Module 8: Non-infectious Diseases and Disorders

8.1: Homeostasis

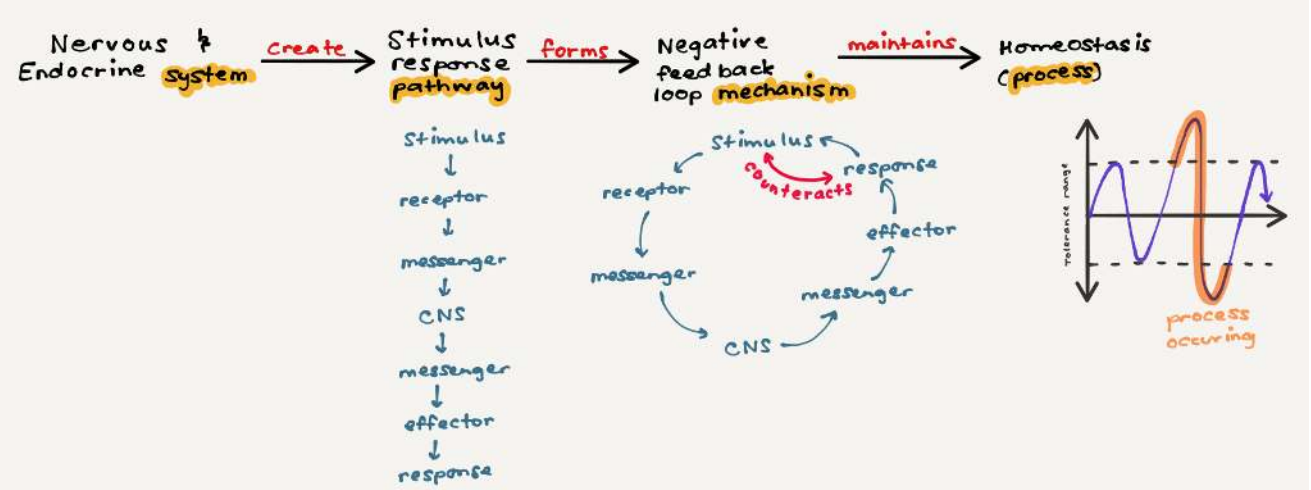
How is an organism's internal environment maintained in response to a changing external environment

Homeostasis: A process through which the internal environment of an organism is maintained within a tolerance range in response to a changing external environment.

Homeostasis is maintained due to a **negative feedback loop mechanism** which is a response where the body counteracts the change due to a stimulus.

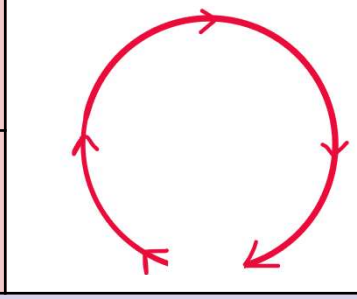
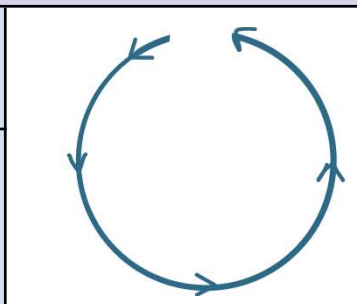
The NFLM occurs because of the **stimulus response pathway** created from the **nervous (and endocrine)** systems, which consists of:

Stimulus	A change in the external environment
Receptor	Detects change and converts into electrical impulses
Messenger	Sensory neurons which transmit impulses to CNS
Central nervous system	**Receives** and **processes** impulses **Transmits** electrical impulses for a response
Messenger	Motor neurons which transmit impulses to effector
Effector	Carry out a response
Response	Counteracts change from stimulus



[8.1.1] Negative feedback loops

TEMPERATURE REGULATION

Messenger: Sensory neurons	**CNS:** Cooling center of the hypothalamus	**Messenger:** Motor neurons
Receptor: Thermoreceptor		**Effectors** - Blood vessels - Sweat glands - Thyroid gland
Stimulus: Increase in body temp *due to* external heat increase		**Response:** Drop in body temp *if* the external heat is decrease
Normal body temp		
Stimulus: Decrease in body temp *due to* external heat decrease		**Reponse:** Increase in body temp *if* the external heat is increased
Receptor: Thermoreceptor		**Effectors** - Blood vessels - Muscles - Thyroid glands - Hairs
Messenger: Sensory neurons	**CNS:** Heating center of the hypothalamus	**Messenger:** Motor neurons

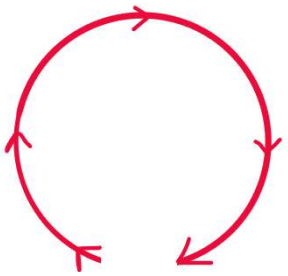
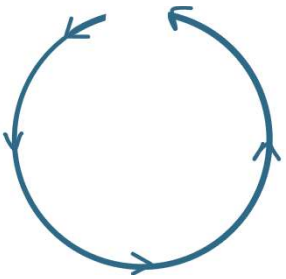
Effectors for cooling

Organ	Response	Effect
Blood vessels	Vasodilate, bringing more blood to the skin	Heat lost from skin increased
Sweat glands	Produced sweat is evaporated by heat from skin	Evaporative cooling
Thyroid gland	Drops thyroxine production	Metabolism in cells is reduced, less heat released

