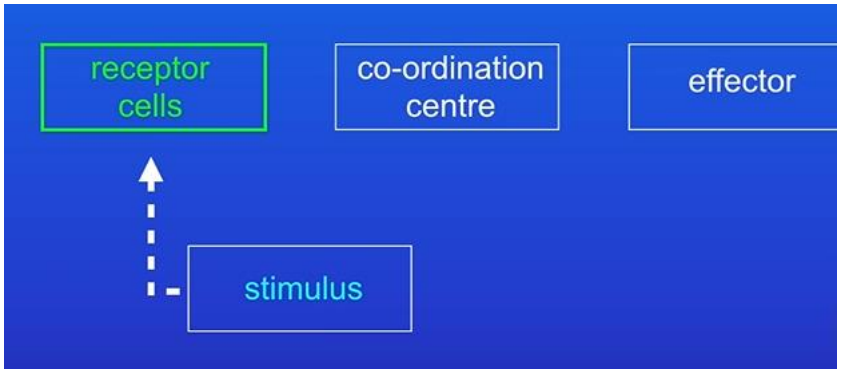
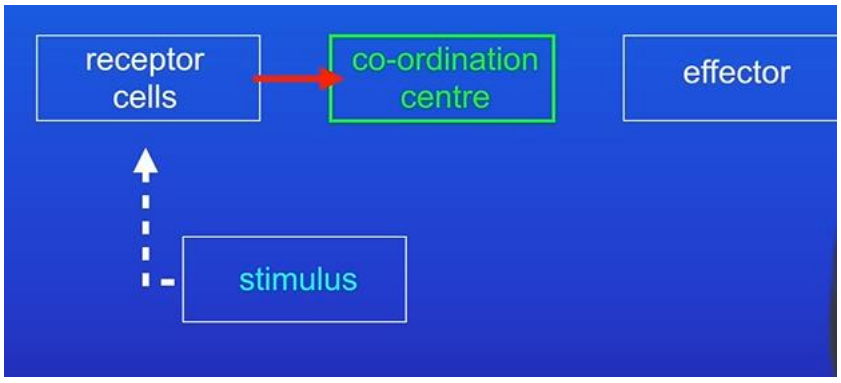
Homeostasis:

Homeostasis is the regulation of the internal conditions of a cell/organism to maintain optimum conditions in response to internal and external changes



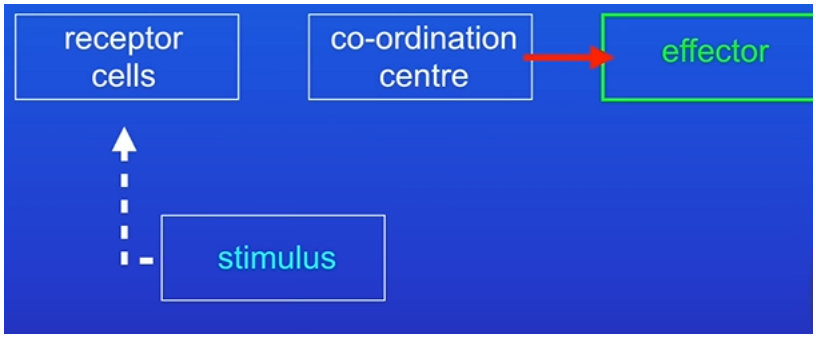
Receptor cells detect changes in the environment (body's internal/external conditions)

Stimulus is a change to the environment

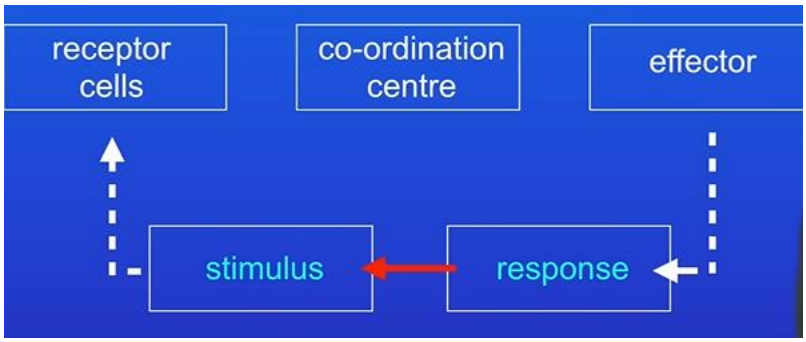


Receptor cells pass information to the co-ordination centre CNS (brain, spinal cord)

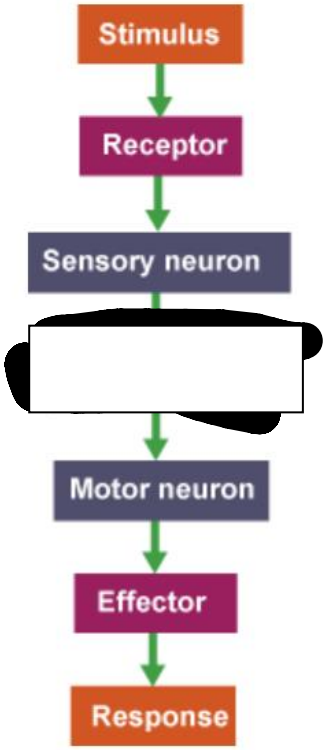
Co-ordination centre processes information from receptor cells



Co-ordination centre sends instructions to the effector (muscles, glands)

