

START

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Biology Homeostasis & Response

Homeostasis: Maintaining a constant internal environment in response to internal and external change - **through both nervous and hormonal (chemical) control.**

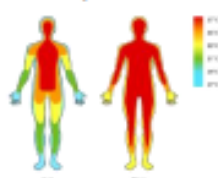
Examples of factors controlled by homeostasis include:

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1. Blood glucose



2. Temperature



3. Water levels



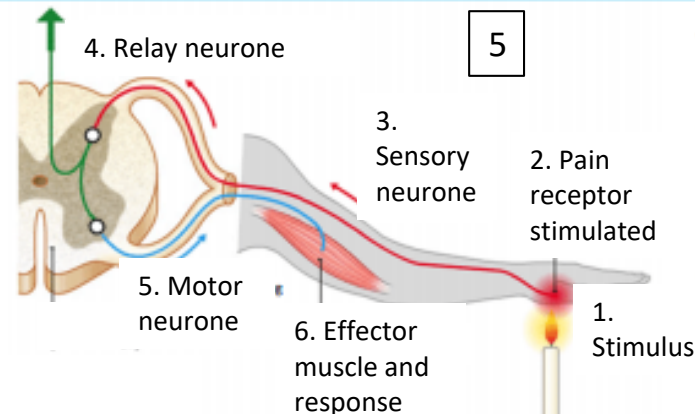
Key words:

1. **Homeostasis:** Maintaining a constant internal environment
2. **Receptor:** Detect a change in the environment
3. **Effector:** Muscle or gland that carries out a response
4. **Stimulus:** A change in the environment
5. **Sensory neurone:** Carries an electrical impulse from the receptor to the CNS
6. **Relay neurone:** Carries the impulse from the sensory neurone to the motor neurone
7. **Motor neurone:** Carries the impulse from the CNS to the effector
8. **Synapse:** A tiny gap between 2 neurones
9. **Reflex:** An automatic response that does not require processing, helps an organism survive
10. **CNS:** Central Nervous System - the brain and spinal cord
11. **PNS:** Peripheral Nervous System - the neurones that connect the rest of the body to the CNS

All homeostatic control systems include:

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1. **Cells call receptors** – which detect stimuli.
2. **Coordination centres** – E.g. the CNS (brain and spinal cord) or the pancreas
3. **Effectors** – Muscles or glands which bring about responses to restore optimum levels



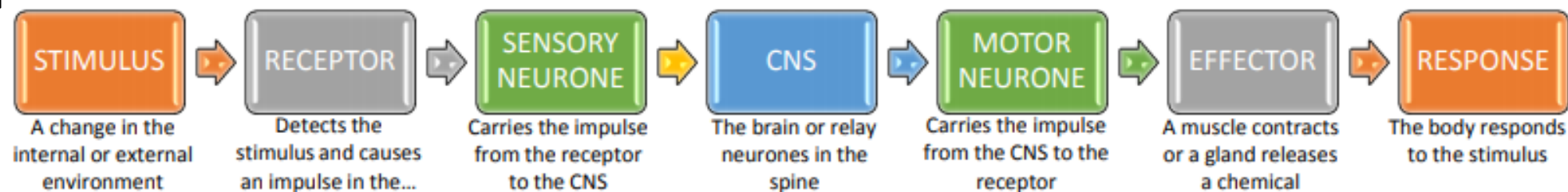
The Reflex Arc

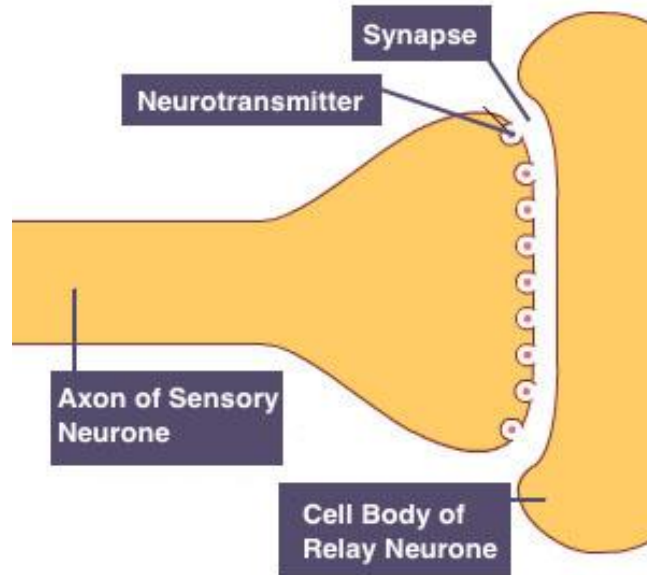
Reflexes are automatic or involuntary responses to a stimulus. The brain is **not** involved in the response, so the response is faster and automatic: reflexes protect us from harm.

Special **relay neurones** in the spine carry impulses from the sensory neurone directly to a motor neuron. The impulse is sent to an effector for a super-fast response!

