AQA Homeostasis and Response Knowledge Organiser

Homeostasis

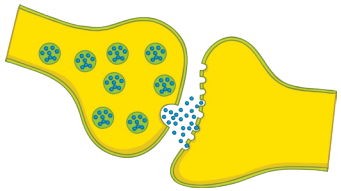
Homeostasis is the regulation of a **constant internal environment**. The conditions are maintained to ensure optimum conditions for metabolism and changes in response to both internal and external fluctuations.

In humans, homeostasis regulates the **blood glucose** (sugar) levels, the body **temperature, CO_2** levels and **water** levels.

The levels are monitored and regulated by automatic control systems which can be either nervous responses (coordinated by the **nervous system**) or chemical responses (coordinated by the **endocrine system**). Information about the environment is called a **stimulus** and is detected by a **receptor**. The information is processed by a **central coordination** system and a response is initiated by an **effector**.

Synapses

A **synapse** is the gap where the ends of two neurons meet.



The information needs to be passed from one neuron to the next, but cannot be passed as an electrical impulse over the synapse (gap). Instead, the message is transmitted by chemical neurotransmitters.

When the electrical impulse arrives at the terminal of the first neuron, it causes a release of neurotransmitter chemicals into the synapse. They travel across the gap and bind to receptor sites on the terminal of the next neuron.

The receptor sites are specific for each type of neurotransmitter. A nerve impulse will only be created in the second neuron when a complimentary chemical binds.

The Nervous Pathway

A stimulus is a change in the environment (internally or externally). In a typical response to stimuli, this information is received by the receptor and sent as an electrical impulse along a sensory neuron towards the central nervous system (CNS). The CNS is comprised of the brain and spinal cord. Here, the impulse is passed through relay neurons and a response to the stimulus is coordinated. This could be consciously or subconsciously. The CNS sends information about the response along a motor neuron as an electrical impulse. The effector receives the impulse and carries out the response.

[stimulus] → receptor → sensory neuron → CNS → motor neuron → effector → [response]

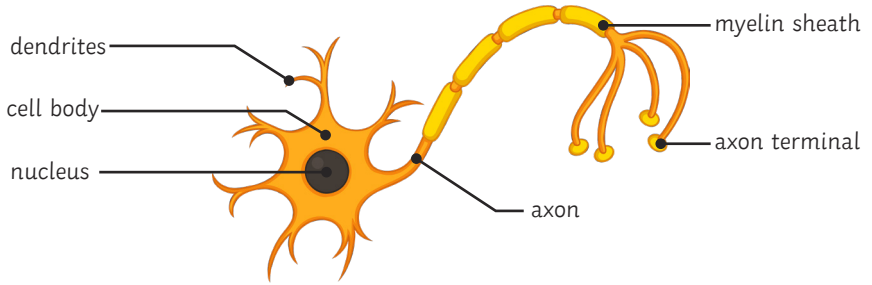
Examples of receptors include rod and cone cells within the eye which respond to light and allow us to see. Or it could be the cells in the skin which respond to pressure or temperature changes allowing us to feel.

An effector could be a muscle or a gland. In response, a muscle might contract to make a movement or a gland releases a chemical into the body.

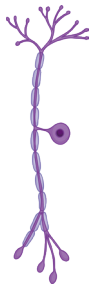
The Human Nervous System

The nervous system allows a fast, short-lived response to a stimulus in the surroundings. The information is received by a receptor, passed along the neurons (nerve cells) as an electrical impulse and results in a response.

You might have to label the parts of a typical neuron:



- The axon is the main part of the nerve cell. It is a long, stretched-out fibre of cytoplasm which the electrical impulse will travel along.
- Some axons are surrounded in a layer of fatty cells called the myelin sheath and it helps to insulate the electrical impulse.
- The branched endings, dendrites, connect the neurons together to create a network.

sensory neuron	relay neuron	motor neuron
		

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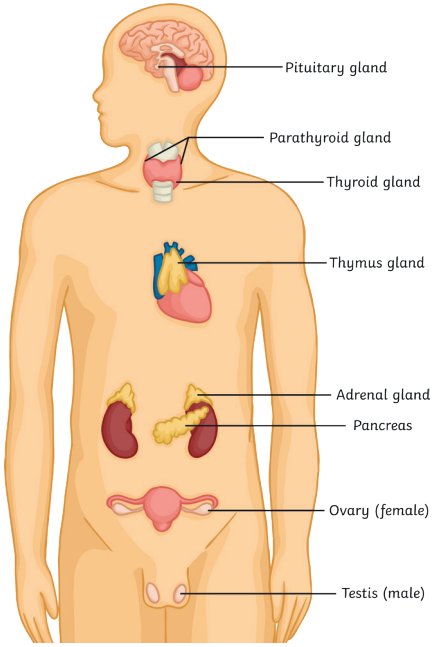
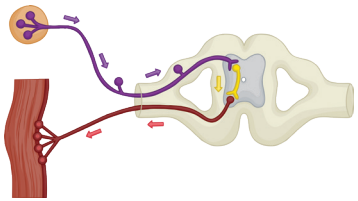
The Endocrine System

You should be able to identify the major glands of the endocrine system, as shown below.