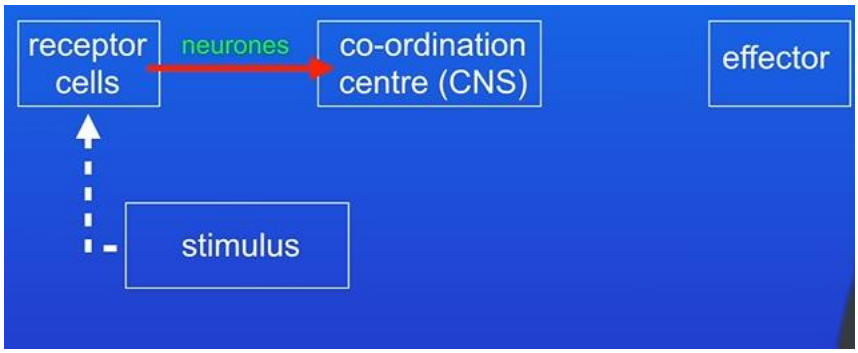


The effector's job is to carry out a response (restore condition to optimum level)

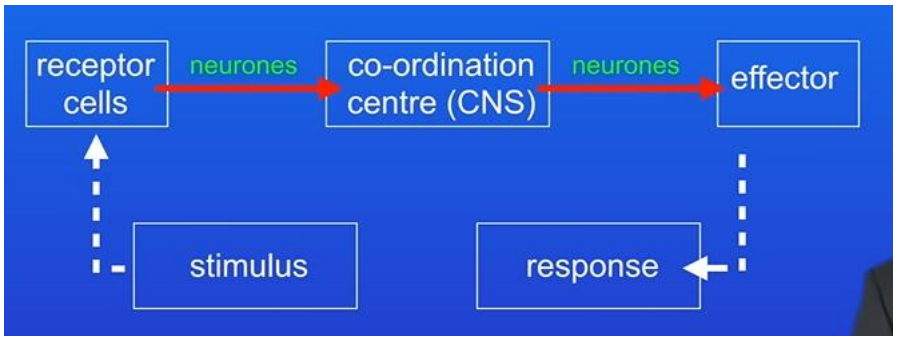


The nervous system:

The brain and spinal cord is the Central Nervous System (CNS)



Receptors send electrical impulses down neurons (nerve cells) to the CNS



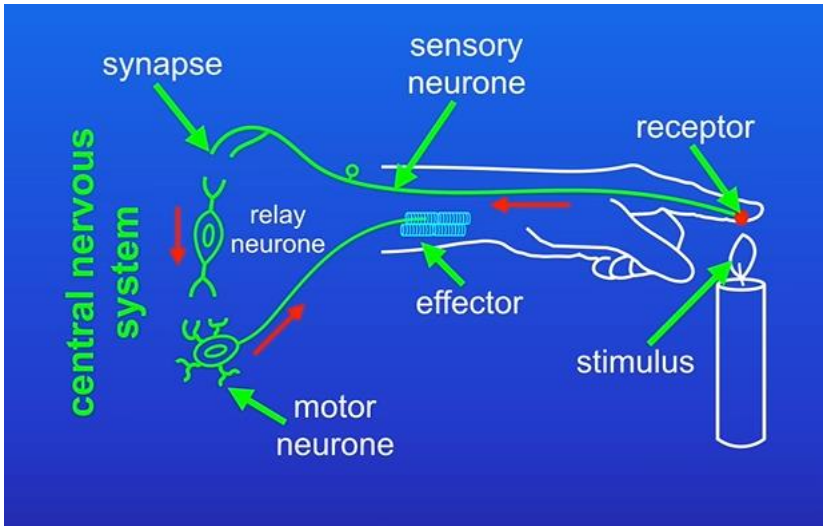
The CNS sends electrical impulses down other neurons to effectors

Effectors are a muscle which contracts or a gland which secretes hormones

A key role of the nervous system is that it enables humans to react to their surroundings and co-ordinate their behaviour

Reflex arc:

When touching a hot object



The stimulus is the heat

The receptor is in the skin

Electrical impulses pass from receptor along a sensory neurone to the CNS (spinal cord)

At the end of the neurone, there is a junction called a synapse which releases a chemical which diffuses across to a relay neurone in the CNS where it triggers an electrical impulse

The electrical impulse reaches another synapse which releases a chemical triggers an electrical impulse in the motor neurone

The electrical impulse passes down the motor neurone to an effector which is a muscle in this scenario

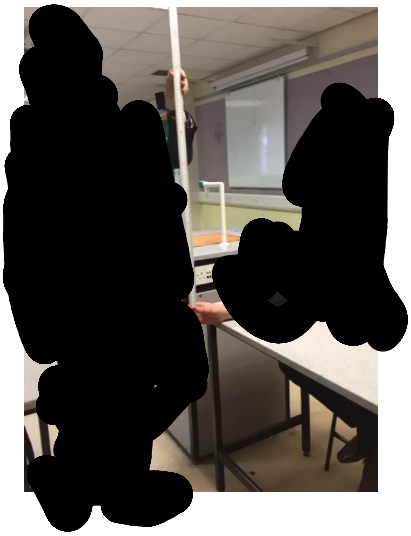
The muscle contracts and pulls the hand away from the heat (response)

This is a reflex action which means that it is an automatic and fast response to danger

Reflexes CNS is usually the spinal cord as it is fast and is a subconscious decision

