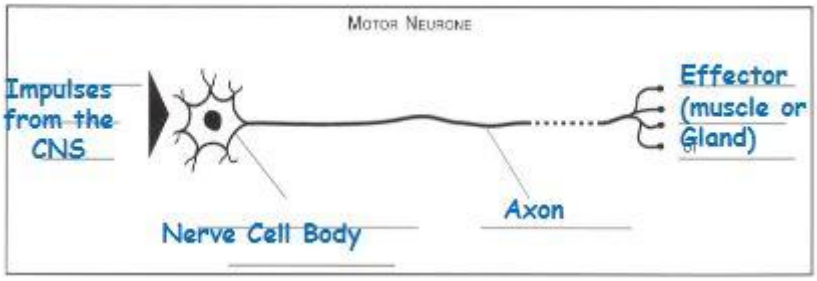
Inter neurons transmit impulses to **other neurones** such as motor neurones. *(i.e. they relay information from one neurone to another).*

They are only found inside the CNS



Motor neurones transmit impulses from CNS to effectors such as muscles or glands, enabling a response to the stimulus.

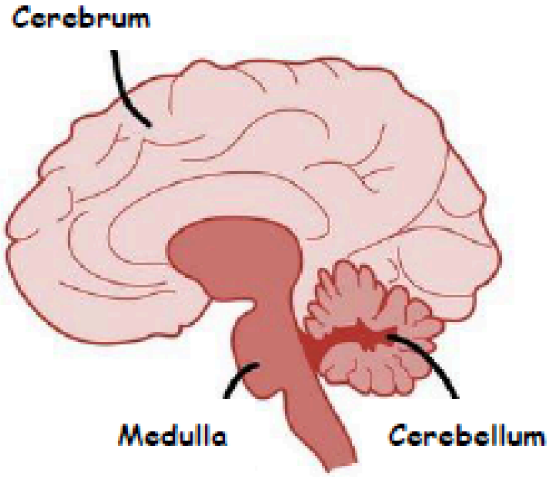
Muscles will produce a quick response by contracting, glands will produce a slower response by releasing chemicals such as hormones.



The Brain

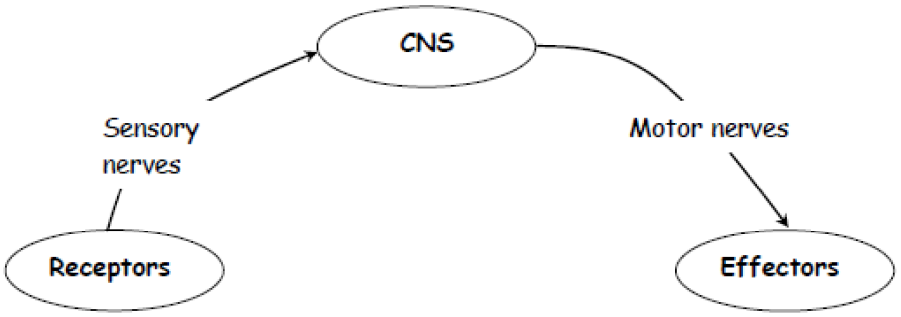
SQA Course specification: Structure and function of parts of the brain — cerebrum, cerebellum and medulla.

Part of brain	Function
Medulla	Controls rate of breathing and heartbeat.
Cerebellum	Controls balance and muscular coordination.
Cerebrum	The cerebrum is the largest part of our brains and controls higher order functions such as thought, perception and personality.



SPINAL CORD AND INFORMATION FLOW

Sensory nerves carry information from the body's **receptors** (e.g. sense organs) to the CNS, **Inter** neurones connect the sensory and motor neurones and are found only in the CNS. **Motor** nerves carry information to the body's **effectors** (e.g. muscles).

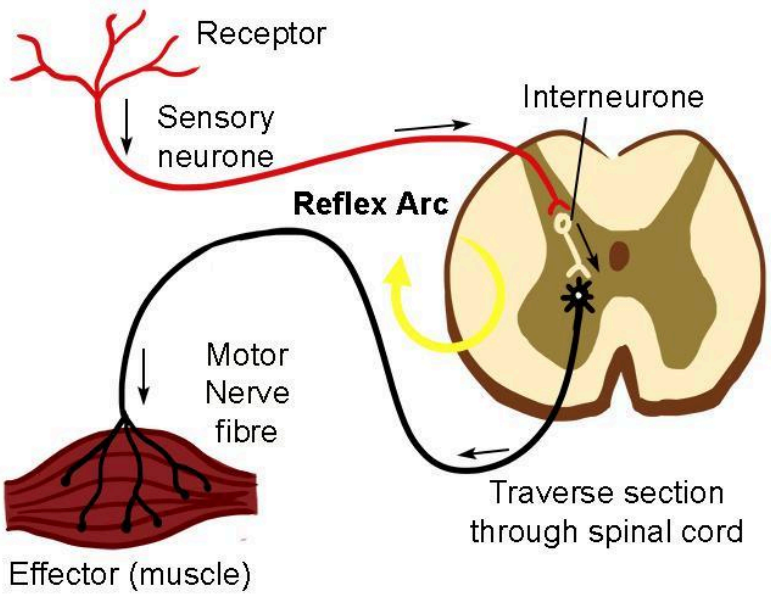


SQA Course specifications: Neurons are of three types: sensory, inter and motor. Receptors detect sensory input/stimuli. Electrical impulses carry messages along neurons. Chemicals transfer these messages between neurons, at synapses.

Reflex arc

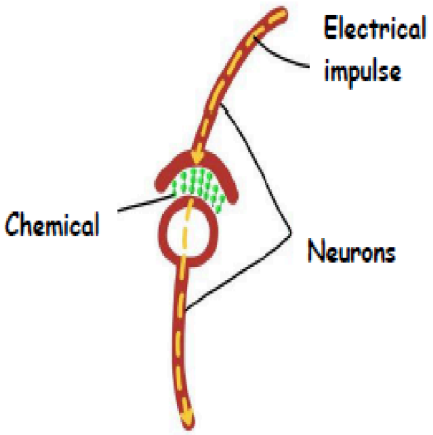
When a stimulus indicates that an organism could be in danger of harm a **reflex** response occurs. The brain is not involved in this response and as a result this response is involuntary and fast.

The diagram below shows the **reflex arc** that forms the reflex response. When a sense organ detects a potentially harmful stimulus, the sensory neurone passes this information to an inter neurone in the spinal cord. The inter neurone passes this information onto a motor neurone and this causes a response in an effector (usually a muscle).