Reflexes

A **reflex** is a fast and automatic response to a particular stimulus which may be harmful to the organism. They are quick because there is no conscious thought or process to deliver the response (they are an **involuntary** action). The pathway which carries the information about a reflex action is called a **reflex arc**.



A **reflex arc** begins with the **stimulus** e.g. a bee sting or a hot object on the skin. The stimulus is detected by the **receptor** cells and an electrical **impulse** is transmitted along the **sensory neuron**. The impulse is passed through **relay neurons** in the spinal cord or the **unconscious** areas of the brain. The response is coordinated **automatically** and sent along the **motor** neuron to the **effector** cells.

Hormones

Hormones are **chemical** messengers transported in the **bloodstream** to an effector where they can activate a response. They are produced and released from glands around the body which all make up the **endocrine system**. Hormones do a similar job to the neurons of the nervous system but there are some differences.

	neurons	hormones
speed	fast	slow
duration	short	long
target area	specific	general

The hormones released travel in the blood plasma to their **target cells** and affect only those certain cells. Hormones act on organs or cells where constant adjustments are made to maintain a stable state.

Some examples you should know:

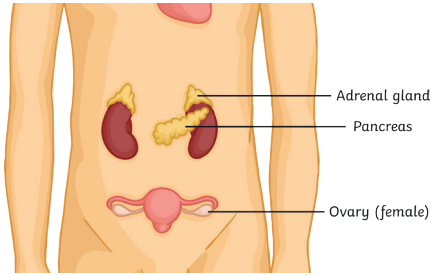
The **pituitary gland** produces a range of hormones including FSH and LH which help to regulate the menstrual cycle. The pituitary gland acts as a **master gland** because many of the hormones it releases control and coordinate the release of other hormones from other glands in the body.

Diabetes

There are two types of diabetes: type 1 and type 2.

Type 1 diabetes is a disorder affecting the pancreas. In type 1 diabetes, the pancreas does not produce enough insulin to control the blood sugar level and so the levels become higher than normal. Type 1 diabetes is usually treated by injections of insulin.

Type 2 diabetes is a disorder of effector cells which no longer respond to the hormones released from the pancreas. Type 2 diabetes can usually be managed through lifestyle choices such as maintaining a carbohydrate-controlled diet and regular exercise.



The risk of developing type 2 diabetes is higher in people who are obese (have a BMI >30).

Hormones in Human Reproduction

Oestrogen is the main reproductive hormone in females. It is produced in the **ovaries**. During puberty, this hormone increases and it stimulates an egg to be released from an ovary each month. This process is called **ovulation** and happens, on average, every 28 days.

Testosterone is the main reproductive hormone in males. It is produced in the **testes**. This hormone stimulates the production of sperm.

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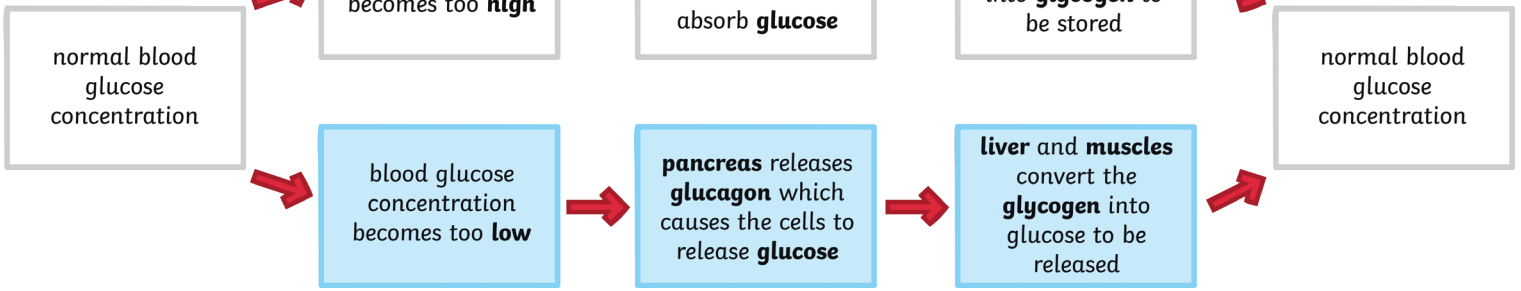
Control of Blood Glucose

The pancreas is the organ and gland which monitors and regulates the blood glucose concentration.

(HT only)

If the blood glucose concentration becomes too low, a negative feedback loop is triggered and the pancreas releases another hormone, **glucagon**, which acts on the liver and muscles to cause the stored **glycogen** to be converted back into **glucose** and released into the bloodstream.