The Stimulus-Response Chain: ALL nervous responses, whether voluntary or involuntary, follow this pattern:

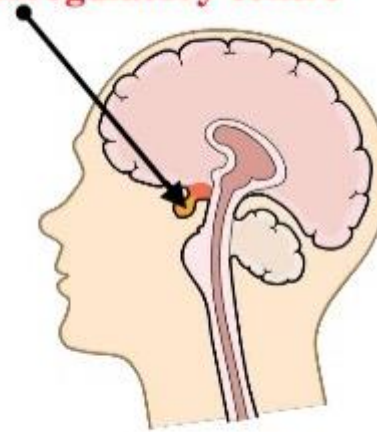
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- A Synapse is a gap between one neurone and the next.
1. The electrical nerve impulse arrives at the synapse
 2. A neurotransmitter is released into the synapse
 3. It moves across the synapse
 4. Binds to receptors on the second neurone
 5. Causes a new impulse to be generated in the neurone

Thermoregulatory centre



Monitoring body temperature

The thermoregulatory centre in the hypothalamus in the brain monitors blood temperature using temperature receptors

Body temperature too low

Sweating stops

Vasoconstriction

Shiver

Body temperature too high

Sweating starts

Vasodilation

Controlling temperature

Too cold	Too hot
<p>The diagram shows skin with three hairs. The hair muscles (A) are contracted, pulling the hairs (B) upright. This traps air. The capillaries (C) are constricted, reducing blood flow. The blood vessels at the bottom are also shown.</p>	<p>The diagram shows skin with three hairs. The hair muscles (D) are relaxed, so the hairs (E) lie flat. Sweat glands (F) are active, secreting sweat onto the skin surface for evaporation. The capillaries (F) are dilated, increasing blood flow.</p>
<p>A - Hair muscles pull hairs on end.</p> <p>B - Erect hairs trap air.</p> <p>C - Blood flow in capillaries decreases.</p>	<p>D - Hair muscles relax. Hairs lie flat so heat can escape.</p> <p>E - Sweat secreted by sweat glands. Cools skin by evaporation.</p> <p>F - Blood flow in capillaries increases.</p>

Parts of the brain

Cerebral cortex

- Consciousness
- Intelligence
- Memory
- Language

Thermoregulatory centre (hypothalamus)

- Monitors blood temperature

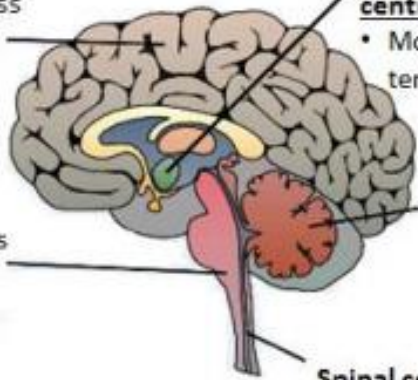
Medulla

- Unconscious activities
e.g. breathing, heartbeat

Cerebellum

- Muscle coordination

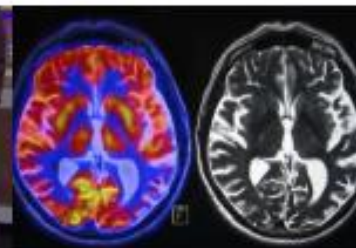
Spinal cord



The brain controls complex behaviour. It is made of billions of interconnected neurones and has different regions that carry out different functions, as shown above.

The complexity and delicacy of the brain, along with the crucial processes it controls, make it difficult to investigate. Neuroscientists have been able to map the regions of the brain to particular functions in 3 main ways:

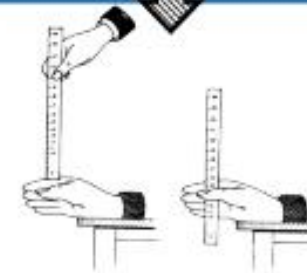
- 1) Studying patients with brain damage (e.g. Phineas Gage).
- 2) Electrically stimulating different parts of the brain.
- 3) Using MRI scanning (magnetic resonance imaging).



Biology Homeostasis & Response

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



Ruler drop method

The person being tested rests their arm on a table with their hand over the edge. They hold their thumb and forefinger a short and fixed distance apart.

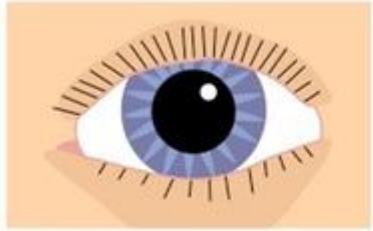
The ruler is held so that the top of the ruler is in line with the top of the person's forefinger. Ensure the ruler is held in the same place in any further tests.

Without warning, the ruler is dropped and the person attempts to catch the ruler as quickly as possible. The distance on the ruler at the top edge of the person's thumb is recorded, and a conversion table is used to convert this into a reaction time.

Repeat tests can be taken and a mean average calculated.

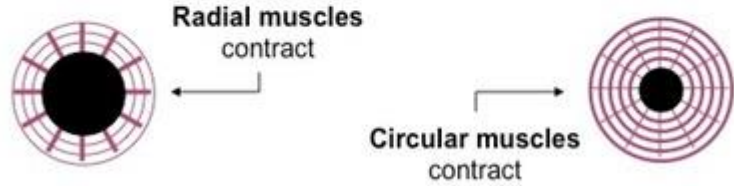
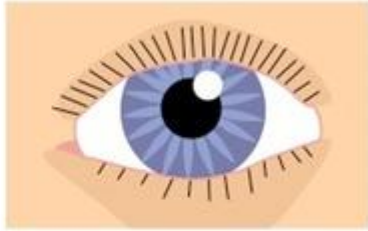
Computer based reaction time tests can offer more accurate results as there is less room for human error

DIM LIGHT



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BRIGHT LIGHT



Pupil Dilation

Pupil Contraction

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cornea

protects eye surface and focuses light rays

suspensory ligaments

hold lens in place

lens

focuses light on retina

iris

regulates amount of light entering eye

ciliary muscles

change shape of the lens

retina

senses light

optic nerve

transmits impulses to the brain

How do we see?