Synapses

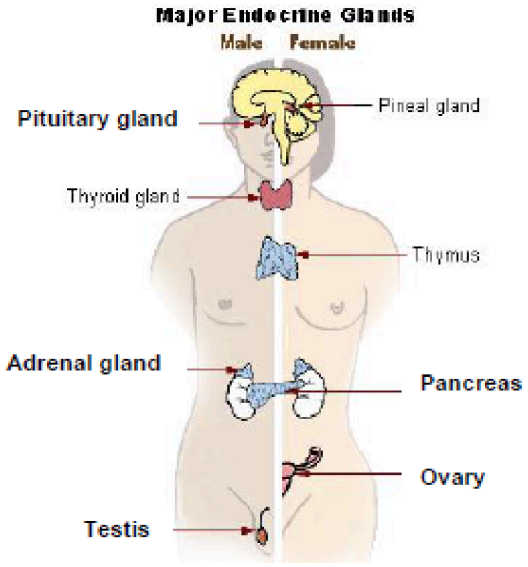
The gaps between the neurons are called **synapses**. When the electrical impulse reaches the end of one neuron it stimulates the release of a **chemical** (neurotransmitter). This chemical diffuses across the gap between the two neurons. When the chemical reaches the second neuron it stimulates a new electrical impulse which then travels along this neuron. The processes of the synapse are shown in the diagram.



Hormonal Control

SQA Course specification: Endocrine glands release hormones into the bloodstream. Hormones are chemical messengers. A target tissue has cells with complementary receptor proteins for specific hormones, so only that tissue will be affected by these hormones.

As well as electrical impulses sending information around our bodies it can also happen by chemical messengers. These messengers are called **hormones** and they are carried round to various parts of the body in the **bloodstream**. Hormones are produced by **endocrine glands**.



Hormones stimulate certain tissues known as **target tissues**. These tissues have cells with special **receptor proteins** on their surface. Only tissues with receptor proteins for a specific hormone will be affected by it.

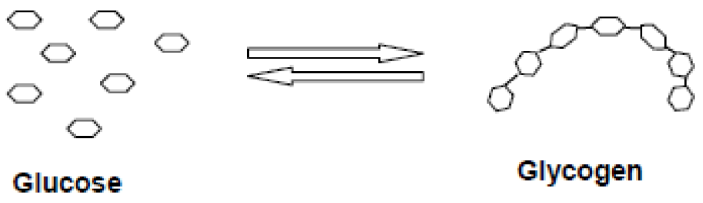
Control of Blood Glucose Levels

SQA course specification: Blood glucose regulation. The roles of insulin, glucagon, glycogen, pancreas and liver.

It's important that the levels of **glucose** in our blood are maintained within certain limits. If there is not enough glucose our cells won't be able to respire efficiently. If there's too much glucose in the blood our body cells may lose water by osmosis.

The hormones that control glucose blood levels are **insulin** and **glucagon** and these are produced by the **pancreas**.

Your **liver** stores glucose in the form of **glycogen**. Glycogen is made up of chains of glucose.



When your blood glucose levels get too high (e.g. after a large meal) cells within the pancreas are stimulated to produce **insulin** and this is transported in the bloodstream to the liver where an enzyme catalyses the reaction:

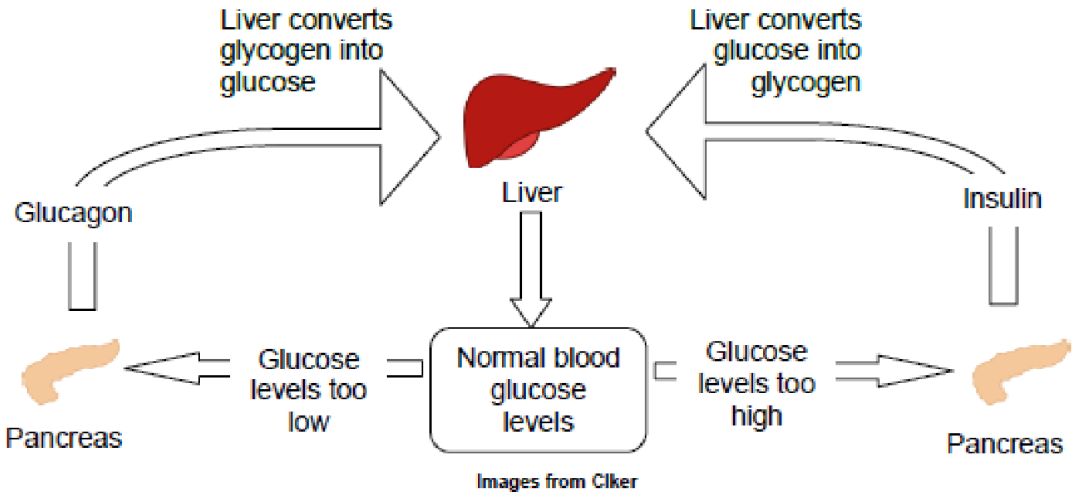
glucose ⟶ **glycogen**

This lowers blood glucose levels back within normal levels.

When blood glucose levels get too low (e.g. during the night) different cells within the pancreas are stimulated to produce **glucagon**, this is transported to the liver where a different enzyme catalyses the reaction:

glycogen ⟶ **glucose**

This raises blood glucose levels back within normal limits.



Reproduction

SQA Course specification:

- Cells are diploid, except gametes, which are haploid.
- The types of gametes, the organs that produce them and where these are located in plants and animals.
- The basic structure of sperm and egg cells.
- Fertilisation is the fusion of the nuclei of the two haploid gametes to produce a diploid zygote, which divides to form an embryo.

Diploid cells - contain two copies of each of the chromosomes for that species, e.g. humans have 23 pairs of chromosomes in their body cells, 46 in total.