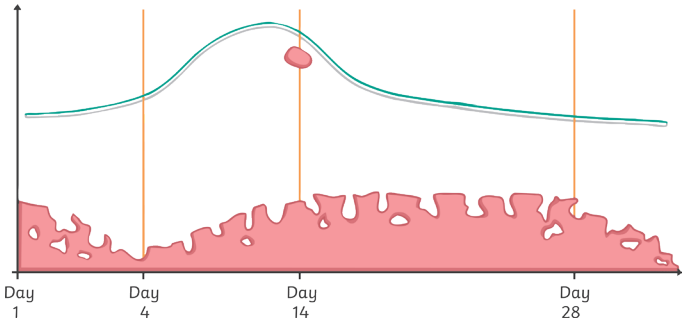


The Menstrual Cycle

The **menstrual cycle** occurs in females, approximately every **28 days**. It is a cyclical process of the building of the lining of the **uterus** and **ovulation**. If the **egg** become fertilised by a sperm, then **pregnancy** follows. If the egg is not fertilised, then the lining of the uterus is shed away and leaves the body as the **menstruation** (or period).

The whole cycle is controlled by four main reproductive hormones:

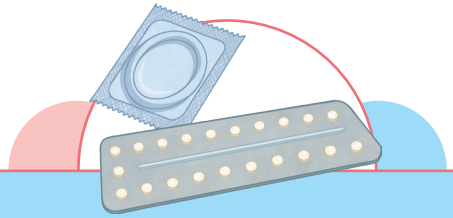
- **follicle stimulating hormone (FSH)**
- **oestrogen**
- **luteinising hormone (LH)**
- **progesterone**



Hormone	Where It Is Produced	Response Caused	Interaction with Other Hormones (HT only)
FSH	pituitary gland	An egg to develop in one of the ovaries.	Stimulates the production of oestrogen.
oestrogen	ovaries	The lining of the uterus builds up and thickens.	Stimulates the production of LH. Inhibits the production of FSH.
LH	pituitary gland	Ovulation (at around day 14 of the cycle).	Indirectly stimulates the production of progesterone.
progesterone	ovaries	The uterus lining to maintain.	Inhibits the production of LH.

Contraception

There are many different types of **contraceptive** (or birth control) methods. They are categorised as **hormonal** methods and **non-hormonal** methods.



Method	Hormonal or Non-Hormonal	How It Works	Pros and Cons
oral contraceptives ('the pill')	hormonal	Pill taken which contains hormones to **inhibit FSH** so that an egg does not mature.	Easily self-administered. Short-term effects. Can easily be reversed. Very reliable. May have mild side-effects associated. Could lead to pregnancy if missed. Does not protect from STIs.
injection, implant or skin patch	hormonal	Contains **progesterone** which is slowly released to inhibit the release of eggs for months or even years.	Administered through routine appointment at GP surgery. Requires little to no aftercare or maintenance. Very reliable. May take some time for effects to be reversed once removed. Does not protect from STIs.
condoms or diaphragm (female condom)	non-hormonal	Creates a **physical barrier** to prevent the sperm from reaching the egg.	Easy to use. Short-term effects. Very reliable. Provides protection from most STIs. Can fail.
intrauterine devices (coil)	hormonal	The device is attached to the lining of the uterus and **releases hormones or prevents the implantation** of an embryo.	Requires little to no aftercare or maintenance. Very reliable. May take some time for effects to be reversed once removed. Does not protect from STIs.
spermicidal agents	non-hormonal	Contains chemicals to **kill** or **immobilise sperm** cells.	Easy to use. Short-term effects. Does not protect from STIs. Less effective when used as the only method.
abstaining from intercourse (around the time of ovulation)	non-hormonal	Avoiding sexual intercourse when there is a likelihood of an egg being present in the oviduct.	inexpensive Not always reliable.
surgery	non-hormonal	A surgical procedure carried out in men or women. In males, the vas deferens tubes are sealed or blocked to prevent the passage of sperm from the testes. In females, the fallopian tubes (oviducts) are sealed or blocked to prevent the passage of the egg from the ovaries.	Risks associated with surgery (such as infection). Difficult to reverse (if at all possible). Can take several months to be reliable.

Infertility (HT Only)

Depending on the reason for the **infertility**, there are different methods of treatment and technologies to help women become pregnant.

The hormones **FSH** and **LH** can be given in a **'fertility drug'** to help stimulate the normal cyclic processes and enable the woman to become **pregnant** naturally.

In Vitro Fertilisation (IVF) is a treatment which involves several stages:

- The woman is given FSH and LH to **stimulate the ovaries** to mature and release several eggs.
- The **eggs** are then collected from the woman and **fertilised** using **sperm** collected from the man. This is done in the lab (in vitro means "outside the living organism").
- The fertilised eggs develop into **embryos**.
- At the early stage of development (blastocyst), one or two embryos are inserted into the woman's **uterus** for **implantation**.
- If successful, the **pregnancy** progresses as normal.

Fertility treatments offer couples the chance to have their own baby. However, the processes are often very stressful and emotional. The success rates are low. The underlying causes of the infertility are not usually being treated. Fertility treatments can carry a higher chance of multiple births (twins, triplets or more), which carries a risk to both the mother and the unborn babies.