Effectors for heating

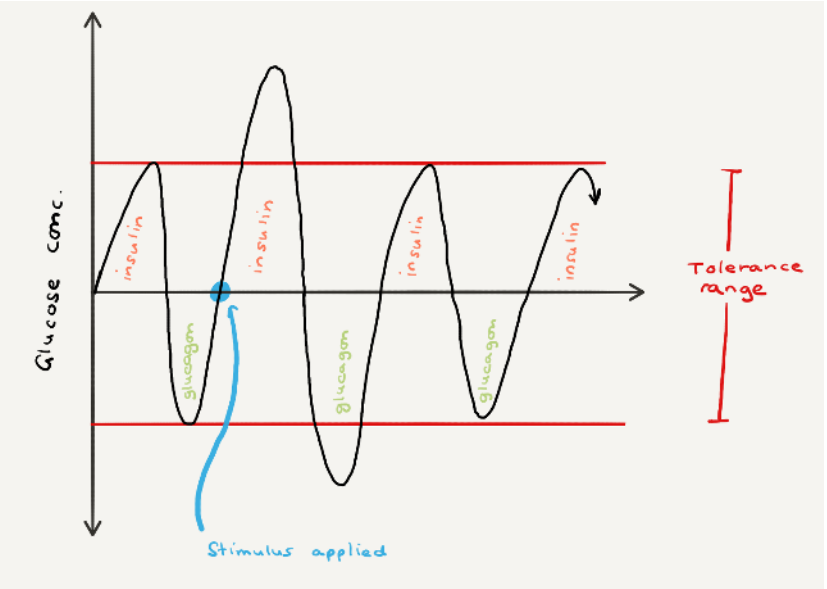
Organ	Response	Effect
Blood vessels	Vasocontract, bringing less blood to the skin	Heat loss from skin decreased
Muscles	Rapidly expand and contract	Shivering increases KE, to increase heat
Thyroid gland	Increases thyroxine production	Metabolism in cells increased, more heat released
Hair cells	Hairs stand up straight	A layer of air trapped around body, which insulates

BLOOD GLUCOSE REGULATION

<table>
<tr><td>Messenger:
Sensory neurons</td><td>CNS:
Hypothalamus</td><td>Messenger:
Motor neurons</td></tr>
<tr><td>Receptor:
Chemoreceptor</td><td rowspan="2">  </td><td>Effectors
Beta cells of the pancreas
↓
Release insulin
↓
Converts blood sugar into glycogen, which is stored in the liver</td></tr>
<tr><td>Stimulus:
Increase in blood glucose due to consumption of sugars/ carbohydrates</td><td>Response:
Blood sugar conc. decreases if consumption is stopped.</td></tr>
<tr><td colspan="3">Normal blood glucose concentration</td></tr>
<tr><td>Stimulus:
Decrease in blood glucose due to fasting period</td><td rowspan="2">  </td><td>Reponse:
Blood sugar conc. Increase if sugars/ carbs are consumed.</td></tr>
<tr><td>Receptor:
Chemoreceptor</td><td>Effectors
Alpha cells of pancreas
↓
Release glucagon
↓
Converts glycogen into glucose and releases into the blood</td></tr>
<tr><td>Messenger:
Sensory neurons</td><td>CNS:
Hypothalamus</td><td>Messenger:
Motor neuron</td></tr>
</table>

In homeostasis, the NFLM goes beyond the tolerance level in the other direction. Therefore, a **secondary loop** is required to stop the effectors in the initial response...
(eg. Stop the α-cells releasing glycogen to increase blood glucose once the initial reduction has been counteracted, and glucose levels are too high) ...so that conditions stay within the tolerance range.

These loops occur continuously in both ways, meaning that levels in the body are not constant, but fluctuate within a tolerance range.



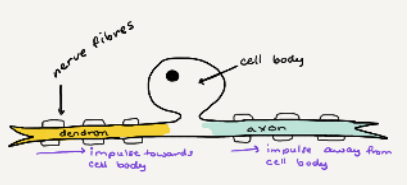
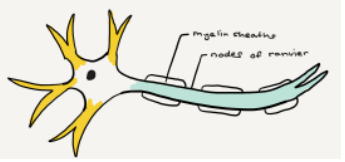
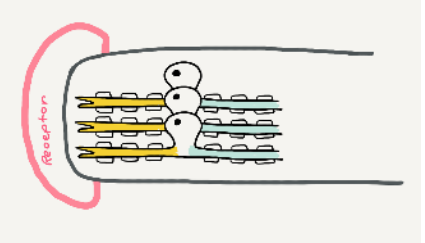
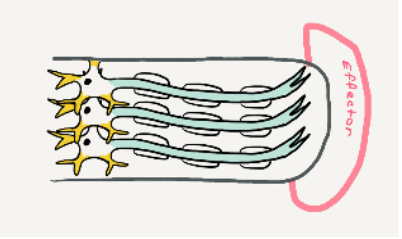
[8.1.2] Internal coordination systems

THE NERVOUS SYSTEM

The nervous system is made of the:

		Stimulus
Sensory division of peripheral nervous system	Sensory neurons connecting the receptor to the CNS	Receptor ↓ Messenger ↓
Central nervous system	Interneurons in brain and spinal cord.	Spine ↓ Brain ↓
Motor division of the PNS	Motor neurons connecting the CNS to the effector	Messenger ↓ Effector ↓
		Response

Neurons

	Sensory neuron	Interneuron	Motor neuron
Structure	One dendron One axon Myelin sheaths 	Many dendrites One axon No myelin sheaths 	Many dendrites One axon Myelin sheaths 
Location	PNS	Brain and spine (CNS)	PNS
Nerve formation	Many dendrons form the sensory nerve, which connects to a receptor 	/	Many axons form the motor nerve, which connects to an effector 
Transmission direction	Receptor → Spine → Brain → Spine → Effector		

TRANSMISSION PATHWAYS

The full transmission is electrochemical.

- Electrical thought the nerve fibres
- Chemical in the synaptic cleft

Electrical *(through the nerve)*

Positive Na^+ ions flow *out of* the nerve faster than positive K^+ ions move in

↓

Therefore, the inside of the nerve fibre is negative while the outside is positive. The nerve is polarised with a resting membrane potential of -70 mV

↓

A stimulus causes an impulse that the reverse of the ion flow, such that the nerve depolarises and its potential increases

↓

If the potential reaches/ surpasses the threshold potential (-55 mV), an action potential is triggered.