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1. Light from the object enters the eye.

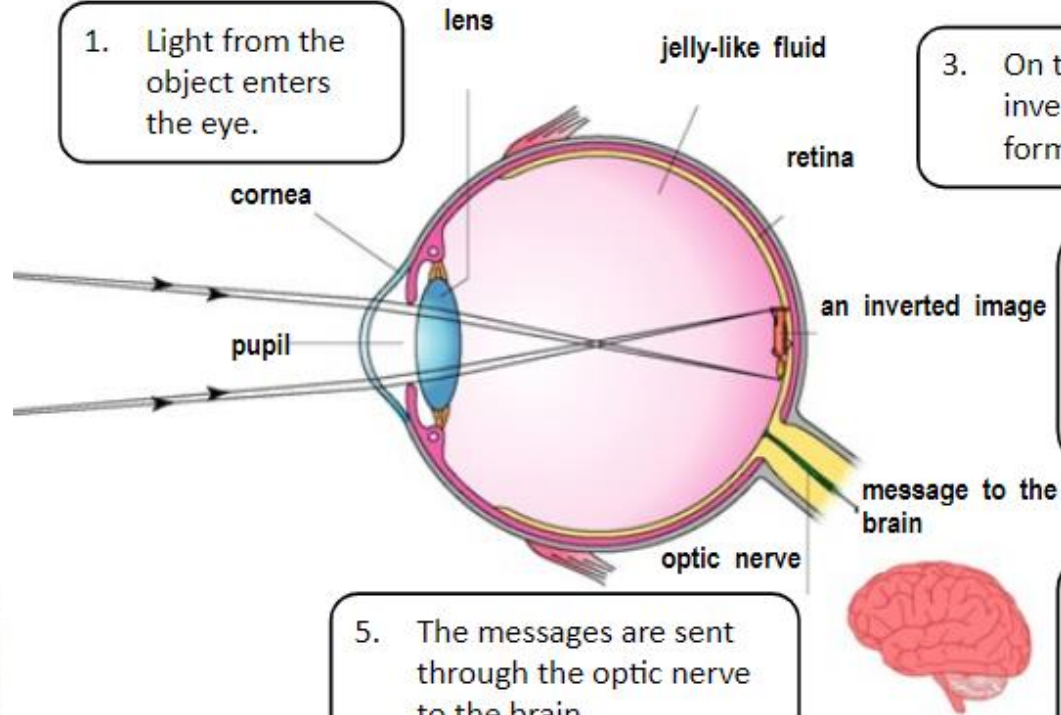
2. The cornea, the lens and the jelly-like fluid of the eye focus the light onto the retina.

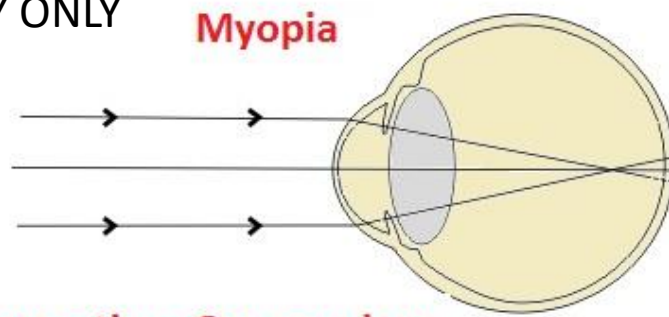
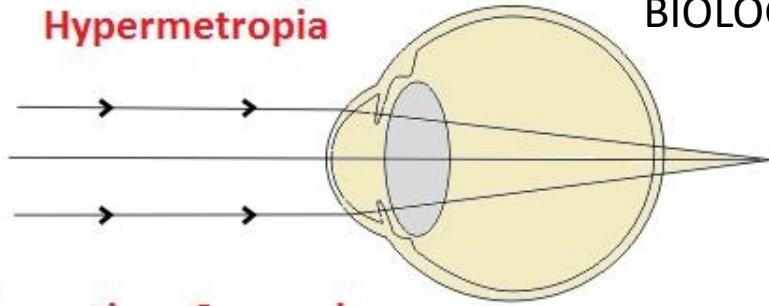
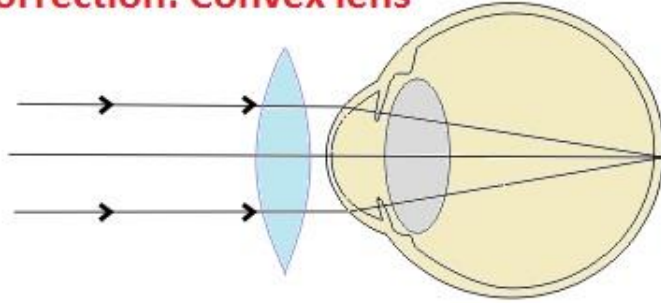
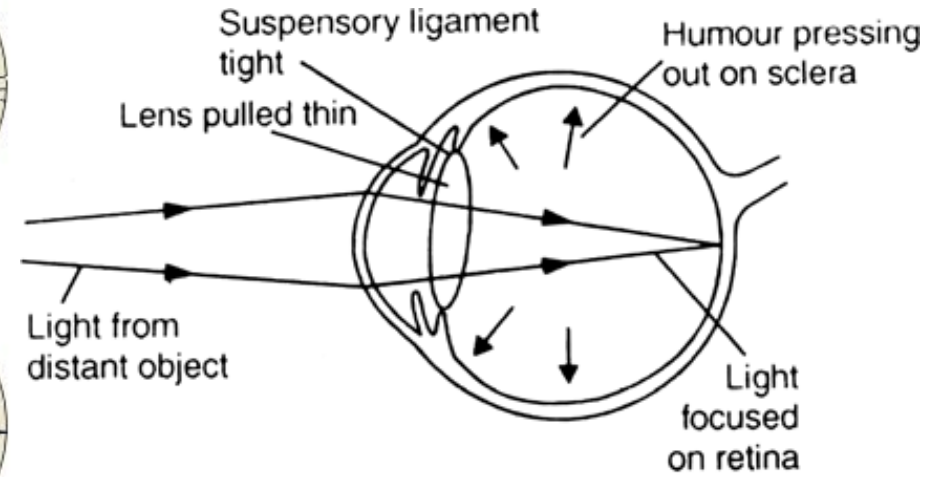
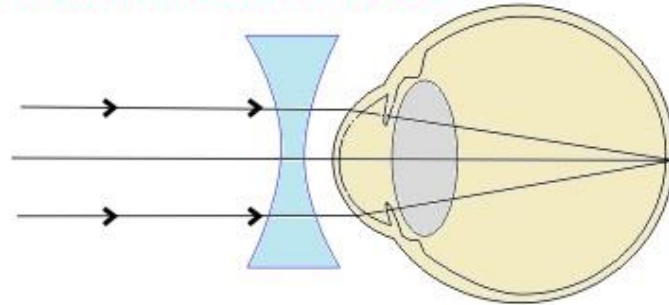
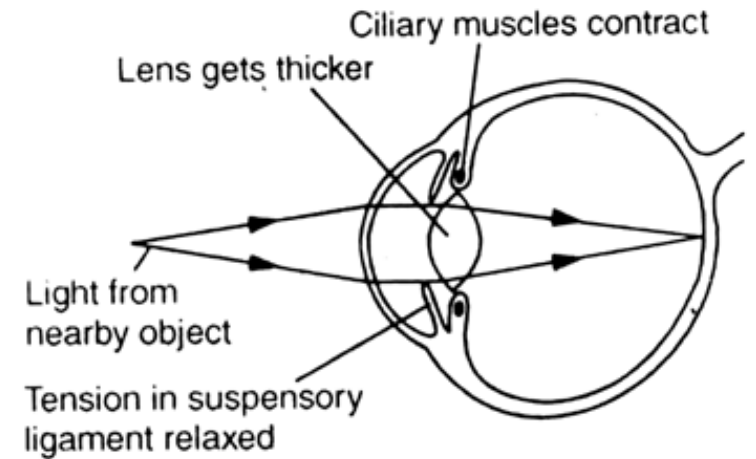
3. On the retina, an inverted image is formed.