Adrenaline and Thyroxine (HT Only)

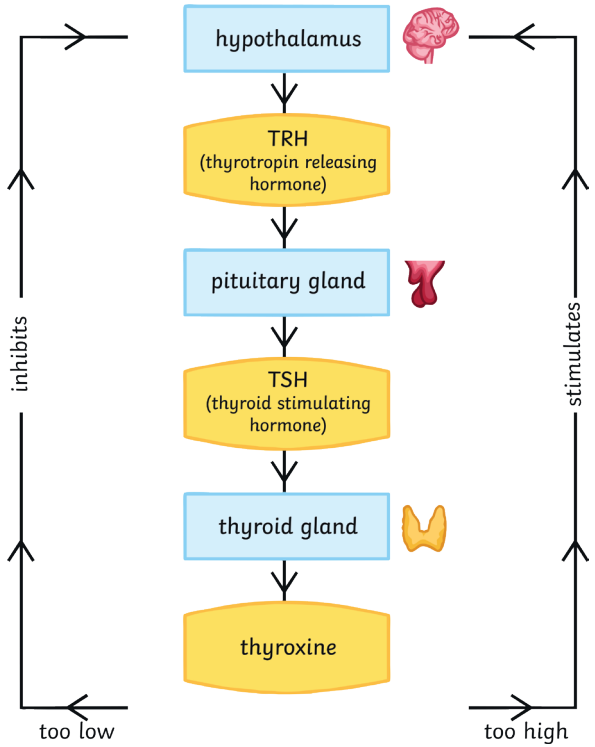
Adrenaline is a hormone produced by the **adrenal glands**. It is released in response to stress or fear. The hormone acts on major organs including the heart and lungs. The effect is to increase the heart rate and breathing rate and cause vasodilation (widening of the blood vessels), in order to supply the brain and muscles with more oxygen and glucose.

This prepares the body for a 'flight or fight' response to the fear or stress.

Thyroxine is a hormone produced by the **thyroid gland**. It stimulates the rate of **metabolism** in the body by controlling how quickly food products and oxygen are reacted, therefore controlling how quickly **energy** is released.

Negative Feedback of Thyroxine

A **negative feedback** system regulates the level of thyroxine in the body.



Required practical activity 7: plan and carry out an investigation into the effect of a factor on human reaction time.

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

Method:

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

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

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

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

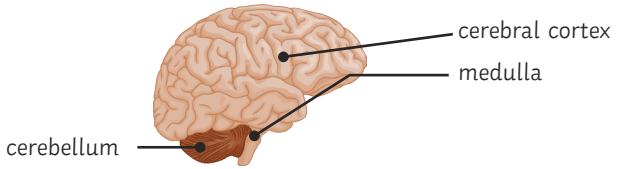
The Brain

The human **brain** is made up of a huge network of billions of **neurons** which control complex **behaviours**, both conscious and subconscious. The brain is made up of different **regions** and each contributes to carrying out different functions in the body.

Cerebral cortex – controls conscious activities and other functions including memory, language, speech and intelligence.

Cerebellum – controls muscle coordination.

Medulla – controls unconscious functions including the heartbeat and breathing.



The Brain (HT only)

The human brain is a fascinating organ which scientists are really interested in studying.

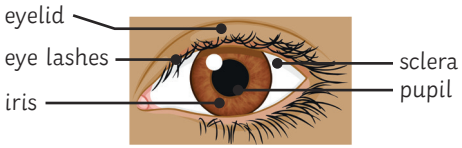
In order to study the functions of the brain, scientists use a range of methods:

- **Studying patients who have suffered brain damage** - by looking at how the behaviour of the patient changes, scientists are able to imply the function of that area of the brain. For example, if a patient suffered a trauma to the frontal lobe of their brain and consequently lost the ability to walk, then we know that part of the brain has a role in coordinating movement.
- **Electrical stimulation of the brain – electrodes** can be inserted into the brain tissue and used to send electric impulses which stimulate that area of the brain. The response can then be observed and links made between the region of the brain and the observed response.
- **MRI scanning – a magnetic resonance imaging scanner** is a large piece of medical equipment which can scan entire areas of the body, such as the brain, to produce detailed images of the structure. By scanning the brain and observing the brain whilst a patient is doing a specific activity (such as listening to music), scientists can see which parts of the brain are active and stimulated during certain activities.

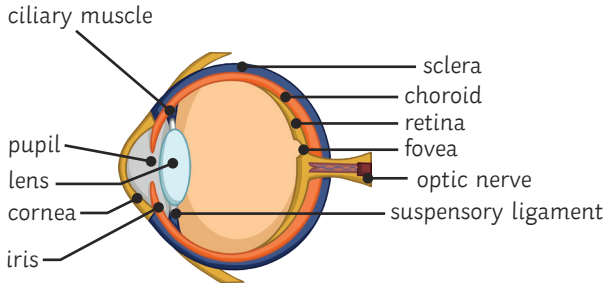
The brain is highly complex and difficult to study but, using the methods described above, scientists have been able to map which regions of the brain are linked to particular functions.

The Eye

The human **eye** is a sense organ which enables us to receive **light rays** and transmit them to our **brain** to produce an **image**. Receptor cells in the eye allow the eye to detect light intensity and colour.