If it doesn't reach the TP, the impulse is not transmitted (all or nothing law)

↓

This causes a nerve impulse to be transmitted through the nerve fibre, either:

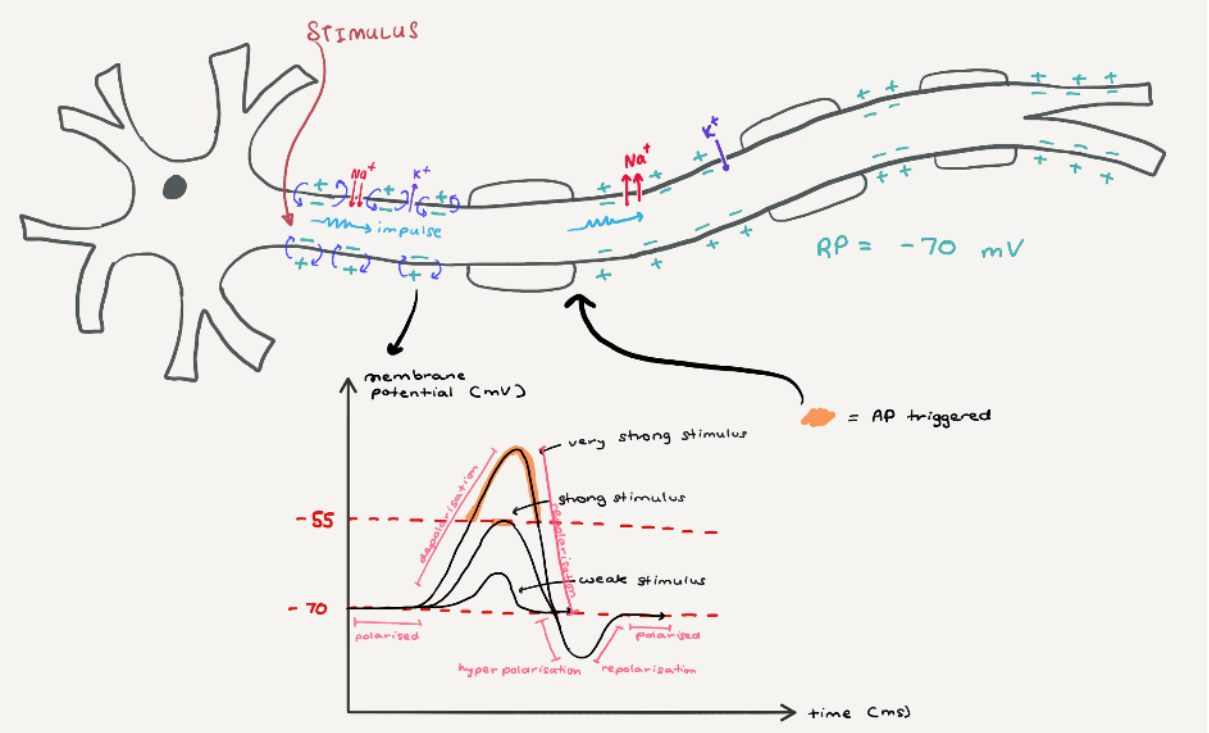
- Jumping between the nodes of ranvier in the sensory and motor neurons
- Continuously thought the interneurons

↓

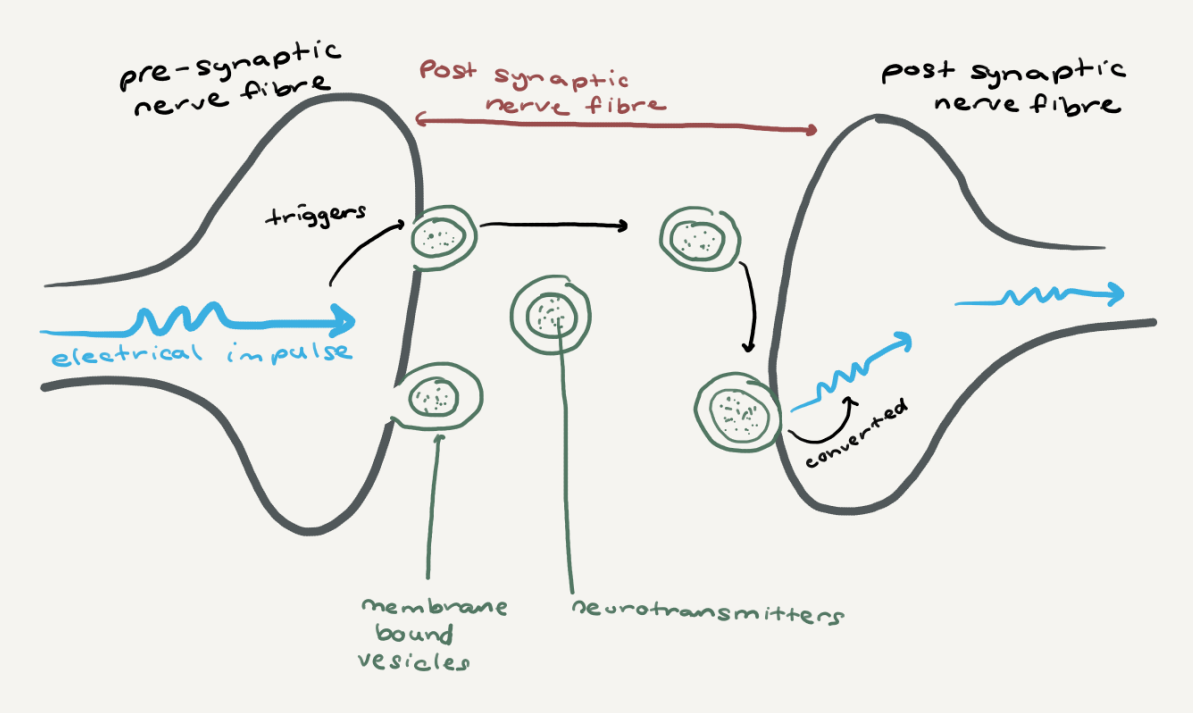
Once the AP has left a part of the nerve fibre, the ion flow returns to normal and it becomes repolarised (by homeostasis)

↓

Hyperpolarisation causes the voltage to become too low, before it returns to the normal RP