Required Practical: Reaction time

1. Person 1 sits on a stool with a good upright posture
2. Person 1 places their forearm on the table with their dominant arm
3. Person 2 holds a ruler standing between person 1s index finger and thumb
4. Person 2 then tells person 1 to get ready to catch the ruler
5. Person 2 releases the ruler at a random time
6. Person 1 catches the ruler as quickly as possible
7. Person 2 records the measurement on the thumb
8. Person 1 has a short rest
9. We repeat the experiment several times and then calculate a mean
10. Person 2 does the same experiment and repeats the whole process
11. We compare results



Independent variable: Person doing the experiment

Dependent variable: Reaction time

Control variable: Starting distance between thumb and finger should be kept constant, measure ruler at the top of the thumb and keep conditions in the room the same

The brain:

Parts of the brain and functions:

- Cerebral cortex: Language, memory and consciousness
- Cerebellum: Controls our balance and co-ordinates our movements
- Medulla: Controls heart rate and breathing rate

It is difficult to treat brain damage/disease:

- Difficult to access because of the skull

- Structures of brain are complex so hard to work out
- Brain is very delicate so it can be easily damaged

Ways Scientists Investigate the Brain:

1. Link Brain Damage to Function:

- By studying patients with brain damage, scientists can see which parts of the brain are responsible for specific functions (e.g., memory, movement).

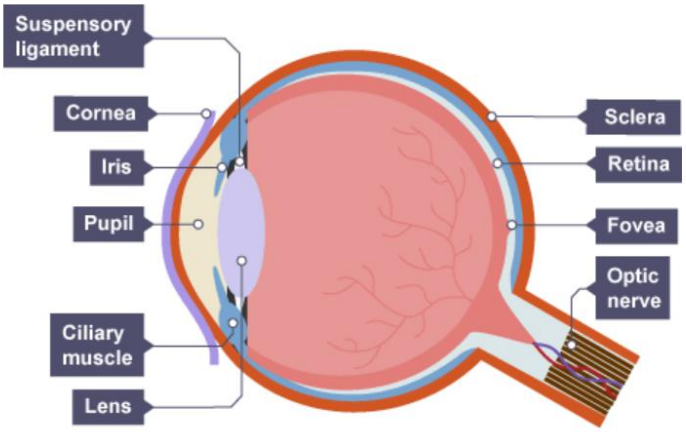
2. Electrically Stimulate the Brain:

Scientists can apply small electrical currents to different brain areas and observe how it affects behaviour or movement, helping to understand the role of each part.

3. MRI Scanning:

MRI scans show which parts of the brain are active during different tasks, helping scientists understand which areas control activities like speaking, thinking, or moving.

The eye:



Functions of eye:

- Cornea: Starts focusing of light rays
- Pupil: Allows light to pass through in the centre of the iris
- Lens: Focuses light rays at the back of the eye (retina)
- Retina: Contains receptor cells which allows us to detect light intensity and light colour
- Optic nerve: Receives electrical impulses from receptor cells
- Sclera: Protects the eye
- Suspensory ligaments & ciliary muscles: Allow us to focus on distant or near objects
- Iris: Controls size of pupil

If it is dark

- Radial muscles contracts
- Circular muscles relaxes
- Causes pupil to dilate so more light can enter the eye.

R-C

C-R

PD

If it is bright

- Radial muscles relaxes
- Circular muscles contracts
- Causes pupil to constrict so less light can enter the eye

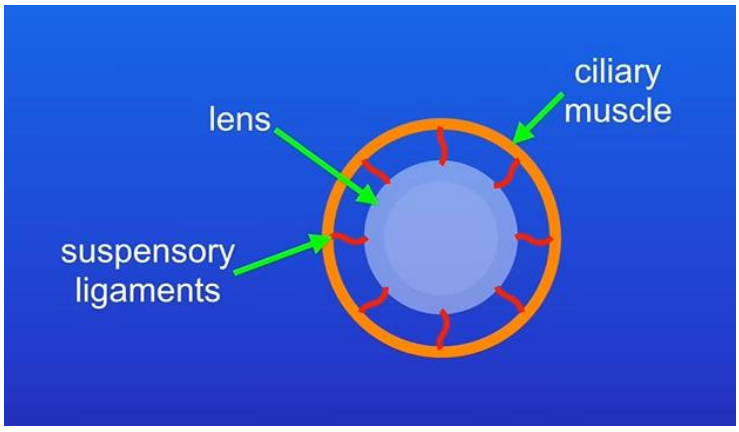
R-R

C-C

PC

How the eye focuses:

Ability for lens to change shape is called accommodation



Ciliary muscles contract and suspensory ligaments loosen to make lens more thicker and refracts light more strongly

Ciliary muscles relax and suspensory ligaments tighten making the lens more thinner and only refracts light slightly

For Distant Objects:

- Ciliary muscles relax
- Suspensory ligaments tighten
- Lens becomes thinner
- Light is refracted slightly

Really Tiny, thin Snakes

For Close Objects:

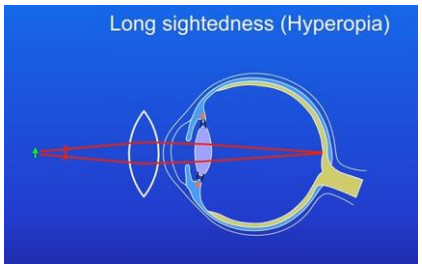
- Ciliary muscles contract
- Suspensory ligaments loosen
- Lens becomes thicker
- Light is refracted more strongly