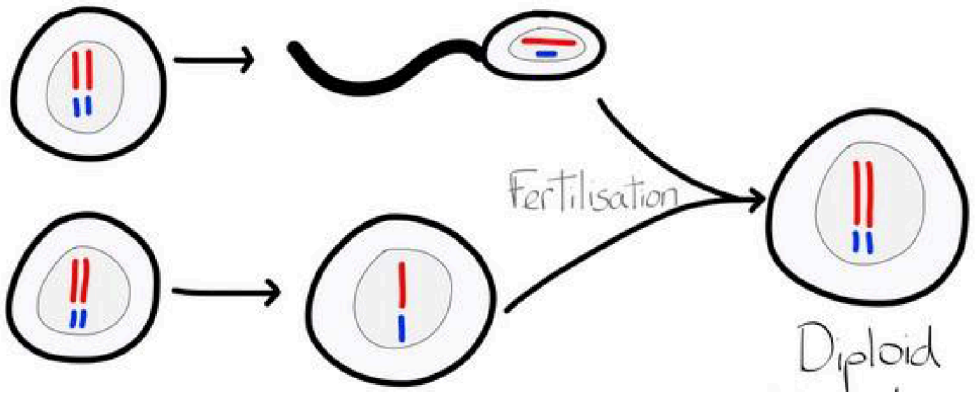
Haploid cells - have only one set of chromosomes, these are the gametes (sex cells) in plants and animals. In humans sperm and egg cells have 23 chromosomes.

Animal Reproduction

Animals reproduce by **sexual reproduction**.

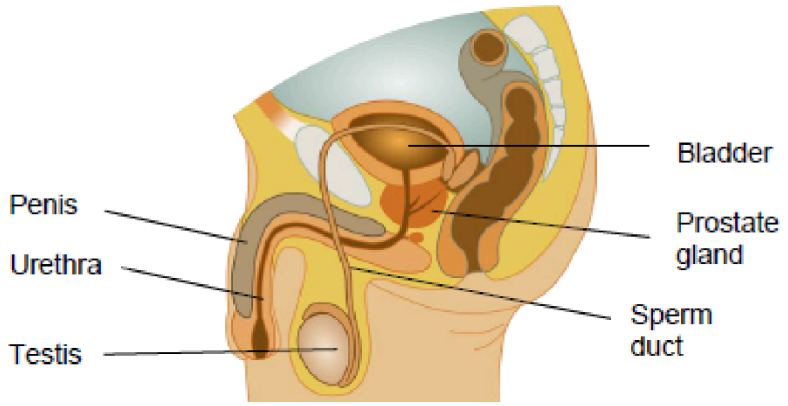
Fertilisation is the fusion of the nuclei of the sperm and the egg (two haploid cells), forming a diploid cell called a zygote.

The zygote will then divide many times and develop into an **embryo**.

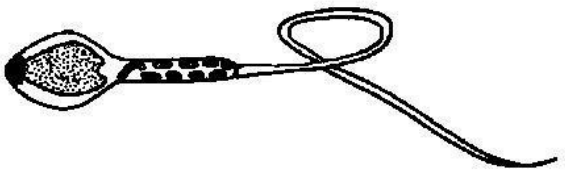


<u>Male Reproductive System</u>

The male sex cells are called **sperm** and are produced by organs called the **testes** (singular = testis).



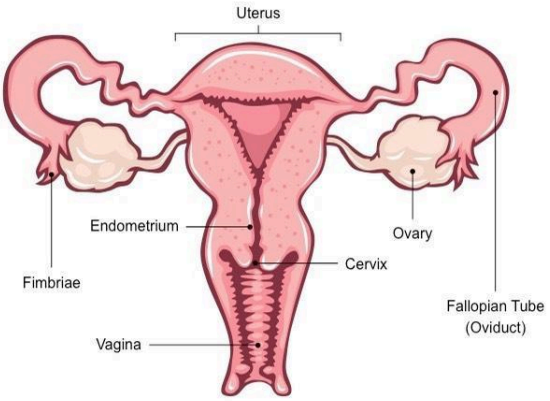
Sperm



Sperm cells have a small head containing their genetic information. They also have a long tail which makes them specialised to their job of swimming towards the egg cell.

Female Reproductive System

The female sex cells are called **eggs** (ova) and are produced by organs called the **ovaries**. Once produced the egg travels along the oviduct.





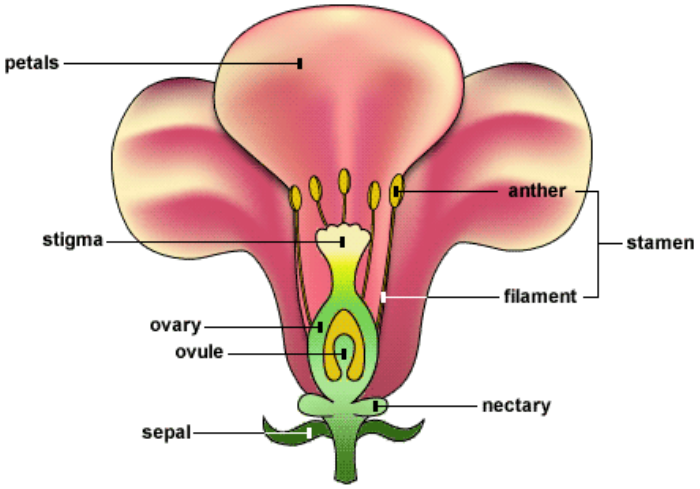
Egg Cell

Egg cells are much bigger in size than the sperm cell so they are easily located.
They are specialised as they contain a large yolk to give nutrition once it has been fertilised.

Plant Reproduction

In plants, the male gamete is the **pollen** and this is produced in the plants **anther**.

The female gamete is called an **ovule** and is produced in the plants **ovary**.

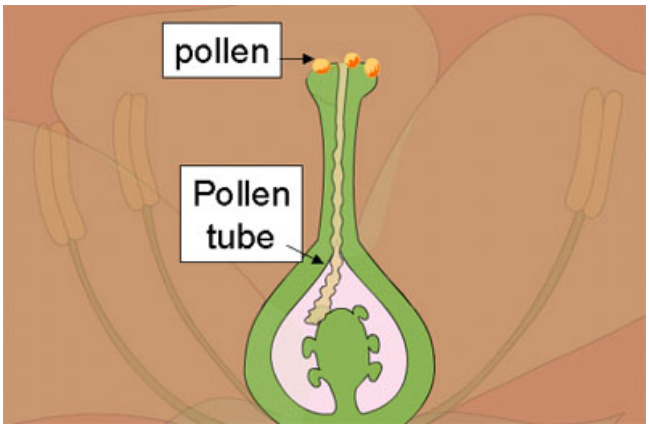


Pollination is the transfer of **pollen grains** (containing the male gamete) from an **anther** to a **stigma** (female part of plant).

Once the pollen grain lands on the stigma, a pollen tube is formed which grows down the female tissue of the plant to the ovules.