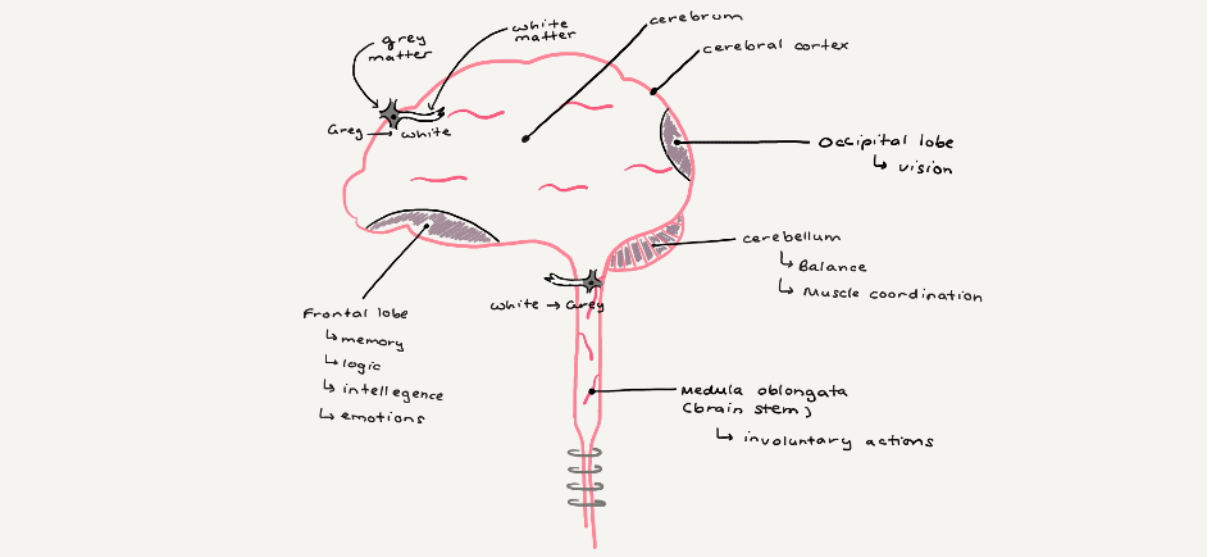
Chemical *(between nerve synapses)*



The electrical impulse in the pre-SNF triggers the production of vesicles containing neurotransmitters, which transmit the impulse as chemical messengers between the synaptic cleft.

These reach the post-SNF and are converted back into the electrical impulse.

THE BRAIN



THE ENDOCRINE SYSTEM

Glands and hormones from the endocrine system may be part of the effectors in the SRP, but the CNS still remains as the control center as the endocrine system is *controlled by* the nervous system.

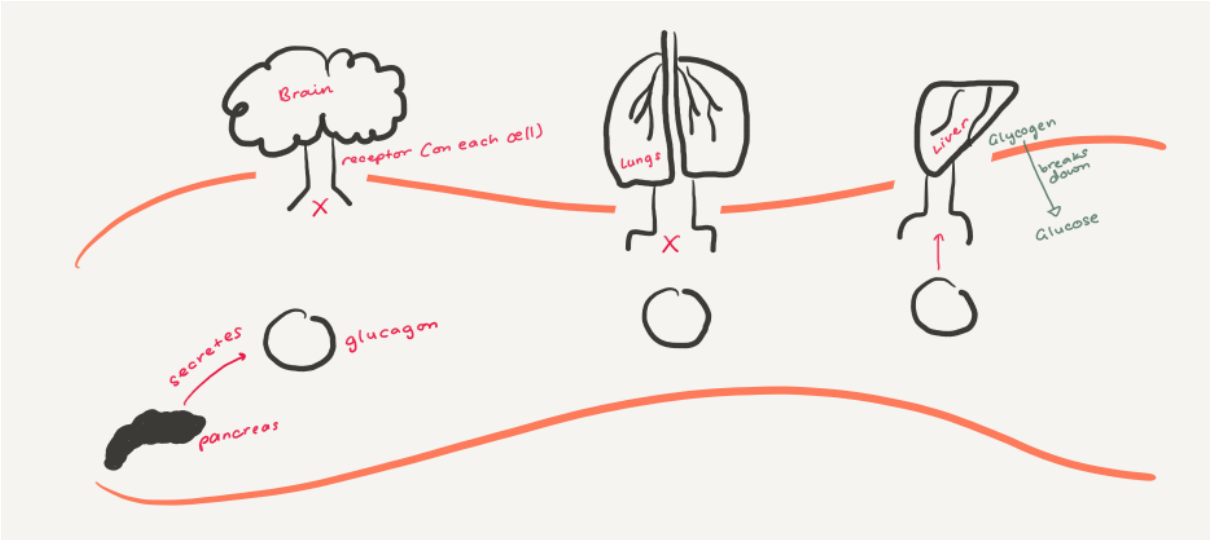
The hypothalamus holds the **pituitary gland** which is a master gland that:

(a) Triggers other endocrine glands to produce hormones (chemical messengers)
(b) Directly produces hormones

And these hormones can counteract a stimulus in the NFLM.

Gland	**Hormone**	**Function**
Thyroid gland	Thyroxin	Increases metabolism (to increase temp)
Pancreas (β cells)	Insulin	To convert glucose to glycogen (to decrease blood glucose conc.)
Pancreas (α cells)	Glucagon	To convert glycogen to glucose (to increase blood glucose conc.)
Adrenal gland	Aldosterone	Increase sodium reabsorption
Direct from pituitary	ADH	Increase water reabsorption

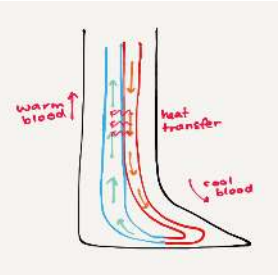
Hormones are released into the bloodstream and target cells/ tissues/ organs with a specific receptor.



[8.1.2] Mechanisms to maintain internal environment

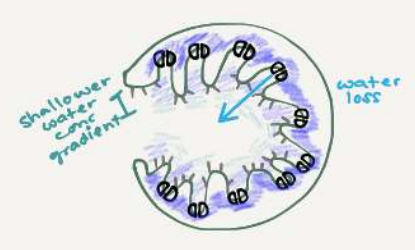
ADAPTATIONS IN ENDOTHERMS (animals which can regulate their body temp)

	Adaptation for hot environments	**Function**
S	Large, vascularised ears *Fennec fox, Elephants*	Large SA where blood can be transported, so heat is lost
S	Large SA: V ratio *Bilby*	Large SA for heat loss
P	Vasodilation *Fennec fox*	Increased blood flow towards skin for heat loss
P&B	Aestivation *Biliby*	Burrows and lays dormant underground, to escape surface conditions
B	Nocturnal *Biliby*	Permanently hunts at night to avoid heat in day
B	Panting *Dogs*	Evaporative cooling by evaporating saliva

	Adaptation for cold environments	**Function**
S	Insulation *Whale blubber, yak fur*	Prevents heat loss through skin
S	Low SA: V ratio *Orcas*	Lower SA for heat loss
P	Vasoconstriction *Arctic fox*	Reduced blood flow to skin for heat loss
P	Countercurrent mechanism *Orcas, penguins* 	Blood in the arteries approaching extremities heats the blood in the parallel veins leaving extremities. Leads to less heat loss in extremities, and more heat transported into the body.
B	Migration *Birds, whales*	Movement to warmer areas in winter
B	Huddling *Bats*	Sharing generated body heat in groups

ADAPTATIONS IN XEROPHYTIC PLANTS

For plants that live in hot environments, there must be a balance between water conservation and temperature regulation. ($Water\ conservation \propto \frac{1}{temperature\ regulation}$).