You should be able to identify the different parts of the human eye, including those not visible from the outside. They are labelled below on the cross-sectional view of the human eye.



retina	Incoming light is **focused** onto the retina. This part of the eye contains the light receptor cells, **rods and cones**, for detecting light intensity and colour, respectively.
optic nerve	Contains the **neurons** which transmit the impulses between the eye and the brain so we can process the received information and form an image.
sclera	This tough, opaque outer layer protects the eye.
cornea	The cornea is continuous with the sclera. It is transparent and allows the light enter the eye. Light is **refracted** (bends) as it enters the eye through the cornea to help focus the rays onto the retina.
iris	The iris is made up of circular and radial **muscles** which contract and relax to **dilate** the pupil. This controls the amount of light which is let into the eye.
ciliary muscles	These **muscles** are attached to the **lens** (via the suspensory ligaments) and alter the shape of the lens to **focus** the incoming light.
suspensory ligaments	Attaches the ciliary muscles to the lens of the eye.

The Pupil Reflex

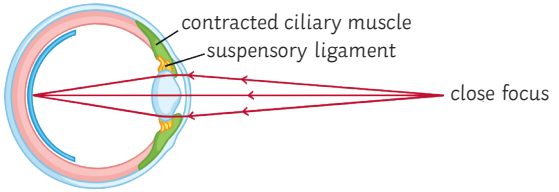
The muscles in the iris contract and relax to change the size of the pupil and to control the amount of light allowed to pass into the eye. This action is controlled by a **reflex action**.

When there is **bright light**, the **pupil contracts** and becomes smaller (left-hand image). This is to **reduce the amount of light** entering the eye and prevent the retina becoming damaged. The **radial muscles** in the iris **relax**, whilst the **circular muscles contract**.

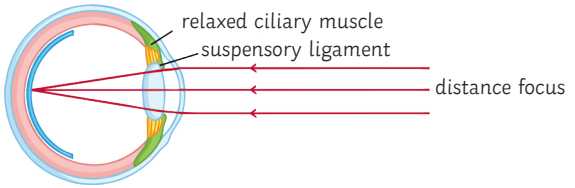
When there is **dim light**, the **pupil dilates** and becomes larger (right-hand image). This is to **increase the amount of light** entering the eye so a clearer image can be produced. The **radial muscles** in the iris **contract**, whilst the **circular muscles relax**.

Accommodation

The **lens** changes shape, controlled by the **ciliary muscles** and **suspensory ligaments**, in order to focus on near or distant objects. This process is called **accommodation**.



Near objects – to focus on an object near to the eye, the **lens becomes thicker** so that the light rays are **refracted more**. To make the lens fatter, the **suspensory ligaments loosen** and the **ciliary muscle contract**.



Far objects – to focus on an object in the distant, the **lens becomes thinner** so that the light rays are **refracted less**. To make the lens thinner, the **suspensory ligaments contract** and the ciliary **muscles relax**.

Vision Defects

The two most common vision defects are **hyperopia** and **myopia**.

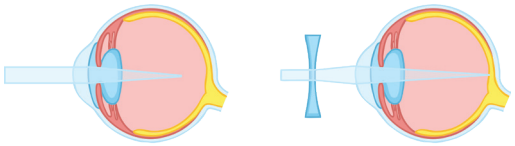
These eye defects are usually corrected through the use of **spectacle lenses** (glasses) or **contact lenses**.

Laser eye surgery or **lens replacement** can be performed to correct vision more permanently. Laser eye surgery changes the shape of the cornea to correct the degree of refraction of light into the eye.

Myopia, or **short sightedness**, is the inability to focus clearly on distant objects.

Myopia is caused when the eye is elongated meaning that refracted light rays cannot reach the retina when they are focused. It could also be caused when the lens is too fat or curved, again meaning that the light is refracted and focuses before reaching the retina. A concave lens is used to correct myopia.

How lenses correct **myopia**:

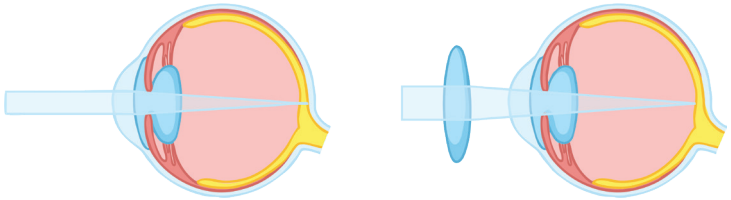


myopia | myopia correction

Hyperopia, or **long sightedness**, is the inability to focus clearly on near objects.

Hyperopia is caused when the eye is too short meaning that refracted light rays focus after the retina. It can also be a result of reduced elasticity in the lens, which is usually linked to ageing. A convex lens is used to correct myopia.