The male gamete travels down the pollen tube to reach the female gamete.

The nuclei of the gametes fuse (fertilisation) and a zygote is formed.



Variation and Inheritance

SQA Course Specification:
Comparison of discrete variation (single gene inheritance) and continuous variation (polygenic inheritance).

Variation is determined by the genes that we possess. A **gene** is a piece of **genetic information** that is made from DNA. Genes are located on **chromosomes**.

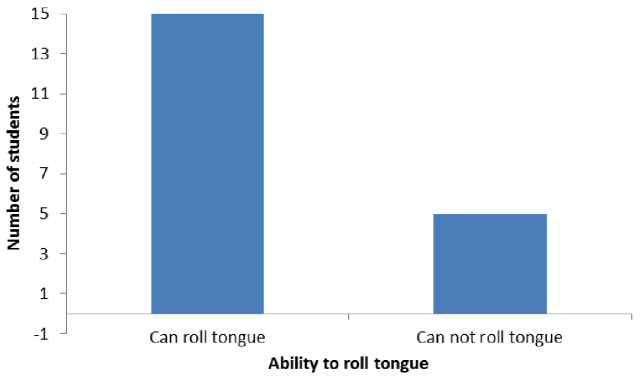
DISCRETE VARIATION

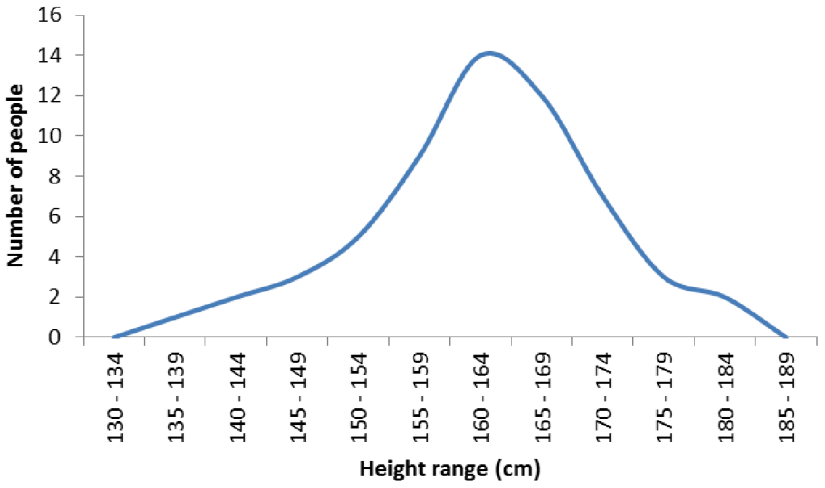
Discrete variation – this describes a characteristic that can be used to separate a species into two or more distinct groups.

Discrete variation = distinct groups

Examples include the ability (or not) to roll your tongue and the four blood group types (A, B, AB or O).

Use a **bar graph** for this data.





CONTINUOUS VARIATION

Continuous variation – this describes a characteristic that can be anywhere within a range of values. Examples include height and finger length.

Use a **line graph** for this data.

SINGLE GENE OR POLYGENIC CHARACTERISTICS

Characteristics that show **discrete variation** are controlled by a **single gene**.
Characteristics that show **continuous variation** are controlled by many different genes and are said to be **polygenic**.

INHERITANCE

SQA Course Specification:
Understanding of genetic terms: gene; allele; phenotype; genotype; dominant; recessive; homozygous; heterozygous and P, F1 and F2.

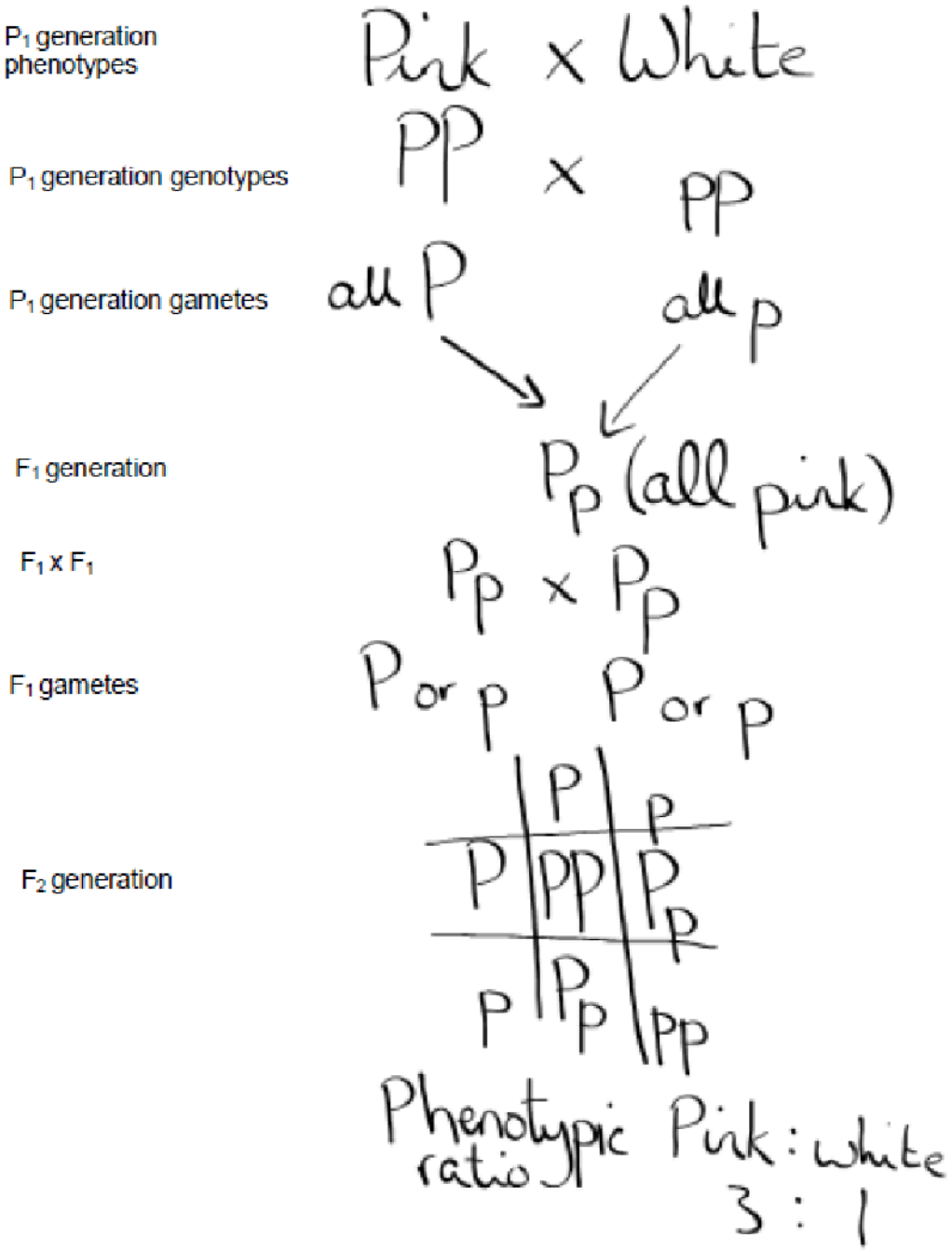
Monohybrid crosses from parental generation through to F2 generation. Reasons why predicted phenotype ratios among offspring are not always achieved.