Adaptation	Function
Low leaf SA	Lowers SA for transpiration, therefore lowers water loss
Leaf hair & sunken stomata 	Captures a layer of air which shallows the water conc. gradient inside and outside the leaf, reducing rate of water loss
Vertically-hanging leaves & Leaf curling	Reduces sunlight exposure, lowering transpiration rate
Thick, waxy cuticle	Reflects sunlight, lowering heat exposure to lower transpiration rate
Evaporative cooling	When heat increases, transpiration increases to cool the plant ↓ Water loss, reducing osmotic pressure ↓ Stomates close and the plant wilts ↓ Reduces SA exposed to sunlight ↓ Lowers transpiration rate and water loss

8.2: Causes and Effects

Do non-infectious diseases and disorders cause more deaths than infectious diseases?

YES, because:

- Infectious diseases have a shorter prevalence
- Infectious diseases have known pathogens, meaning it is easier to develop treatment and prevention methods
- Non-infectious diseases are harder to treat, so there is a greater emphasis on prevention
- Most non-infectious diseases impact multiple organs

The top causes of death globally are from non-infectious disease:

1. Ischaemic heart disease (12%)
2. Dementia (9%)
3. Diabetes (2.9%)
4. Colon cancer (2.8%)

GENETIC DISEASE

Disease caused by mutations to the genome.

Eg1. Down's syndrome

Cause	Trisomy 21 due to nondisjunction of 21st pair in metaphase II of meiosis.
Effects	- Delayed development - Small face with folds of fat under the eyes - Mental retardedness
Treatment	/

Eg2. Cystic fibrosis

Cause	Point mutation (deletion) in CFTR gene of chromosome 7
Effects	Mucous lining all systems with external openings becomes thick and sticky. This causes the systems to become blocked, which has multiple effects:

Respiratory	Prevents pathogens caught being expelled, allows them to grow in the mucous and cause respiratory infection
Digestive	Prevents nutrient absorption and expulsion of feces
Reproductive	Infertility

Treatment	Gene therapy to remove the mutated gene and replace it with a healthy one.

NUTRITIONAL DISEASE

Diseases caused by:

- Undernutrition: Lack of nutrient intake
- Overnutrition: Too much nutrient intake
- Malnutrition: Imbalance in nutrient intake

Eg1. Scurvy

Cause	Lack of vitamin C in diet
Effects	Vitamin C is used to strengthen connective tissue in joints and gums. Deficiency causes weakening of this tissue, leading to: - Joint and gum pain - Cracks and bleeding in gums which allows for pathogen entry
Treatment	Vitamin C increase in diet

Eg2. Obesity

Cause	Over-intake of calories
Effects	Excess body fat which increases risk of heart disease, hypertension and stroke
Treatment	Consuming a low fat and sugar diet

Eg3. Kwashiorkor disease

Cause	Over-intake of carbohydrates and under-intake of proteins
Effects	Very skinny except for the stomach region, which is swollen due to fluid retention
Treatment	Gradual increase of proteins in diet

ENVIRONMENTAL DISEASE

Disease caused by mutagens in the natural environment or immediate society.

Eg1. Melanoma (skin cancer)

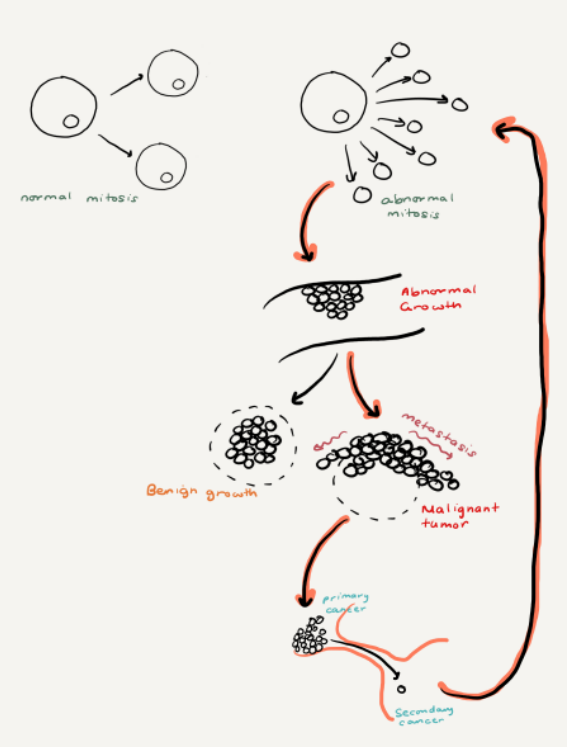
Cause	Malignant growth of pigment cells due to high UV exposure.
Effects	Cancerous growth on skin, and secondary cancers if mutated cells enter the bloodstream.
Treatment	- Surgical removal of elevated skin patch - Chemotherapy or radiation therapy - Constant monitoring for re-emission

Eg2. Lung cancer

Cause	Malignant growth of lung cells due to carcinogens in cigarette smoke.
Effects	Cancerous growth in lungs, and secondary cancers if mutated cells enter the bloodstream.
Treatment	- Chemotherapy - Radiotherapy - Surgical removal of part of lung

CANCER

Process

Uncontrollable and abnormal mitosis occurs	
Differentiation & specialisation can't occur in these mutated cells, meaning that growths form instead of tissue The growths: - Over-consume nutrients - Block systems	
These growths can be: (1) Benign Occurs within a limit, and doesn't cause health impacts (2) Malignant Growth has no limits, and causes health impacts	
Malignant growths are called tumors. They spread by metastasis.	
If cancer cells enter the bloodstream, they can establish in other areas and cause secondary cancers.	