Longsighted = Hyperopia

Shortsighted = Myopia

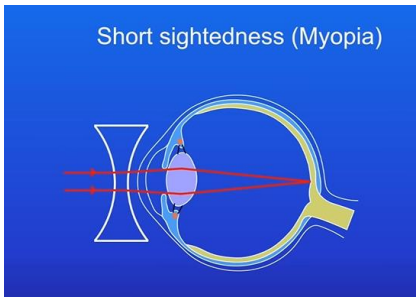
Hyperopia:

- Light rays focused behind the retina (focal point)
- Convex lens used to make light rays focus on retina



Myopia:

- Light rays focused in front of the retina (focal point)
- Treated with concave lens



Laser surgery can change shape of cornea to allow light to focus more or less to help people with hyperopia or myopia

Lens can be replaced with artificial lens

<u>Thermoregulation:</u>

Temperature controlled with a part of the brain called the thermoregulatory centre

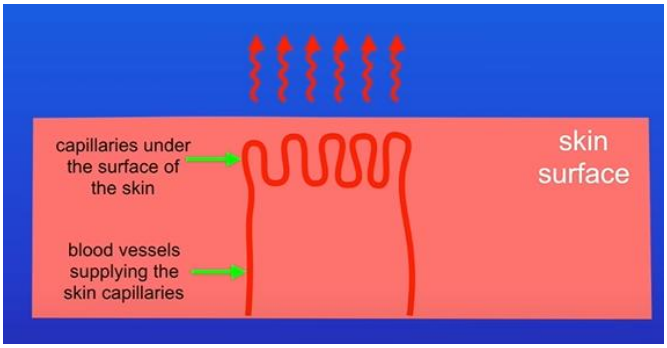
Thermoregulatory centre contains receptors which can detect change in temperature of the blood

Skin also contains receptors which sends electrical impulses down sensory neurons

When body temperature is too high:

- Sweat glands release sweat onto the surface of skin
- Sweat evaporates which takes energy from the body, cooling it down

- **Flushing:**
  - Blood vessels supplying capillaries dilate
  - This is called vasodilation
  - More blood flows through the capillaries
  - Heat now transfers out of the blood
  - Body temperature returns to normal



When temperature of body is too low:

- Blood vessels supplying capillaries constrict (become narrower)

- This is called vasoconstriction
- Less blood flows through the capillaries so less heat is lost

- We also shiver which makes skeletal muscles contract and to generate energy for this contraction the muscle cells increase rate of respiration which releases heat that warms the body
- We also stop sweating

The Endocrine system:

Key glands in the Endocrine system:

- Pancreas releases hormones to control the concentration of glucose in the blood
- Ovaries and testes release hormones involved in puberty and reproduction
- Thyroid gland produces hormones which is used for body growth and in regulating the basal metabolic rate
- Adrenal gland releases adrenaline which is produced in fear or stress
- Pituitary gland causes other hormones to be released

Controlling of Blood Glucose Concentration:

Pancreas monitors blood glucose concentration

When blood glucose concentration is too high:

- Insulin is produced by pancreas and it travels in the bloodstream
- This triggers cells to promote (take up) glucose from the blood
- Insulin also triggers liver and muscle cells to store excess glucose as a storage molecule (glycogen)
- Returns back to normal

When blood glucose concentration is too low:

- Pancreas releases glucagon into the bloodstream
- Glucagon triggers liver cells to convert glycogen stores back to glucose
- This will cause it to return to normal

Type 1 diabetes:

- Pancreas cannot produce enough insulin
- Insulin injections taken to make blood glucose concentration return back to normal
- Insulin pump can also be used which automatically pumps insulin when needed

Type 2 diabetes:

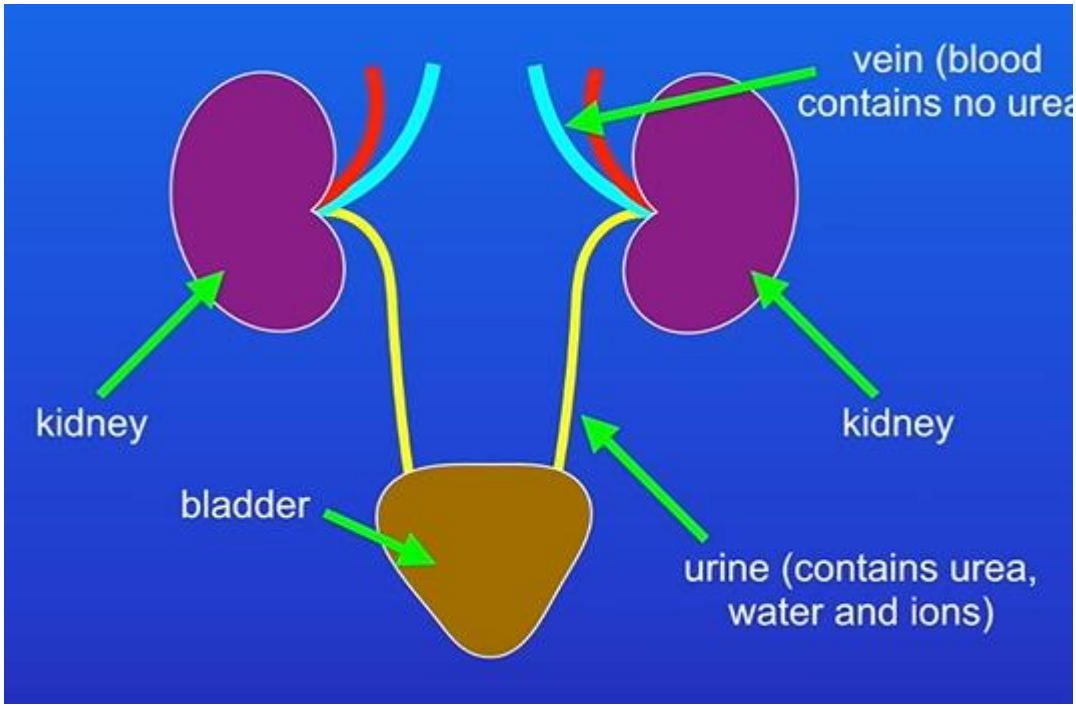
- Body cells stop responding to insulin produced by pancreas
- This is controlled by eating a controlled amount of sugar and carbohydrates
- They should also do exercise