4. The inverted image stimulates the light-sensitive cells to produce messages.

5. The messages are sent through the optic nerve to the brain.

6. The brain interprets the message as an upright object.



Hypermetropia**BIOLOGY ONLY****Myopia****Correction: Convex lens****Correction: Concave lens****(A) Accommodated for distant object****(B) Accommodated for near object**

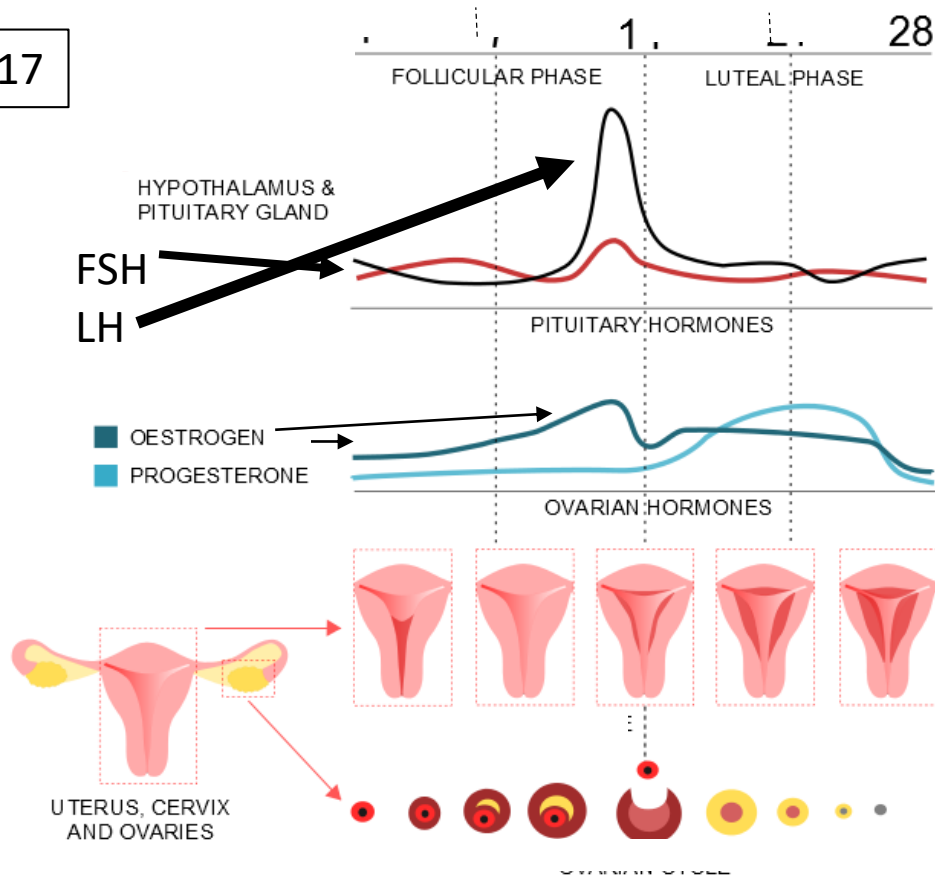
	Normal vision	Myopia	Hyperopia
Where is the image formed?	On the back of the retina	In front of the retina	Behind the retina
Why does this happen?	Light is correctly refracted by the cornea and lens in the eye.	The lens is too strong, or the eyeball is too long.	The lens is too weak or the eyeball is too short.
What can be done to correct this, if necessary?		Use a concave lens	Use a convex lens