Genes involved in cancer

Proto-oncogenes	Genes which have a high susceptibility to mutate into genes which cause cancer (oncogenes)
Tumor-suppressor genes	Codes for proteins which suppress rapid cell division
DNA repair genes	Repair the incorrect sequence in oncogenes

Eg. Breast cancer

Mutated P10 gene: Mutation in a gene that regulates mitosis in breast cells, and can cause breast cancer.

Mutated BRCA1 &2 genes: Mutation in tumor-suppressor cells, which increase breast cancer *susceptibility* as they can not suppress growths if P10 mutates.

8.3: Epidemiology

Why are epidemiological studies used?

To **collect and analyse relevant data** to look for **trends and patterns** to establish the **cause-and-effect relationship** between a factor and a disease.

Stage	Process	
Descriptive study	Relevant data is identified and collected	Identifies relevant data to be collected ↓ Target group identified, which needs to be reflective of the whole population by being *wide-spread* - Equal age and gender distributions - Many ethnicities - Large no. of people ↓ Target group split into 2 groups: 1. Experimental (*impacted by factor/ disease*) 2. Control (*not impacted by factor/ disease*) ↓ Both groups are asked questions about: - Family history - Age of onset - Lifestyle - Environment - Socioeconomic status - Ethnicity
Analytical study	Analyse data to find trends and patterns to find a potential causation factor	Data is graphed and trends & patterns are identified ↓ A potential cause is identified based on similarities and differences between the control and experimental groups ↓ A formal report is written, peer-reviewed and published
	An external group will implement prevention/ treatment strategies depending on the trend.	A strategist will use this relationship to create management strategies (prevention, treatment, control) targeting that cause in the experimental group
Interventional study	Epidemiologist restarts w/ a descriptive study to see if addressing the factor has led to any change. If it has, then it may be a causation	Incidence, prevalence and mortality rate data are collected after the intervention ↓ Descriptive study re-conducted to see if the cause-effect relationship was accurate ↓ If incidence/ prevalence/ mortality rate in the experimental group is reduced, then the factor may be a cause

CASE STUDY: Lung cancer study

Two large groups were selected:

1. Individuals who didn't have lung cancer but were smokers (experimental)
2. Individuals who had lung cancer but were not smokers (cause)

And observed for 10 years for the progression of lung cancer cases.

While lung cancer *prevalence* was higher in group 2, the *incidence* was higher in group 1. This indicated that smoking was a potential cause of lung cancer.

Evaluation of method	**Benefits of epidemiology**
• Valid and reliable, due to the large wide-spread groups and the use of a control • Random error due to random inconsistencies in environment and patient condition • Systematic error due to biases in group (non-reflective of population)	• Prediction of general disease trends • Identifies potential cause so specific management strategies can be implemented • Increases public awareness of disease • Shows distribution of disease between groups, indicating where strategies need to be targeted

8.4: Prevention

How can non-infectious diseases be prevented

- Public health campaigns
- Genetic engineering

PUBLIC HEALTH CAMPAIGNS

Raises public awareness of a disease and encourages:

- Early screening
- Avoidance of areas/ practises of risk
- Personal protection and control strategies

Eg. 'QUIT' encouraging giving up smoking to reduce risk of lung cancer
'Slip, slop, slap' giving advice on sun protection to reduce risk of melanoma

GENETIC ENGINEERING

To alter the genotype of a species so it is no longer susceptible to the mutation causing a specific disease.

- Vaccines to prevent viral-induced cancers
- Embryo screening to detect mutations
- Gene therapy and CRISPR to remove (and replace) defective genes
- Transgenic rice high in vitamin A prevents onset of vision defects

Benefits of prevention	**Effectiveness of prevention**
- Stops disease from occuring to reduce patient suffering - Less cost to family and community - Better use of health resources	- Depends on the type - Relies on public compliance or patient willingness - Genetic engineering may introduce side effects or ethical issues - Can be very effective if followed correctly