Insulin and glucagon are involved in negative feedback

The kidneys:

Three ways which water is the lost in the body:

- Losing water in the lungs when we exhale
- Sweating causes water, ions and urea loss
- Losing water in the kidneys by urine



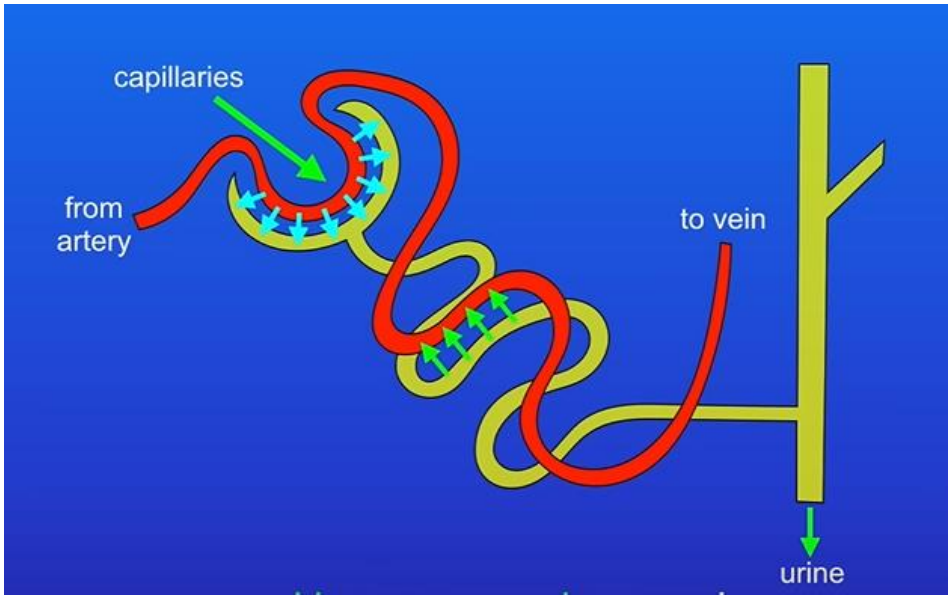
Blood comes into the kidneys via the artery

Kidney removes urea and excess ions and excess water which leaves the kidneys as urine and is stored in the bladder

Blood leaves through a vein and the blood contains no urea

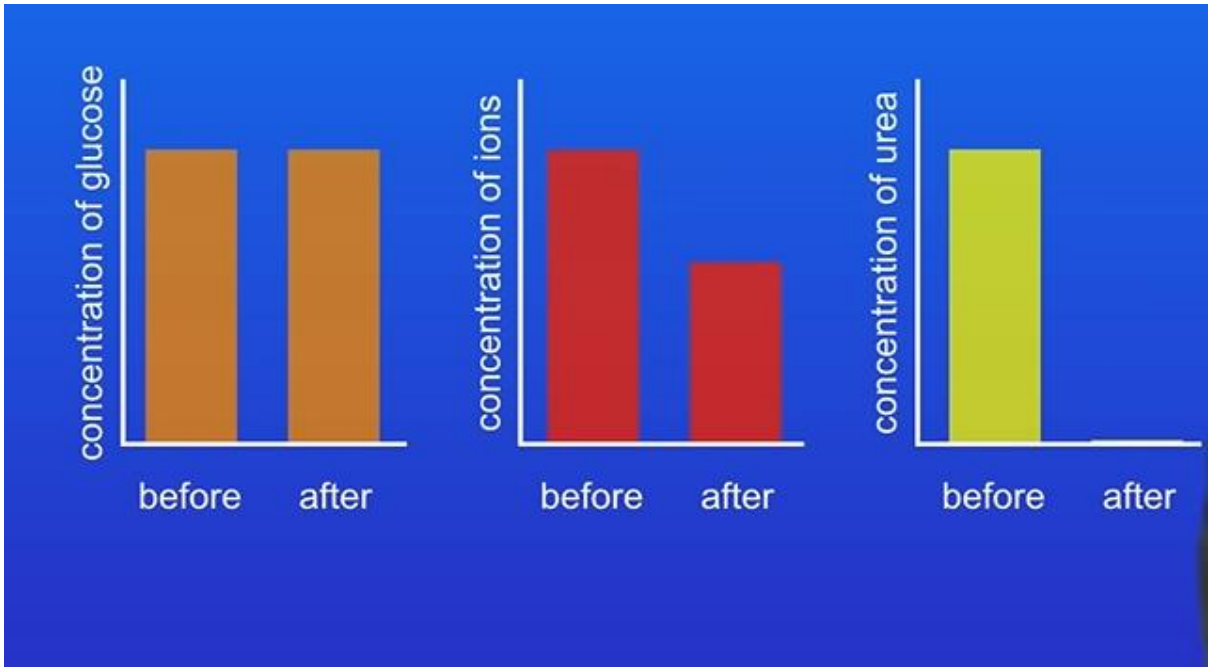
How kidneys adjust to level of molecules in the blood:

1. Blood passes through the capillaries. Molecules such as urea, ions, water and glucose are filtered out and then passes through a tube.
2. All of the glucose, some of the ions and water is reabsorbed into the blood (selective reabsorption) depending on the bodies need
3. Urea, excess ions and excess water is released as urine



Blood is filtered going from the capillaries to the tubules from a high pressure to a low pressure.

Large proteins and blood cells are filtered out and unable to enter the tubules



Glucose concentration has not changed because it is reabsorbed back into the blood

Concentration of ions decreases because the kidneys filter out blood but reabsorbs it according to the body's needs

Concentration of urea falls to zero because the kidneys filter it out completely

We eat more proteins than needed for the body and this is broken down into amino acids which passes into the blood

The liver breaks down the excess amino acids and produces ammonia (deamination)

Ammonia is toxic so the liver converts it to urea which is then excreted

Maintaining the body's water balance:

Water levels fall in blood:

1. Pituitary gland releases ADH into bloodstream
2. ADH travels to kidneys
3. This causes kidney tubules to increase permeability so more water can pass through (more water can pass out the tubules)
4. More water is reabsorbed back into blood because of this less urine is produced
5. As blood levels go back to normal, pituitary gland stops releasing ADH

If blood becomes too dilute:

1. Pituitary gland stops releasing ADH
2. Less water is reabsorbed into the blood
3. More urine is produced
4. The concentration of water returns back to normal

If a person's kidneys fail then they can use a dialysis machine to adjust the concentration levels of water, ions and urea (kidney dialysis)

Kidney failure means higher concentration of water, ions and urea

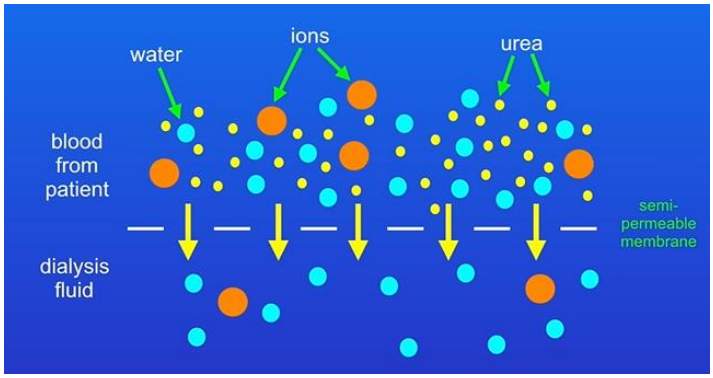
How kidney dialysis works:

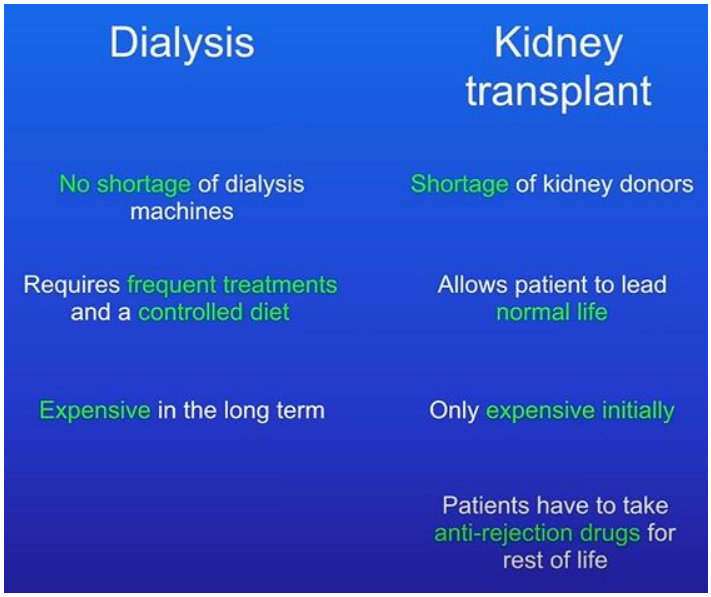
1. Blood passes over a semi permeable membrane. This allows urea, ions and water through but will not allow large molecules such as large proteins and blood cells
2. On the other side of the membrane, there is dialysis fluid

- Dialysis fluid contains normal concentrations of water and ions but does not contain any urea

3. Urea will diffuse from the blood into the dialysis fluid
4. Dialysis fluid is constantly refreshed which ensures there is a large concentration gradient of urea
5. Some of the water and ions will diffuse into the dialysis fluid
6. This will cause the concentration of water and ions to return to normal

- This is inconvenient because they have to visit the hospital several times a week
- They must also have a controlled diet otherwise too much urea will be produced
- They can have a kidney transplant. This means that the diseased kidney is replaced with a health kidney from the donor.
- Sometimes the healthy kidney may get rejected by the patients immune system