Variation arises due to sexual reproduction. During fertilisation one set of genes from the father fuses with one set of genes from the mother. The offspring will have a mix of characteristics depending on what forms of the gene they have inherited from each parent.

The following terms are important:

Phenotype	The physical attributes that are observed
Genotype	The combination of genes that is possessed by an organism
Allele	This describes different forms of a gene. In the pea plant example there will be one form of the gene for pink (P) and one form of the gene for white (p)
Homozygous	the two alleles for a gene are the same (can also be called **true breeding**) e.g. PP or pp
Heterozygous	the two alleles for a gene are different (two forms of the gene) e.g. Pp
Dominant	The allele that is expressed in the phenotype
Recessive	The allele that is only observed in the phenotype, if homozygous.

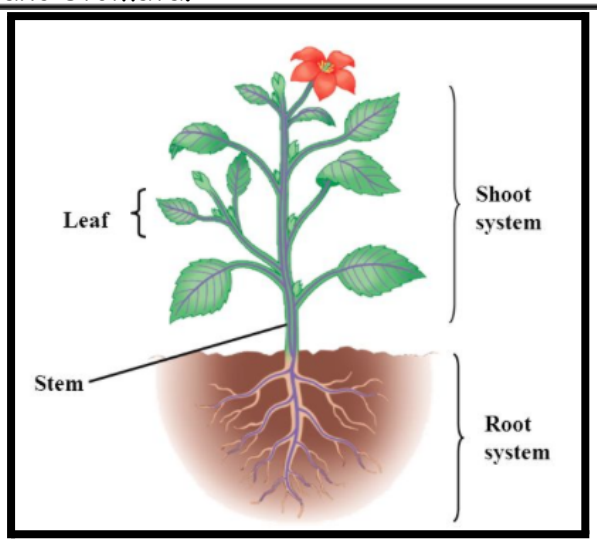
INHERITANCE EXAMPLE USING PEA PLANT FLOWER COLOUR



Ratios of offspring are not always as predicted as fertilisation is a random process.

TRANSPORT SYSTEMS – PLANTS

SQA Course specification: Plant organs are roots, stems and leaves. Leaf structure diagram showing upper epidermis, palisade mesophyll, spongy mesophyll, vein (consisting of xylem and phloem), lower epidermis, guard cells and stomata.



Plant Organs

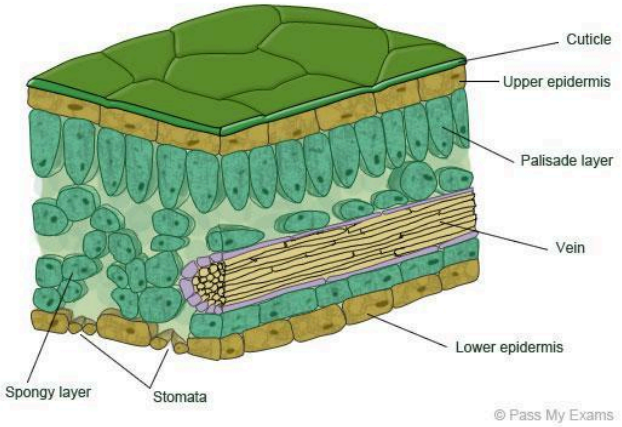
The root
- Get nutrients and water from the soil
- Also support the plant

The stem
- Support for the leaves

The leaves
- Produce food for the plant during photosynthesis

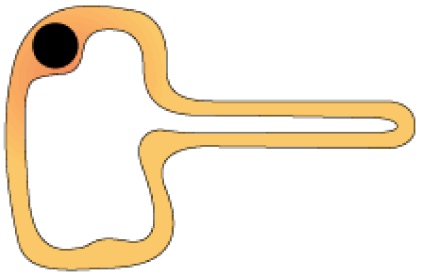
LEAF STRUCTURE

Once the water reaches the leaf some of it is used for photosynthesis and some evaporates out of the leaf. The main structures of a leaf are shown in the diagram below:



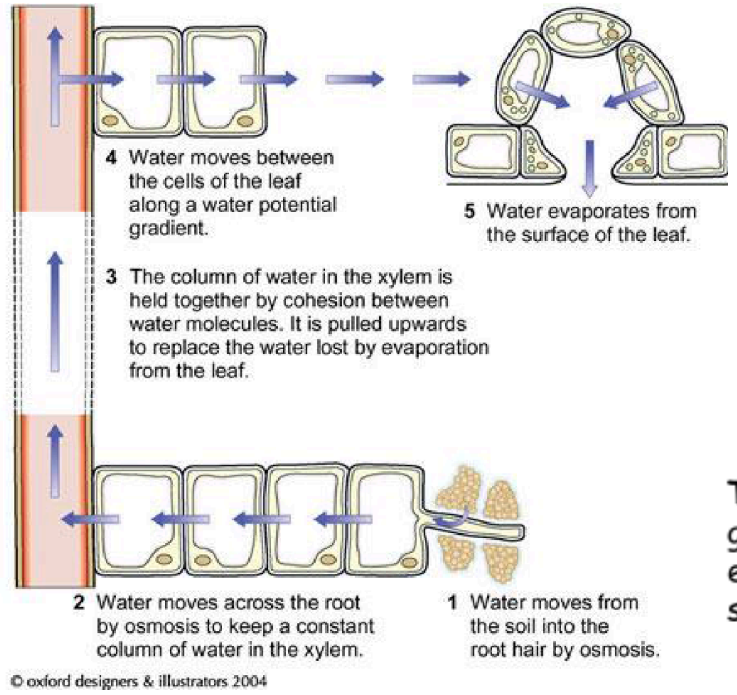
Part of Leaf		Function
Epidermis		A thin layer of cells that protect the leaf. It is transparent to allow light to pass through.
Mesophyll cells	Palisade	Main site of photosynthesis – contains lots of chloroplasts.
	Spongy	Photosynthesis also occurs here and the moist air spaces between the cells allow gases to dissolve before diffusing into cells.
Guard cells		They control the opening and closing of stomata. As this requires energy they also contain chloroplasts.