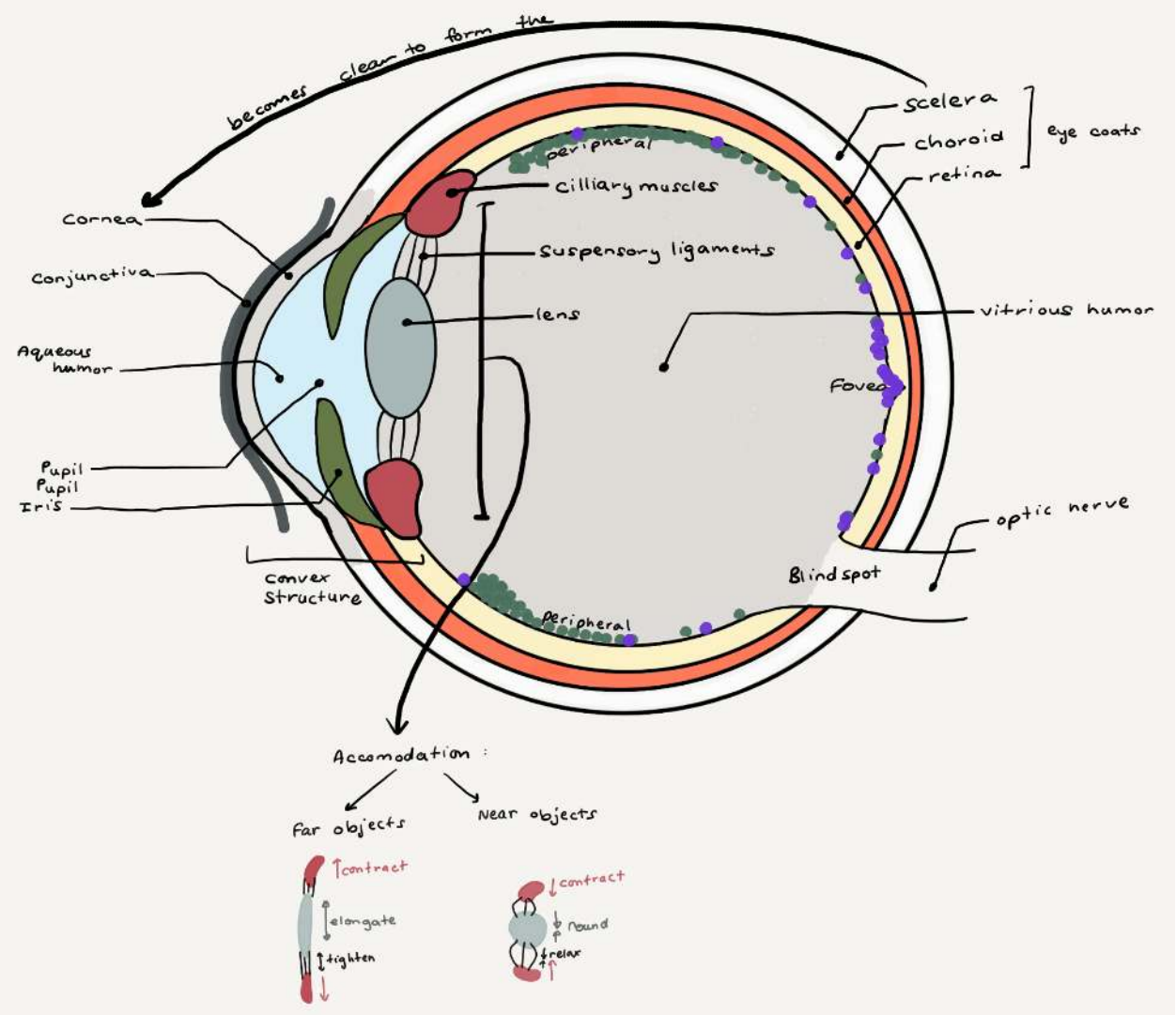
8.5: Technologies and Disorders

How can technologies be used to assist people who experience disorders?

By mimicking the biological process failing to occur in the defective organ.

THE EYE

Structure and function



<table>
<tr><th>Part</th><th>Function</th></tr>
<tr><td>Sclera</td><td>White outer covering which provides protection, maintains shape and prevents light from leaving.</td></tr>
<tr><td>Choroid</td><td>Highly vascularised middle coat which provides nutrients to the eye.</td></tr>
<tr><td>Retina</td><td>Inner layer which contains photoreceptors (rods and cones)
<table>
<tr><th>Rods</th><th>Cones</th></tr>
<tr><td> 

Highly sensitive to light therefore primary light detectors.

Black and white vision.

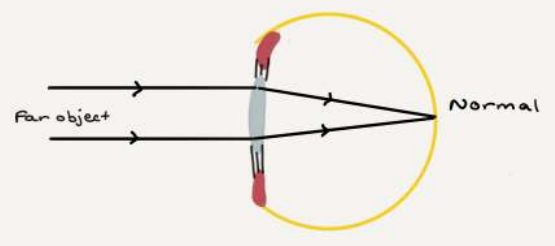
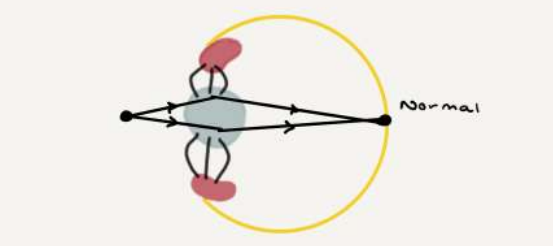
Most concentrated in the periphery with none in the fovea and or blind spot.</td><td> 

Less sensitive secondary light detectors.

Colour vision.

Most concentrated in the fovea with very few in the periphery and none in the blind spot.</td></tr>
</table></td></tr>
<tr><td>Optic nerve</td><td>Sensory nerve which transmits the image to the brain via electrochemical impulses.</td></tr>
<tr><td>Blind spot</td><td>The spot on the retina where the optic nerve penetrates. No photoreceptors here.</td></tr>
<tr><td>Fovea</td><td>A dip in the retina where the cones are concentrated. The clearest image is produced when light is incident on the retina.</td></tr>
<tr><td>Pupil</td><td>A hole which allows light to enter.</td></tr>
<tr><td>Iris</td><td>A pigmented muscle around the pupil which contracts and expands to regulate light entering, either:
a. Expanding to increase entry in dim environments (to increase clarity)
b. Contracting to decrease entry in bright environments (to prevent eye damage)</td></tr>
<tr><td>Cornea</td><td>A clear part of the sclera which covers and protects the eye while still allowing light to pass through.
Also 1st point of refraction.</td></tr>
<tr><td>Conjunctiva</td><td>A clear tissue which covers the cornea to protect it and prevent pathogen entry.</td></tr>
<tr><td>Aqueous humor</td><td>The watery fluid between the cornea and lens. Maintains pressure and provides some refraction.</td></tr>
<tr><td>Vitreous humor</td><td>The jelly-like fluid between the lens and the reina which maintains shape and pressure, moisturises the interior eye and provides nutrients to the parts not directly connected to the choroid.</td></tr>
</table>

<table>
<tr><td>Ciliary muscles</td><td>Contract away from the lens
↓</td><td>Contract towards the lens
↓</td></tr>
<tr><td>Suspensory ligaments</td><td>Tighten
↓</td><td>Relax
↓</td></tr>
<tr><td rowspan="3">Lens