Menstrual Cycle (Some HT)

Ovulation	The release of an egg cell. Occurs approximately every 28 days.
FSH	Produced by the pituitary gland. A hormone that causes an egg to mature in the ovary. Causes oestrogen to be produced.
Oestrogen	Produced by the ovaries. Causes blood lining of uterus to develop. Stops FSH being produced. Stimulates release of LH.
LH	Produced by the pituitary gland. A hormone that causes ovulation.
Progesterone	Produced by the ovary. Maintains blood lining in uterus. Stops production of LH and FSH.

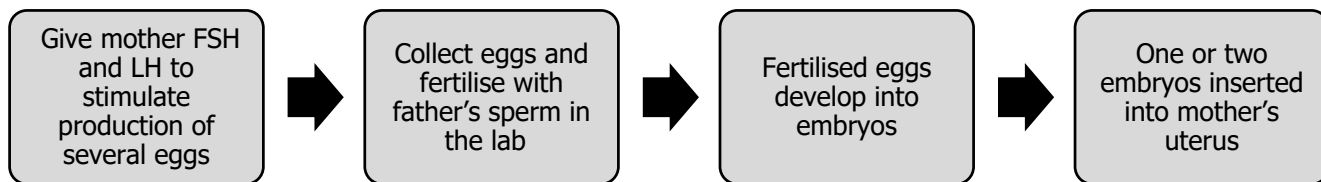
Changes in the Menstrual Cycle (HT)

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**Methods of Contraception**

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Method	How it works	Pros (+) and Cons (-)
Oral contraceptives	The contraceptive pill. Contain hormones to inhibit FSH production so eggs do not mature.	+ 99% effective + Reduces risk of some cancers - Can cause side effects e.g. nausea
Progesterone	Injection, implant or skin patch of slow-release progesterone to stop eggs maturing and being released.	+ Fewer side effects than pill. + Doesn't need to be taken daily so less likely to be forgotten - Less effective than pill
Barrier methods	Condom or diaphragm. Prevents sperm reaching the egg.	+ 98% effective (when used correctly) + Prevent STIs - Can break or be used incorrectly
Spermicide	Kills or disables sperm. Used with diaphragms to make them more effective.	+ Increases effectiveness of some barriers - Can't be used on its own
Avoiding intercourse	Avoiding intercourse when an egg might be in an oviduct.	- High risk of becoming pregnant
Sterilisation	Undergoing surgery to stop sperm or eggs being able to fertilise.	+ Permanently stops pregnancy - Risks from surgery - Expensive to reverse and may not work
Intra-uterine device (IUD)	An implant into the uterus that prevent fertilised eggs implanting into the wall of the uterus or release hormones.	+ Long lasting but can be reversed - Small risk of infection or uterus damage when IUD is implanted

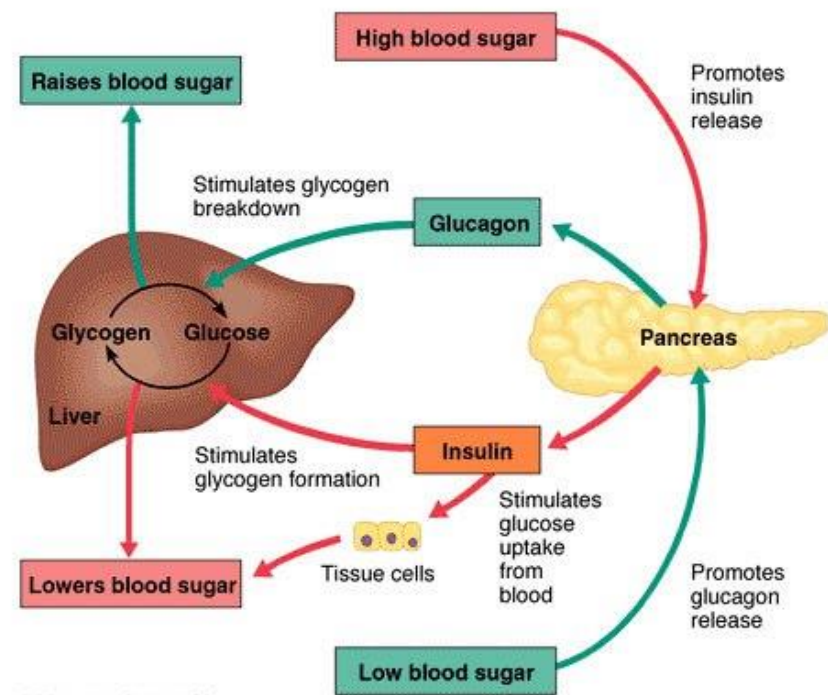
IVF HT - 19**IVF Disadvantages**

- Emotionally and physically stressful.
- Success rates are low.
- Can lead to multiple births which are risky for mother and babies