SQA Course specification: The process of transpiration and how the rate of transpiration is affected by wind speed, humidity, temperature and surface area.



Water enters through root hair cells by osmosis. These are specialised cells adapted for this function by maximising the surface area available for absorption.

The Transpiration stream



Some water will also leave through pits in the side of the xylem to stem cells before reaching the uppermost leaves.

As well as transporting water, the xylem also transports **minerals** dissolved in the water.

Transpiration is the name given to the loss of water by evaporation from the stomata.

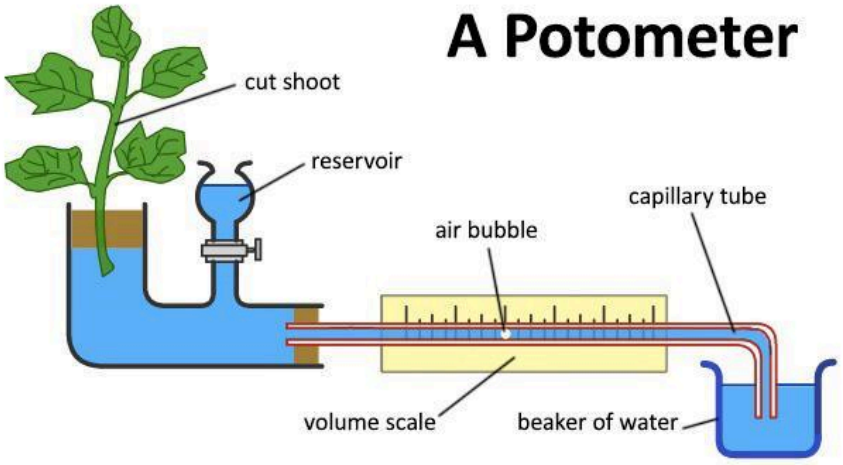
Rate of Transpiration

Transpiration rate can change depending on the environment:

Factor	Description
Wind Speed	Transpiration is faster at higher wind speeds
Humidity	Transpiration is slower in more humid environments
Temperature	Transpiration is faster at higher temperatures
Surface Area	Transpiration increases with larger surface area

Potometer

A potometer can be used to measure the volume of water absorbed and therefore calculate the transpiration rate. Usually a leafy shoot is used instead of a single leaf.



The faster the bubble moves, the greater the rate of water uptake - and so the greater the rate of transpiration.

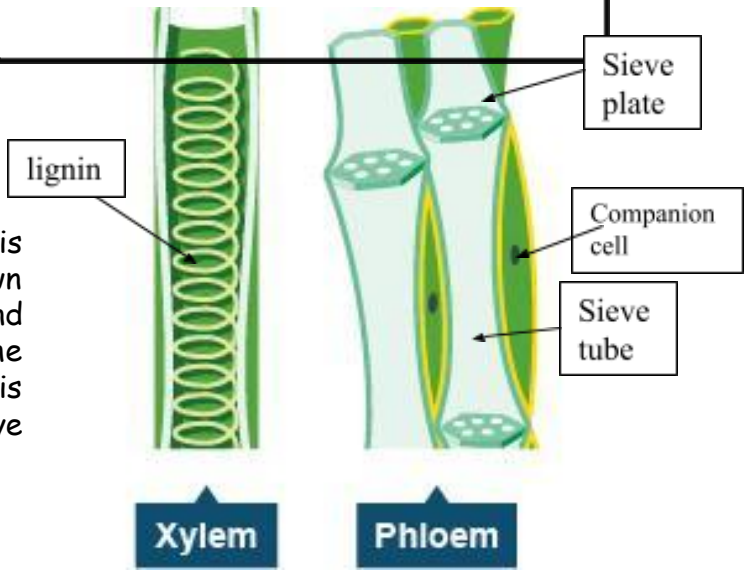
THE XYLEM AND PHLOEM

SQA Course Specification

Parts of the plant involved in water transport. Water and minerals enter the plant through the root hairs and are transported in dead xylem vessels. Structure of xylem vessels.
Sugar is transported up and down the plant in living phloem. Structure of phloem tissue.

The xylem is made of non-living tubes that are hollow with rings or spirals of **lignin** that provide support to the plant. Water always moves **upwards** through the xylem.

The sugar produced in photosynthesis needs to be transported both up and down the plant to areas of new growth (root and shoot tips). Sugar is transported in the **phloem**. Unlike the xylem the phloem is made of living tissue (sieve tubes, sieve plates and companion cells).



Transport Systems – Animals

SQA Course Specification

- In mammals the blood contains plasma, red blood cells and white blood cell. It transports nutrients, oxygen and carbon dioxide.
- Red blood cells are specialised by being biconcave in shape, having no nucleus and containing haemoglobin. This allows them to transport oxygen efficiently in the form of oxyhaemoglobin.
- White blood cells are part of the immune system and are involved in destroying pathogens. There are two main types of cells involved. Phagocytes carry out phagocytosis by engulfing pathogens. Some lymphocytes produce antibodies which destroy pathogens. Each antibody is specific to a particular pathogen.

Blood

In mammals, blood contains plasma, red blood cells and white blood cells. It's function is transport nutrients, oxygen and carbon dioxide.

Red blood cells contain the chemical **haemoglobin;** oxygen binds to this to be transported around the body as **oxyhaemoglobin**. Red blood cells have a **biconcave** shape to allow the maximum uptake of oxygen.



White blood cells are part of the immune system and destroy pathogens, there are 2 main types:

Phagocytes: They engulf pathogens in the process of phagocytosis.