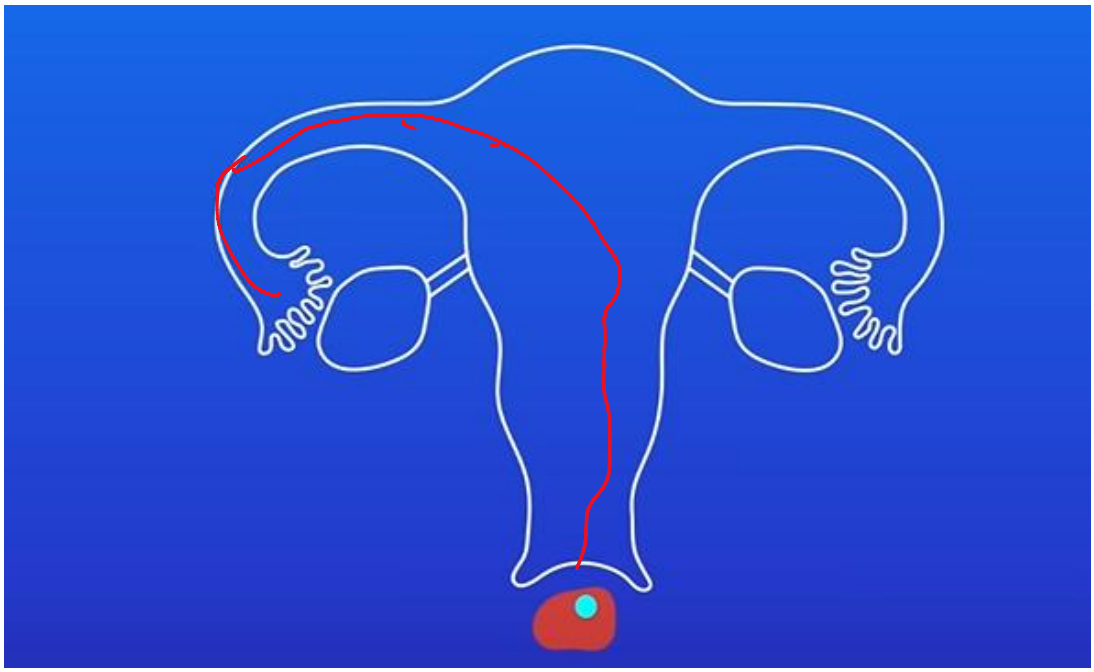


The menstrual cycle:

What happens during the menstrual cycle:

- Every 28 days, ovulation happens and this causes the uterus lining to become thick and spongy
- Egg makes it's way down the uterus
- If sperm is present, then the egg will become fertilised which will make it implant into the uterus wall and start pregnancy

- If the egg does not become fertilised then the egg and the uterus lining is released (period)



Key hormones during the menstrual cycle:

- Follicle stimulating hormone (FSH) causes the maturing of the egg in the ovary
- Luteinising hormone (LH) causes ovulation
- Oestrogen (produced in ovary) develops lining of uterus
- Progesterone maintains the lining of the uterus

How interaction happens between the hormones:

- FSH is released by the pituitary gland and travels in the blood to the ovaries which does the maturing of the egg and it also stimulates ovaries to make oestrogen

- Oestrogen causes lining of uterus to become thick and it also stops production of FSH
- The pituitary gland releases LH which triggers ovulation
- Ovary now produces progesterone which stops production of FSH and LH which prevents more eggs from maturing and being released
- Progesterone keeps lining of uterus thick incase fertilised egg implants and if fertilisation does not take place, then the level of progesterone falls

Contraception:

Oral contraceptive (chemical barrier):

- Contains hormones which prevent body from producing FSH
- Very effective
- Has to be taken every day
- Convenient
- It may also have side effects such as breast cancer or blood clots but there is very small chance
- Does not protect against STI

Implant, skin patch or injection (chemical barrier):

- Contains progesterone which stops eggs from maturing and stops ovulation
- These are more convenient
- May have side effects

- Does not protect against STIs

Condom or diaphragm (physical barrier):

- Prevents fertilisation
- Very effective
- No side effects
- Reduce risks of STIs for condoms but it may break or slip off
- More effective with spermicide gel

IUD (physical defence):

- Prevents implantation
- Highly effective
- Very few side effects
- Does not protect STIs

Sterlisation (surgical form of contraception) (physical barrier):

- Prevents egg from reaching uterus
- Stops sperm from leaving private part
- Very effective
- Very difficult to reverse

Abstain from sexual intercourse (natural contraception) during the time after ovulation:

- Hard to tell when a women has ovulated
- Does not protect against STIs

Some religions say it is unethical, they may say that it is their choice or they say that it stops STIs

Hormones to treat infertility:

One treatment to help women that find it hard to conceive is to give them FSH and LH (fertility drug). This increases ovulation and increases chance of becoming pregnant through intercourse.