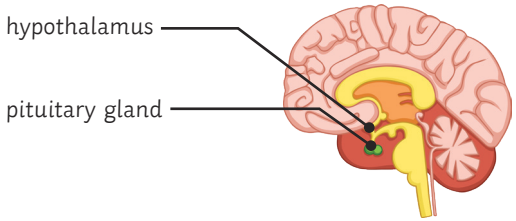
How lenses correct **hyperopia**:



hyperopia | hyperopia correction

Control of Body Temperature

Body temperature is constantly maintained around 37˚C. This is the optimal temperature for **enzymes** which carry out many of the metabolic processes within the body.



Within the **hypothalamus** of the brain is the **thermoregulatory centre** which controls how the temperature is maintained. The thermoregulatory centre contains **receptors** which are responsive to the temperature changes of the **blood**. The **skin** also contains temperature receptors which are responsive to **external temperature stimuli**. They send this information to the brain as **impulses** along the **sensory neurons**.

When our body becomes **too hot**, the following things happen:

- We **sweat** – water released from glands onto the skin's surface is evaporated. This uses heat energy from the body.
- **Vasodilation** occurs – blood vessels near the skin become wider and blood flow increases meaning more heat is transferred away from the body.
- **Skin hairs lie flat** – the hair erector muscles relax and so the hairs lie flat to the skin's surface.

When our body becomes **too cold**, the following things happen:

- We **shiver** – the skeletal muscles contract and relax rapidly to make us shiver. This movement of the muscles generates heat.
- **Vasoconstriction** occurs – blood vessels near the skin become narrower and blood flow decreases meaning less heat is transferred away from the body.
- **Skin hairs stand upright** – the hair erector muscles contract and so the hairs stand erect on the skin's surface. This traps an insulating layer of air across the skin's surface and reduces heat loss.

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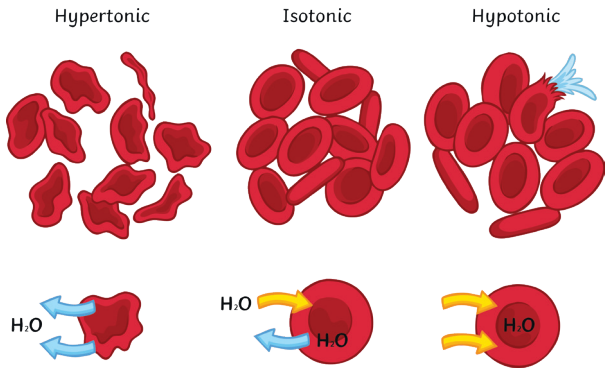
Maintaining Water Balance in the Body

The control of water and mineral salts within the body is called **osmoregulation**.

It is important that the levels are maintained to prevent the cells from **bursting** or **shrivelling** and so that they continue to function efficiently.

If the **concentration** inside the cell is at **equilibrium** to the outside, then the water and salts move in and out of the cell at an equal rate.

If the concentration of salts inside the cell becomes **higher** than the concentration outside the cell, then the solution outside is **more dilute (hypotonic)**. This means that water moves **into** the cell by **osmosis**. This causes the cell to **swell** and it can **burst open**.



If the concentration of salts inside the cell becomes **lower** than the concentration outside the cell, then the solution outside is **more concentrated (hypertonic)**. This means that water moves **out of** the cell by osmosis. This causes the cell to **shrivel** and it cannot function properly.

Water is lost from the body through the **lungs** when **breathing out (exhalation)** and through the skin when we **sweat**. Dissolved in the sweat are **mineral ions** and **urea**. The body does not regulate the amount of water, ions or urea lost through the lungs and skin. Instead, excess water, ions and urea are removed from the body in **urine**, via the **kidneys** which are part of the **urinary system**.

Maintaining Nitrogen Balance in the Body (HT Only)

When our food is digested, **proteins** are broken down by **protease enzymes** into **amino acids**. Not all of these amino acids are needed by the body and the excess need to be removed safely. The body cannot store extra proteins or amino acids.

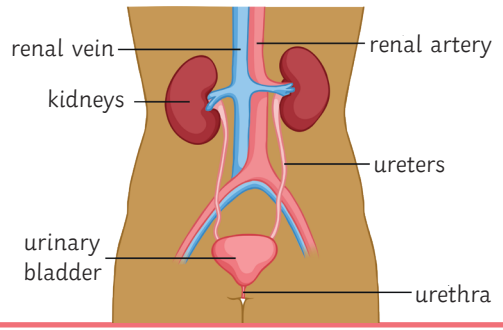
The **liver** forms **ammonia** by the process of **deamination** of excess amino acids. Ammonia is highly **toxic** so the body immediately converts it into **urea** so it can be safely **excreted**. The **liver cells** release urea and water into the **bloodstream** so it can be transported to the **kidneys**. At the kidneys, the blood is **filtered** and the urea is excreted from the body as **urine**.

Filtration and Selective Reabsorption in the Kidneys (HT Only)

Blood is transported to the kidneys through the **renal artery** and filtered at high pressure in the **kidneys**.

Useful materials such as **glucose, salt ions** and **water** are absorbed back into the body in a process known as **selective reabsorption**. Once filtered, the blood returns to the rest of the body via the **renal vein**.