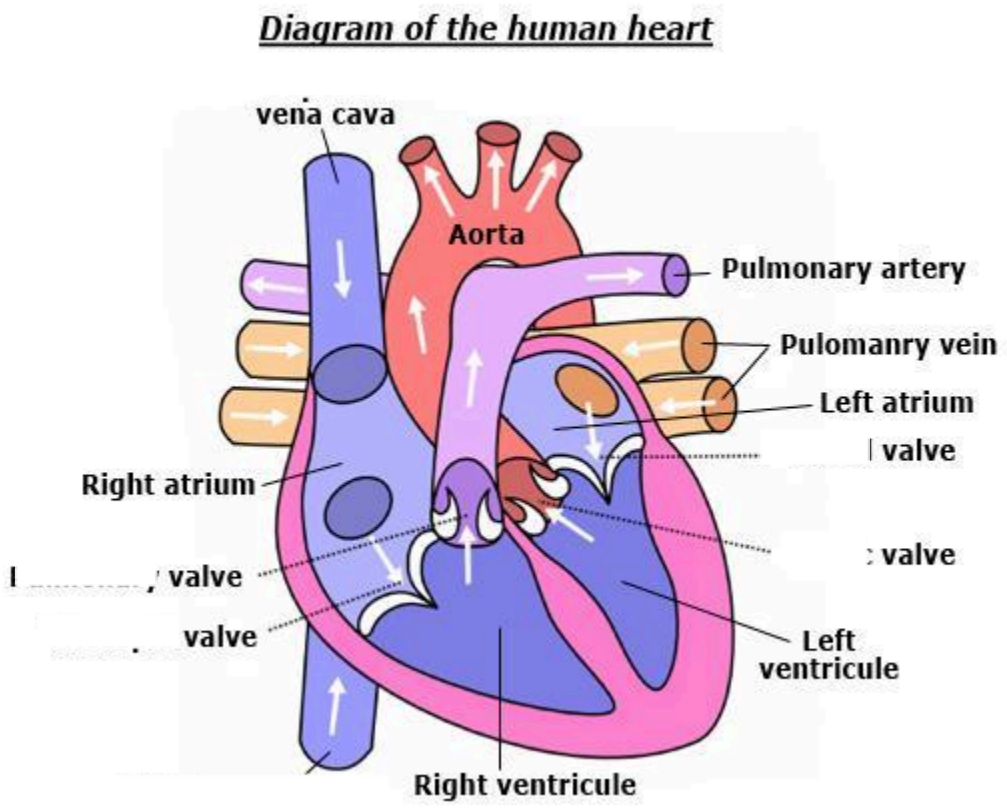
Lymphocytes: They produce antibodies that are specific to a particular pathogen. They attach to pathogens and destroy them.

The Heart

SQA Course specification

- Pathway of oxygenated and deoxygenated blood through heart, lungs and body.
- Diagram of heart to show the right and left atria, ventricles, location of four valves,
- Location of associated blood vessels (aorta, vena cava, pulmonary artery, pulmonary vein and coronary arteries).
- Function of each of these parts.

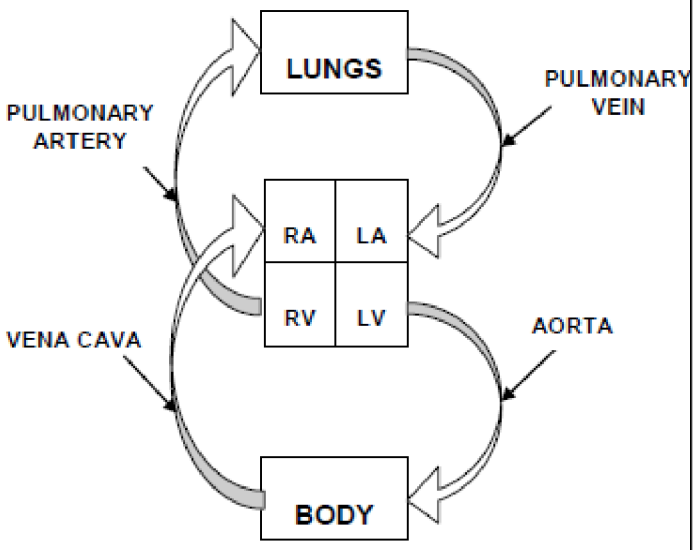
The heart has four chambers, two **atria** (entrances) and two **ventricles**. This is shown below:



Blood enters from a vein into the atria, passes into the ventricles and then leaves the heart through an artery. The heart has valves that prevent the backflow of blood. There are 4 shown on the diagram.

The right side of your heart pumps deoxygenated (low in oxygen) blood to the lungs where it absorbs oxygen and releases carbon dioxide by diffusion. The left side of your heart pumps oxygenated (high in oxygen) blood throughout your body. To enable the blood to travel this greater distance the muscle on the left side of the heart is thicker than the right side.

Blood Flow



The **coronary artery** supplies the heart with a constant supply of energy and oxygen rich blood to enable it to respire so that it has the energy to pump constantly.

- Deoxygenated (low in oxygen) blood enters the heart via the right atrium from the body.
- It then passes into the right ventricle and on to the lungs via the pulmonary artery.
- In the lungs the blood gains oxygen and loses carbon dioxide by diffusion.
- The oxygenated (high in oxygen) blood travel from the lungs to the left atrium via the pulmonary vein.
- It then passes from the left atrium to the left ventricle and leaves the heart via the aorta.
- The aorta takes the blood all around the body where oxygen is used up and carbon dioxide produced during respiration and the cycle continues.

BLOOD VESSELS

SQA Course Specification

- Arteries have thick, muscular walls, a narrow central channel and carry blood under high pressure away from the heart.
- Veins have thinner walls, a wider channel and carry blood under low pressure back towards the heart. Veins contain valves to prevent backflow of blood.
- Capillaries are thin walled and have a large surface area, forming networks at tissues and organs to allow efficient exchange of materials

Arteries have thick, muscular walls and a narrow central channel. This allows them to carry blood away from the heart under high pressure.
Veins have thinner walls and wider channel. They carry blood back to the heart under lower pressure. They contain **valves** to prevent the backflow of blood.
Capillaries form a network between arteries and veins at organs and tissues. They are thin walled and have a large surface area. This allows the maximum exchange of materials between the cells and the blood.