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Control of blood glucose

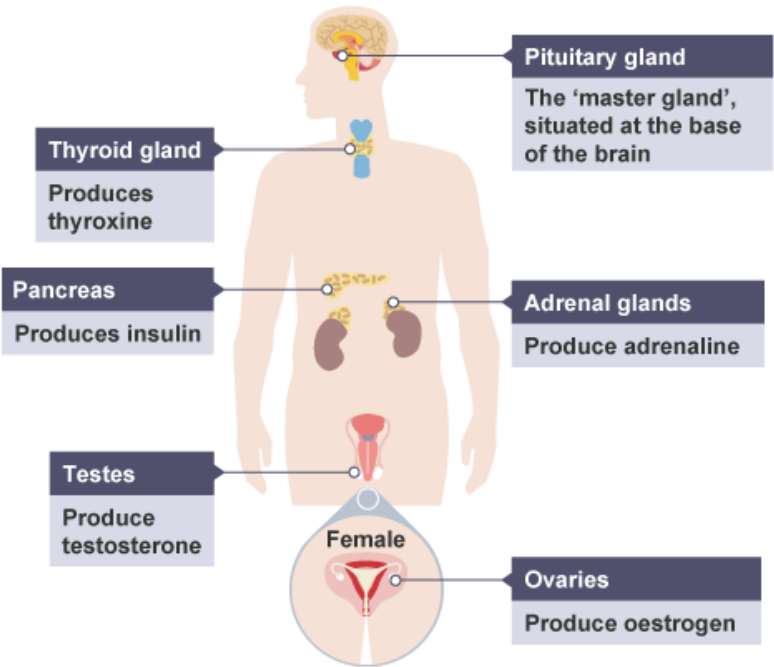
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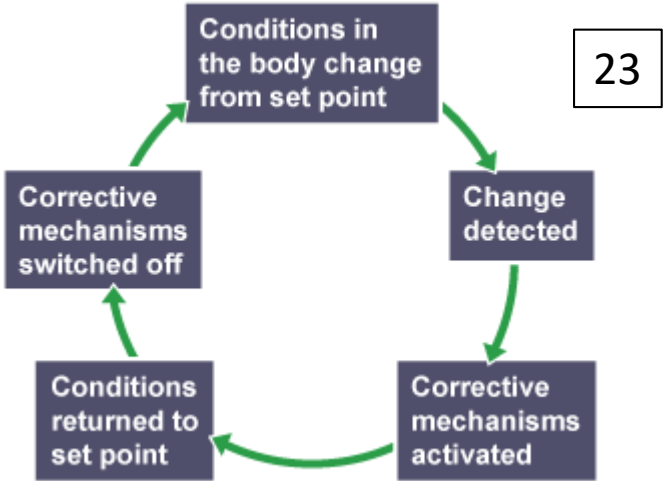
Hormonal Control Key Terms	
Endocrine System	The system of glands that secrete hormones.
Hormone	A chemical secreted by a gland that travels in the blood and has an effect on a target organ. The effects are slower and longer-lasting than responses from the nervous system.
Pituitary Gland	A gland that secretes several hormones into the blood. These hormones in turn act on other glands to stimulate other hormones to be released to bring about effects.
Testosterone	Male hormone produced by testes. Stimulates sperm production.
Adrenaline (HT)	Hormone produced by the adrenal glands in times of fear/ stress. It increases the heart rate and boosts the delivery of oxygen and glucose to the brain and muscles, preparing the body for 'flight or fight'.
Thyroxine (HT)	Hormone produced by the thyroid gland. Thyroxine stimulates the metabolic rate. Important in growth and development.

Location of Endocrine Glands

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Blood Glucose Control Key Terms	
Pancreas	The gland that monitors and controls blood glucose concentration.
Insulin	A hormone produced when blood glucose concentration is too high. Causes glucose to move from the blood into the cells. In liver and muscle cells excess glucose is converted to glycogen.
Glucagon (HT)	A hormone produced when blood glucose concentration is too low. Causes glycogen to be converted into glucose and released into the blood.
Glycogen	A storage molecule made from many glucose molecules bonded together. Found in liver and muscle cells.
Type I Diabetes	Disorder in which the pancreas fails to produce enough insulin. Causes uncontrolled high blood glucose levels. Treated with insulin injections.
Type II Diabetes	Body cells no longer respond to insulin produced by the pancreas. A carbohydrate controlled diet and exercise are common treatments. Obesity is a risk factor.