The waste materials from the filtration process, including urea, are dissolved in water to form urine. This is carried along the ureter to the bladder where it is stored temporarily. When the bladder is filled, the urine leaves the body via the urethra.



Kidney Dialysis (HT Only)

Disease or damage to the **kidneys** can affect the ability to remove toxic waste substances from the body. Humans can function with the use of only one kidney, but in case of total **kidney failure**, treatment is needed urgently. This can be done as an **organ transplant** or by using **kidney dialysis**.

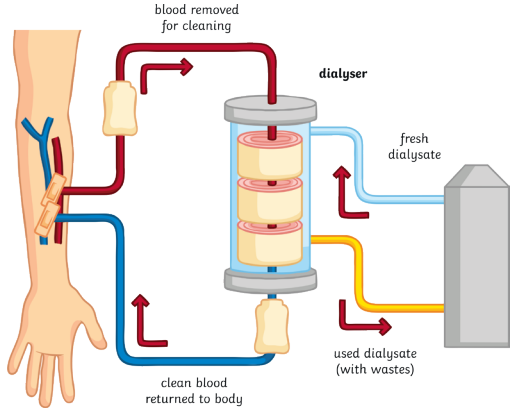
A **dialysis machine** can be used for patients who are waiting for a suitable **donor** to become available for an organ transplant.

Kidney dialysis uses specialised equipment, usually in a hospital setting.

Unfiltered blood is taken from the body via a blood vessel in the arm. It is mixed with **anti-coagulants** to prevent the natural blood clotting and then pumped into the dialysis machine. Inside the machine is a **partially permeable membrane** which separates the patient's unfiltered blood from the **dialysis fluid**.

The blood flows in the opposite direction to the dialysis fluid to ensure a concentration **gradient** is maintained and exchange of substances can occur. The dialysis fluid contains **glucose, ion**s and **no urea**.

This means that the urea moves across the partially permeable membrane, **down the concentration gradient** and into the fluid by **diffusion**. The **glucose** and **ion concentrations** in the dialysis fluid are similar to the concentrations within the blood plasma, so they are only exchanged across the membrane if there is an imbalance and safe levels are maintained.



Kidney Dialysis (HT Only) Continued

The **advantages** and **disadvantages** of **kidney dialysis** are listed in the table.

Advantages	Disadvantages
• Allows a patient with kidney failure to maintain their health. • Reduces the levels of urea in the blood. • Maintains glucose levels. • Restores the natural water and ion levels.	• expensive • Time consuming and restrictive on lifestyle: on average it takes 4 to 6 hours, 2 to 3 times per week, at the hospital. • Only effective whilst the dialysis is being run so patients must monitor their levels carefully between treatments. • Restrictions on diet: must avoid high salt foods and excessive protein consumption. • Only effective for a limited time – many patients die while waiting for an organ transplant.

ADH (HT Only)

The **hypothalamus** in the brain detects any changes in the **blood plasma**, including temperature and **water concentration**. To regulate the water concentration, the hypothalamus stimulates another region of the brain, the **pituitary gland**. The pituitary gland regulates the release of the **anti-diuretic hormone**, or **ADH**. The concentration of water in the blood plasma is controlled by the release of ADH in a **negative feedback loop**.

Organ Transplant (HT Only)

A **kidney transplant** involves replacing the entire **organ** with another taken from a **donor**. It is a much better treatment for kidney failure than dialysis because the patient is usually able to lead a **normal lifestyle** afterwards, without the restrictions imposed by dialysis treatment.

A potential problem of organ donation is the presence of **protein antigens** on the surface of the cells. Every cell in our body has these antigens and they are unique to each individual. The antigens help our body to distinguish between our own cells and invading pathogens or other foreign cells.

As the organ from the donor displays different antigen proteins, the patient's immune system will detect the transplanted organ as foreign and initiate an **immune response** against it. This is called **rejection**.

To help reduce the likelihood of **organ rejection**, there are two **precautions** that can be taken:

1. **Tissue typing** – donors and patients are matched based on how similar their antigens are. This can mean that there is a long wait to find a suitable donor organ and patients have to use dialysis in the meantime.
2. **Immuno-suppressant drugs** – patients take these drugs for the rest of their lives following an organ transplant. The drugs reduce the effect of the immune system and so reduce the response to the transplanted kidney. However, the drugs cannot target the immune response on the kidneys only, and so the patient has a reduced immune response to all other pathogens and this increases the risk of infections.

Unfortunately, even taking both precautions, many patients won't survive more than 10 years before requiring a new transplant or before returning to dialysis treatment.

The **advantages** and **disadvantages** of **organ transplant** are listed in the table.

Advantages	Disadvantages
• Patients can lead a normal and non-restrictive lifestyle. • Cheaper than kidney dialysis overall.	• Patients must take drugs which increases risk of infections. • There is a shortage of organ donors. • Transplanted organs only last 8 to 9 years, on average. • There are risks associated with the operation: excess bleeding, infections, allergic response to anaesthetic.

Plant Hormones

Phototropism – a plant's response to light.