IVF process:

1. Woman given FSH and LH which causes many eggs to mature
2. Eggs are collected from mother
3. Sperm from the father is collected and is used to fertilise eggs in a lab
4. Fertilised eggs develop into embryos
5. Once embryos become tiny balls, they are inserted into uterus which develops into fetus

IVF success rate is not high

IVF is emotionally stressful for both parents

IVF is physically demanding for the mother

IVF can lead to multiple births is risk for the mother and the baby

Not all embryos that are created are inserted into uterus, some are destroyed so people find it unethical

It is also expensive and some people think that the money is spent on other medical issues

Negative feedback:

During times of fear or stress, the adrenal glands produce the adrenaline

The adrenaline is released into the blood

Effects of adrenaline:

- Increased heart rate => More oxygen and glucose transported through blood to brain and muscles => Oxygen and glucose needed for aerobic respiration => Prepares body to fight or run away (called fight or flight)

Thyroid gland found in neck and released thyroxine

Effects of thyroxine:

- Stimulates the body's basal metabolic rate (sum of all reactions in a cell) – It makes chemical reactions take place at a faster rate
- Important for growth and development

Level of thyroxine is monitored by the brain

If level falls, pituitary gland releases TSH into bloodstream

TSH => Triggers thyroid gland to release more thyroxine into blood

This increase in thyroxine is detected by the brain and prevents pituitary gland from releasing more TSH

As TSH level falls, thyroid gland releases less thyroxine

Plant hormones:

Phototropism = Plant shoots grow towards the light

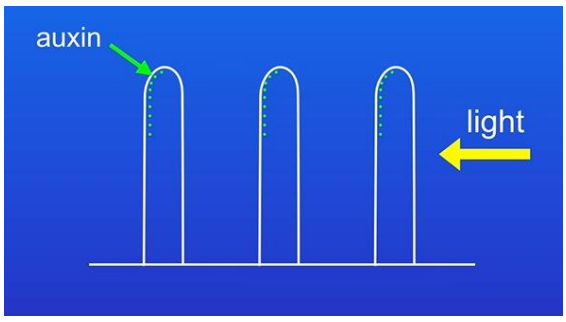
Scientists saw that the tip of the shoot grows towards the light so the cut them off and saw that auxin was being made in the tip of the shoot

Scientists put foil on the tip of the shoot and saw that it did not grow towards the light and concluded that the plants shoot is sensitive to light

Scientists put foil on the lower part of the plant and saw the shoot grow which showed that the lower part of the plant was not sensitive to sunlight

How shoots use auxin to grow towards the light:

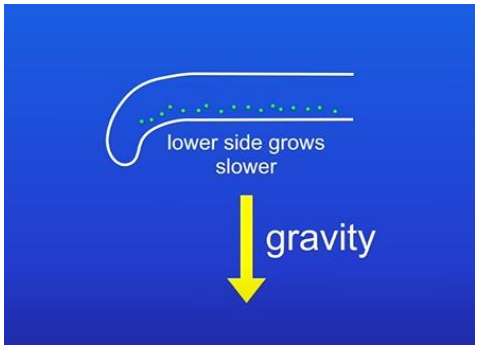
1. Auxin is produced at the tip of the shoot
- Auxin triggers cell growth
2. Light causes auxin to concentrate on the darker side of the shoot tip
3. Auxin spreads down the shoot
- Cells on the darker side grow faster than cells on the lighter side
4. This causes the shoot to grow towards the light



Gravitropism/Geotropism = Plants roots grow towards the force of gravity

How roots use auxin to grow towards ground:

1. Gravity causes auxin to concentrate on the lower side
- In roots, auxin inhibits cell growth
2. Lower side grows more slowly than the upper side
3. Causes roots to grow towards force gravity



Giberellins = Important hormone for starting germination of seeds

Ethene = Controls cell division and ripening of fruits

<u>Plant responses (required practical):</u>

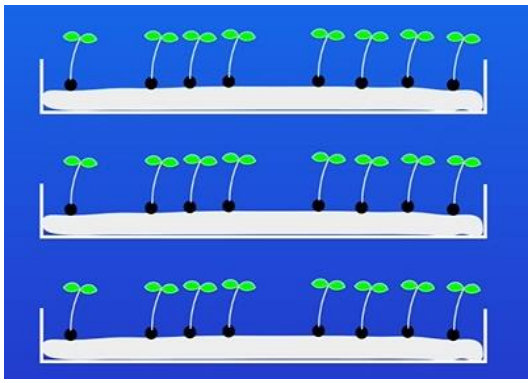
How to investigate the effect of light intensity:

1. First we place cotton wool in three petri dishes.
2. We then soak the cotton wool with equal volumes of water in the petri dish

3. Place ten mustard seeds in each petri dish
4. We leave it in a warm place and allow the seeds to germinate
5. We need to water the seeds every day with the same volume of water

- We need to make sure there is the same number of seedlings in each petri dish
- If some seeds have not germinated, then take them out and make all the petri dishes have equal seedlings

6. We need to measure the height of the seedling carefully without damaging the seedling
7. Place one dish in full sunlight
8. Place one dish in partial light
9. Place the last dish in darkness where there is no light
10. We then measure the height of each seedling for at least 5 consecutive days
11. Record the results in a table
12. Calculate a mean for the height of the seedling for each day and also draw diagrams



How to investigate gravitropism:

1. A dish of seedlings is placed on it’s side in the dark
- We can see the shoots grow against gravity whereas the roots grow towards the force of gravity

Uses of plant hormones:

Uses of auxin:

- Weedkillers
- Rooting powders for cut off plants
- Promoting growth in tissue culture

Uses of giberrelins:

- Used to end seed dormancy (force a seed to germinate earlier)
- Encourage plants to flower
- Make plants grow larger