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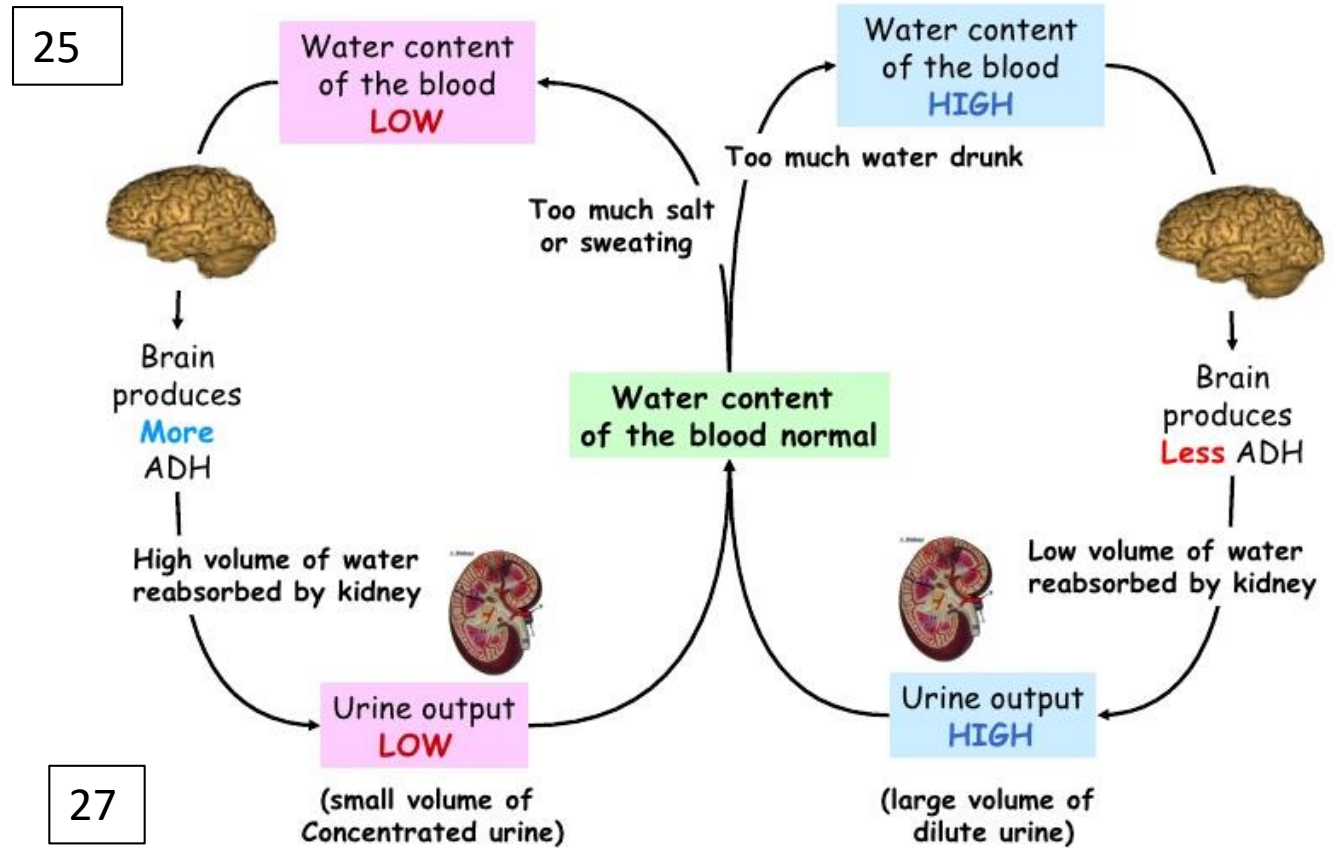
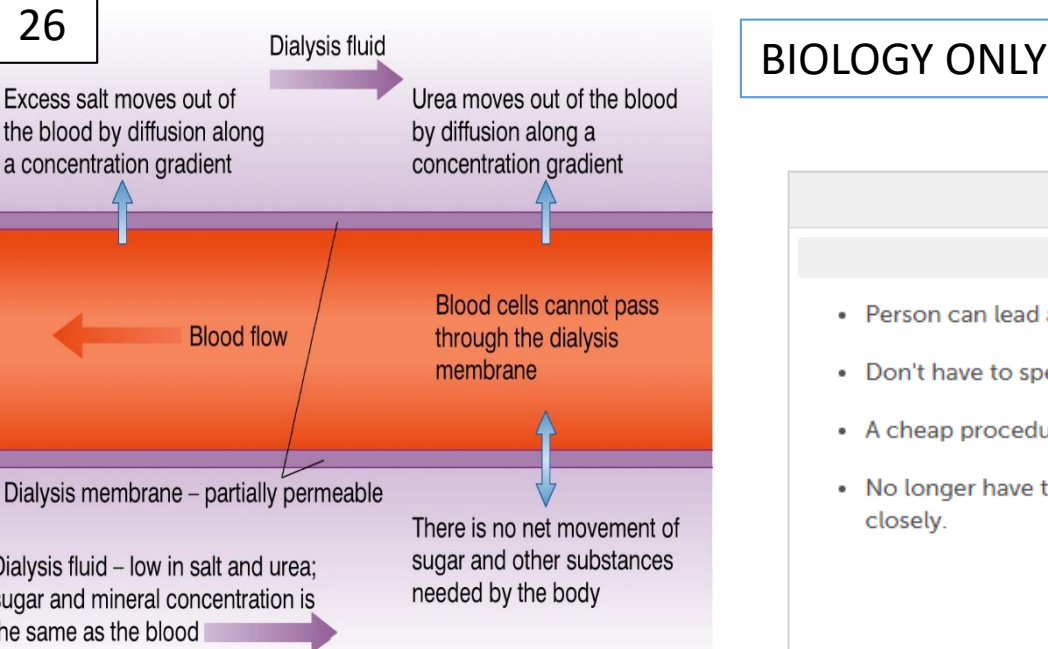
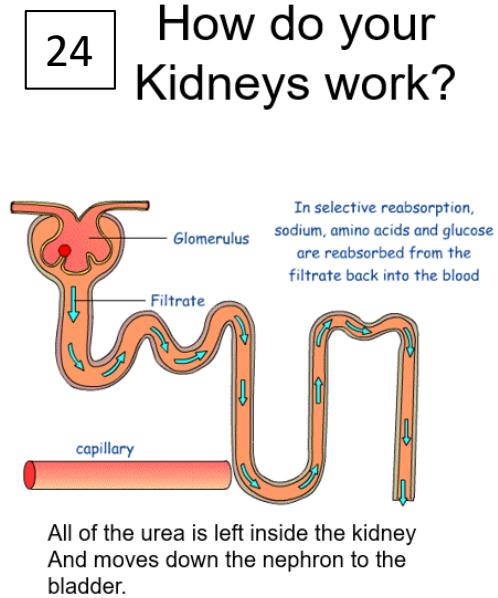
Negative feedback loop

A negative **feedback mechanism** is an important type of control that is found in homeostasis. It responds when conditions change from the ideal or set point and returns conditions to this set point. There is a continuous cycle of events in negative feedback.