Auxins are hormones in plants that control plant growth. They are found in the tips, roots and shoots and are sensitive to light. This is called phototropism. If the tip of the plant is removed, then the plant will no longer grow.

(HT Only)

Gravitropism/geotropism – a plant's response to gravity.

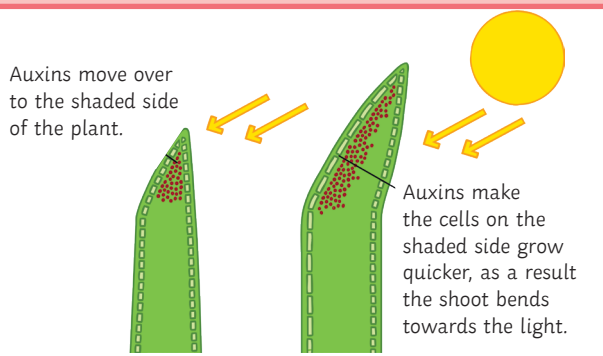
Auxins are also affected by gravity.

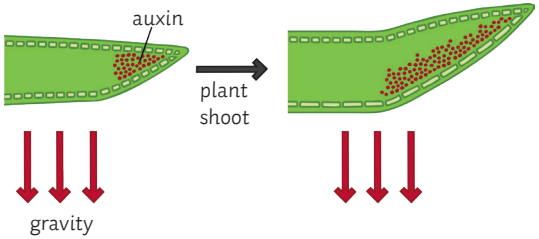
The Shoots

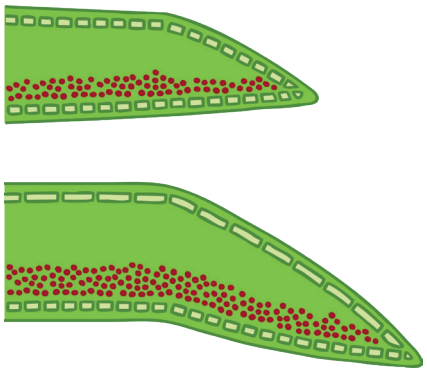
The **shoots** will grow away from gravity. A shoot that grows sideways will end up with more auxin on the lower side of the shoot and the lower side will grow more, causing the shoot to grow upwards.

The Roots

The **roots** will grow towards gravity. If a root grows on its side, more auxins will be on the lower side. In a root, the auxins will stop growth. The cells on the upper surface will grow more, bending the root downwards.







Use of Plant Hormones

Plant Hormone	Uses	Commercial Uses
auxins	Controlling plant growth.	• Killing weeds – some weed killers contain auxins which will only kill larger leaved plants (weeds). They affect how they grow and eventually kill them. • Growing plants from cuttings – by placing the plants in rooting powder (containing auxins), they will produce roots and grow a new plant. • Producing new plants from tissue culture produces clones. Auxins are added to the growth medium to allow the plants to grow.
gibberellin	Starts off seed germination, growth of stems and flowering.	• Gibberellin can be added to seeds to make them germinate at a specific time of year. This ensures that they would all germinate at the same time. • It can be used to grow bigger flowers and also make them flower no matter what the environmental conditions. • Adding gibberellin to some fruit will increase the size.
ethene	A gas produced when a plant ages. It controls cell division and the growth of plants. It is also involved in the ripening of fruit.	• Used to speed up ripening of fruit. Fruit can be picked whilst still unripe, ethene can then be added to ripen this fruit, ready for the supermarket shelf.

Required Practical Activity 7: Plan and carry out an investigation into the effect of a factor on human reaction time.

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

Method:

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

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

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

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

Required Practical Activity 8: Investigate the effect of light or gravity on the growth of newly germinated seedlings.

The aim of the investigation is to investigate the effect of light intensity on the growth of seeds.

Method: Germination of the Seeds

Before the investigation into the effect of light intensity on seedling growth can commence, it is important that the seeds that are to be measured have been germinated in the same conditions.

1. Place equal amounts of cotton wool into the base of three Petri dishes.
2. Add 10ml of water to the cotton wool.
3. Place 10 seeds on the cotton wool in each of the Petri dishes. Try to give each of the seeds plenty of space because it will make it easier to measure them.
4. Place the seeds in a warm place and allow time for them to germinate.
5. Add equal amounts of water to each of the Petri dishes if the cotton wool is becoming too dry.

Method: Measuring Growth of the Seedlings

1. Once the seeds have germinated, ensure there is an equal number in each Petri dish. This may mean you have to remove some. (Some seeds may not germinate.)
2. Place one Petri dish in each of the following places: a dark cupboard receiving no/very little light; a windowsill that will get as much light as possible; an area with partial light.
3. Every day for five days, measure the height of the seedlings and record the results.
4. To measure the height of the seedlings, you must ensure each seedling is at its full height. You may need to use the forceps to carefully lift the seedling.
5. Calculate the mean height of the seedlings each day.

The **independent variable** is light intensity. This is not a numerical value but based on the location of the seeds in the classroom e.g. windowsill or dark cupboard.

The **dependent variable** is the height of the seedlings growth, measured in centimetres.