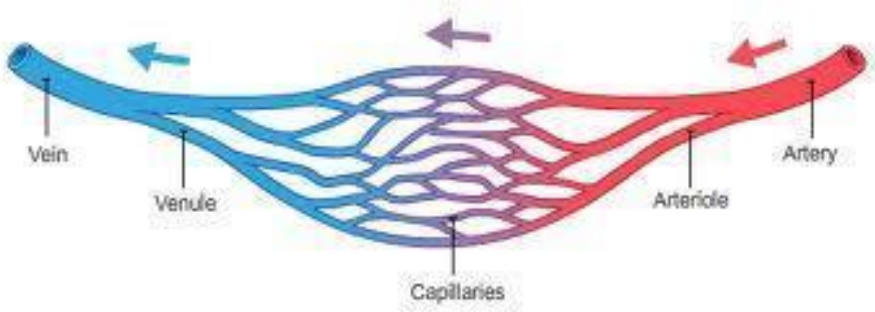
Absorption of Materials

SQA Course specification:

- Oxygen and nutrients from food must be absorbed into the bloodstream to be delivered to cells for respiration. Waste materials, such as carbon dioxide, must be removed from cells into the bloodstream
- Tissues contain capillary networks to allow the exchange of materials at cellular level.
- Surfaces involved in the absorption of materials have certain features in common: large surface area, thin walls, extensive blood supply. These increase the efficiency of absorption

Materials that are required to be absorbed into cells include nutrients and oxygen for respiration. Waste materials such as carbon dioxide need to be removed from cells.

Tissues contain capillary networks to allow the exchange of these materials at cellular level.



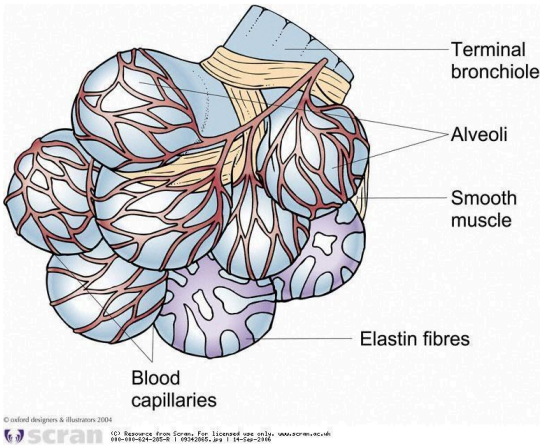
Surfaces that carry out absorption of exchange of materials usually all have the same features to make them efficient at their job:

- **Large surface area**
- **Extensive blood supply**
- **Thin walls**

Lungs

SQA Course specification:

Lungs are gas exchange organs. They consist of a large number of alveoli providing a large surface area. Oxygen and carbon dioxide are absorbed through the thin alveolar walls to or from the many blood capillaries.

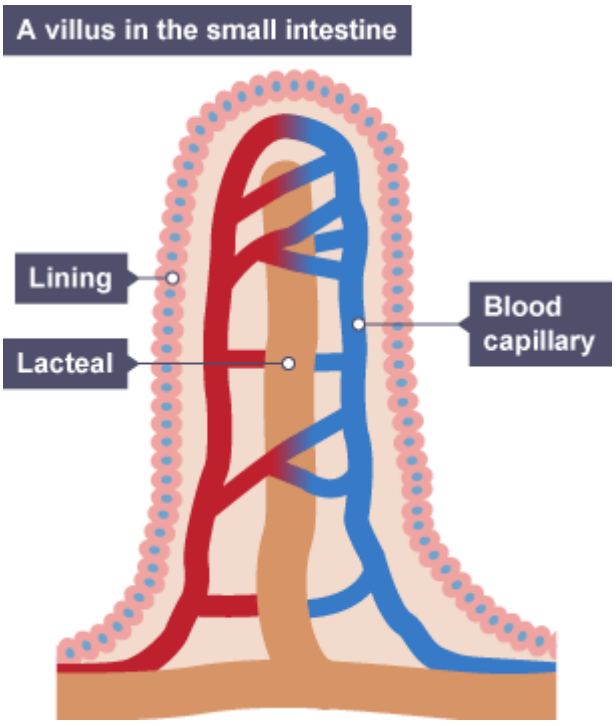


Nutrients from food

SQA Course specification:

Nutrients from food are absorbed into the villi in the small intestine. The large number of thin walled villi provides a large surface area. Each villus contains a network of capillaries to absorb glucose and amino acids and a lacteal to absorb fatty acids and glycerol.

Nutrients from food are absorbed through **villi** in the small intestine. These are finger like projections on the inside of the small intestine. There are many of them to provide a large surface area and they are thin walled, this allows them to be efficient at absorbing materials.



The blood capillaries absorb **glucose** and **amino acids**.

The lacteal absorbs **fatty acids and glycerol**

N5 Biology Problem Solving

Averages:

- Add all the values (numbers) together and divide by how many you have added.
- Eg. 10 + 15 + 5
- Divide by 3 because 3 numbers were added. Answer = 10.

Ratios;

- You must divide all numbers by the same. Simplify it as much as possible but they must all be whole numbers i.e. no decimals.
- E.g. 35 : 21 : 14 all these numbers divide by 7 so the simple whole number ratio is 5 : 3 : 2

Percentages

- To calculate a number as a percentage, divide the number you are trying to find by the total and multiply by a hundred.
- Eg dividing your test score by the total.
- 22 out of 30 = 22 / 30 x 100 = 73%

Percentage change

- Difference divided by the original value multiplied by 100.
- E.g. 50 bacteria at the start, after 5 hours they had multiplied to 700, what is the percentage change in number?
- Difference = 700 - 50 = 650. Divided by the starting value = 50
- 650 / 50 x 100 = 1300

Graphs & charts

- Remember the SLURP rule. Copy labels directly from the table column headings.
- Do not miss out on anything including the **units**.
- You must put a starting value in the origin for each individual axis. This might be zero, but not always.
- Use a ruler to help you plot your points this will reduce the risk of you skipping boxes.
- Remember each box on a scale must be the same value. If you have 10 boxes between 0 and 1. You must have 10 boxes between 1 and 2, 2 and 3 and so on.

Relationships

- As one thing changes it affects another. You must mention both.
- Variables – the only variable that can be changed is the one being investigated. Constant variables, you need to give an example not already mentioned in the question text or diagram.
- Do not use the word amount. You must say the
    - volume of solution… or
    - the pH of….. or
    - the concentration of… the …..
    - the mass of… etc.

Control

- A control is set up to make a comparison. You must state that everything is set up exactly as in the experiment but without the variable being investigated.

Reliability

- The results can be made more reliable by repeating the experiment in exactly the same way.

Validity

- Only one variable should be changed in an experiment to ensure it is a valid investigation.