- Then, **all** of the sugar is reabsorbed back into the blood by active transport.

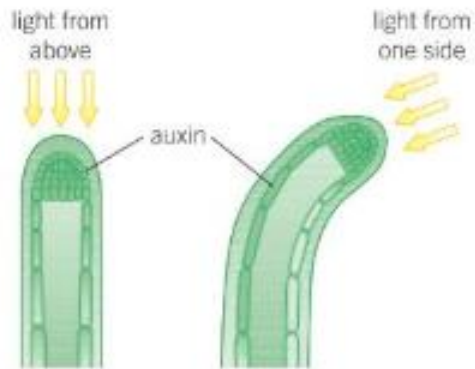
- The amount of water and mineral ions reabsorbed varies depending on what your body needs.

- This is called **selective reabsorption**.



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Kidney Transplants	
Advantages	Disadvantages
<ul style="list-style-type: none"> Person can lead a normal life with a healthy functioning Kidney Don't have to spend hours doing dialysis A cheap procedure No longer have to monitor their glucose, ion and water levels as closely. 	<ul style="list-style-type: none"> Patient has to undergo surgery A long waiting list Kidney can get attacked by antigens and antibodies from your immune system Patient has to take immunosuppressive drugs for the rest of their life Immunosuppressive drugs weaken the immune system making the person more vulnerable to infections



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Figure 2 The response of shoots to light from one direction is the result of an uneven distribution of auxin. This causes uneven growth of the cells, resulting in a bend in the stem

Tropism Key Points

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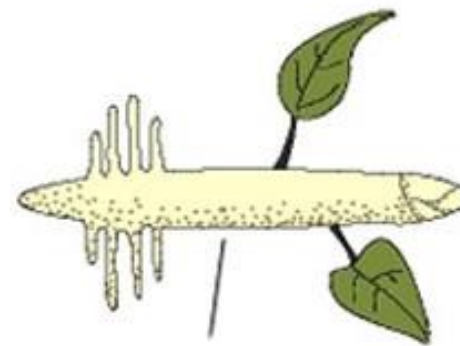
Key points

- Plant hormones are used in agriculture and horticulture.
- Auxins are used as weed killers, rooting powders, and in tissue culture.
- Ethene is used to control fruit ripening.
- Gibberellins can be used to increase fruit size, end seed dormancy, and promote flowering in the malting process, and increase the yield of sugar cane.

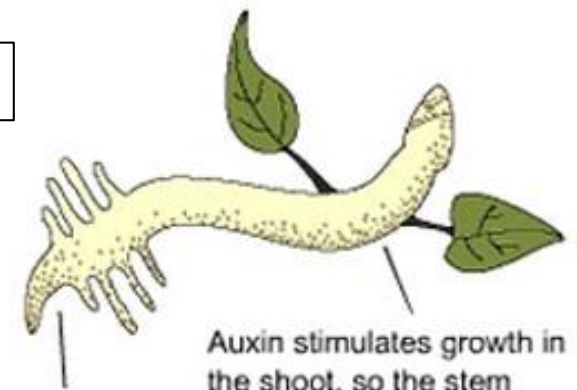
Key points

- Plants are sensitive to light and gravity.
- Plant responses to light and gravity are brought about by the plant hormone auxin.
- The responses of roots and shoots to stimuli of light and gravity are the result of the unequal distribution of auxin.
- Shoots grow towards light and against the force of gravity.
- Roots grow in the direction of the force of gravity.

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If a plant is laid on its side, auxin gathers in the lower half of the stem and root.



Auxin stimulates growth in the shoot, so the stem curves upwards.

Auxin slows growth in the root, so the root curves downwards.

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Required practical activity 8 - Investigating plant growth responses – Required practical

Investigate the effect of light or gravity on the growth of newly germinated seedlings

Record the results of the seeds' length measurements and create a labelled biological drawing to illustrate the effects of light or gravity.

Germination is the beginning of plant growth, and the plant will continue to grow if the correct conditions are available. Mustard or cress seeds are a good choice for this investigation because they grow fast and their roots and stems are clearly visible.

Variables

IV - Place plants in light and dark conditions. Other suitable independent variables are: different colours of light, intensity of light or the direction light comes from.

DV - The mean height of seedlings.

CV - Number of seeds on each dish, how much they are spread out, the volume of water the seedlings are given, the temperature they are kept at.

Method

Put cotton wool into three petri dishes, and add the same volume of water to each dish.

Add ten seeds to each dish and place them in a warm place where they won't be disturbed.

Allow the seeds to germinate, and add more water if the cotton wool dries out.

Once the seeds have germinated, ensure the petri dishes each contain the same number of seeds, and remove any extra seeds if necessary.

One petri dish will sit in full light on a windowsill, the second will be in a dark cupboard, and the final dish will be placed in partial light.

Every day for one week, measure the height of each seedling and record the results in a table. You must record the height of the individual seedlings on each day.

Calculate the mean of the seedlings each day, and compare the mean heights in the three different locations.