(living cells held in the lens capsule)</td><td>Stretched to an elongated shape
↓</td><td>Lens returns to its natural, rounded shape.
↓</td></tr>
<tr><td colspan="2">The lens is the second major refractive sight. It can change its shape and therefore refractive power so that light from any distance can be focused.</td></tr>
<tr><td colspan="2"><table>
<tr><th><u>Far vision</u></th><th><u>Near vision</u></th></tr>
<tr><td>The elongated lens has lower refractive power
↓
Bends parallel light rays from far objects less
↓
Focused on retina for clear vision
  </td><td>The rounded lens has higher refractive power
↓
Bends diverging light rays from near objects more
↓
Focused on retina for clear vision
  </td></tr>
</table></td></tr>
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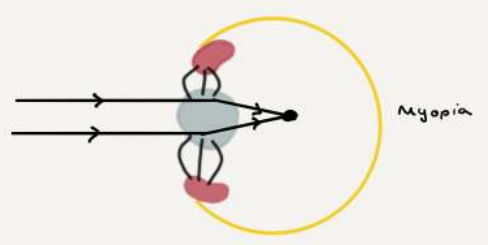
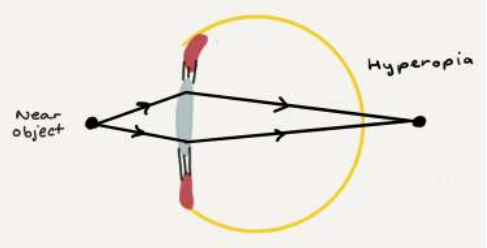
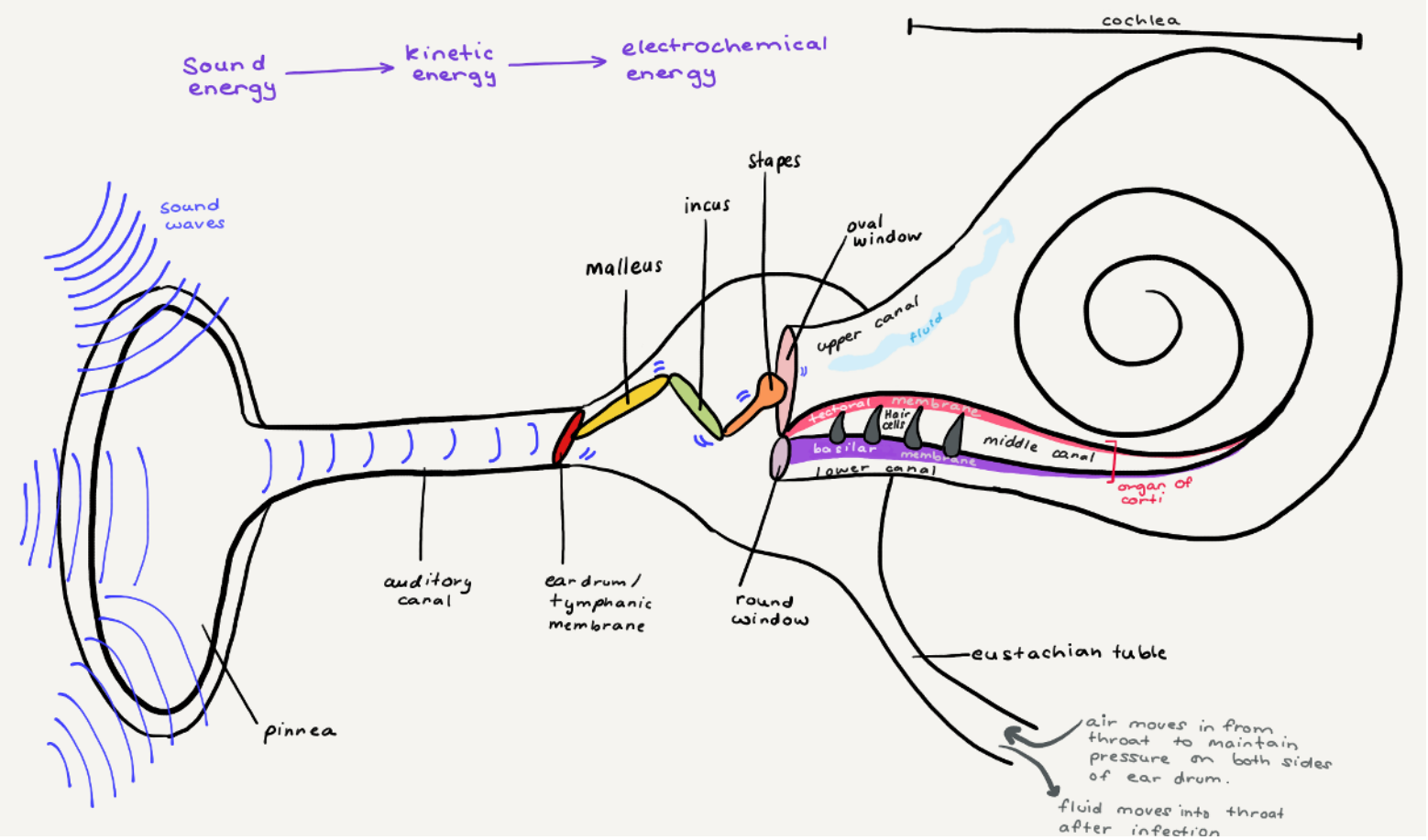
Disorders

Name	Cause	Treatment
Myopia	- Lens too rounded - Eyeball too long Light from far objects is focused before the retina. Far vision is unclear.  	A **concave** lens in front of the eye to diverge rays before they enter. When the lens converges, the net refraction is enough to focus on the retina.
Hyperopia	- Lens too elongated - Eyeball too short Light from close objects is focused after the retina. Near vision is unclear.  	A **convex** lens in front of the eye to converge rays before they enter. The total refractive power is increased so the light can focus on the retina. ✅ No surgery required, meaning no risk of infection ✅ Can be replaced if the condition progresses ❌Constantly have to wear glasses to be effective ❌Very strong lenses can cause bending on the edges of vision as well as headaches.
Cataracts	Lens cells die and protein accumulates, leading to cloudiness in the eye. - Long UV exposure - Age Prevents light from entering, stopping clear vision.	Phacoemulsification. A laser breaks down the lens into small pieces and a probe cleans out the lens capsule and inserts a plastic bionic lens. ✅ Permanent fix to disorder ✅ Efficient surgery with minimal pain and fast recovery time ❌Bionic lens can not accommodate like a normal lens, meaning glasses are required ❌Risk of infection or debris entering eye during surgery

THE EAR

Structure and function



Outer ear

1. Pinna collects the sound and funnels it into the auditory canal.

Middle ear

1. Sound waves hit the tympanic membrane, which causes it to vibrate.
2. The vibration is transmitted through the ear ossicles (malleus, incus, stapes) which are attached at lever-like angles to amplify the vibration.
3. The vibration is transmitted to the elliptical window.

Inner ear

1. Fluid moves through the upper canal and pushes down on the tectorial membrane
2. It then moves into the lower canal and pushes up on the basilar membrane. The circular window stops fluid leaving
3. Hair cells in the middle canal are moved side to side. Hair cells are sound receptors, and convert the kinetic energy into electrical impulses
4. These transmit through the auditory nerve and the brain interprets it as sound

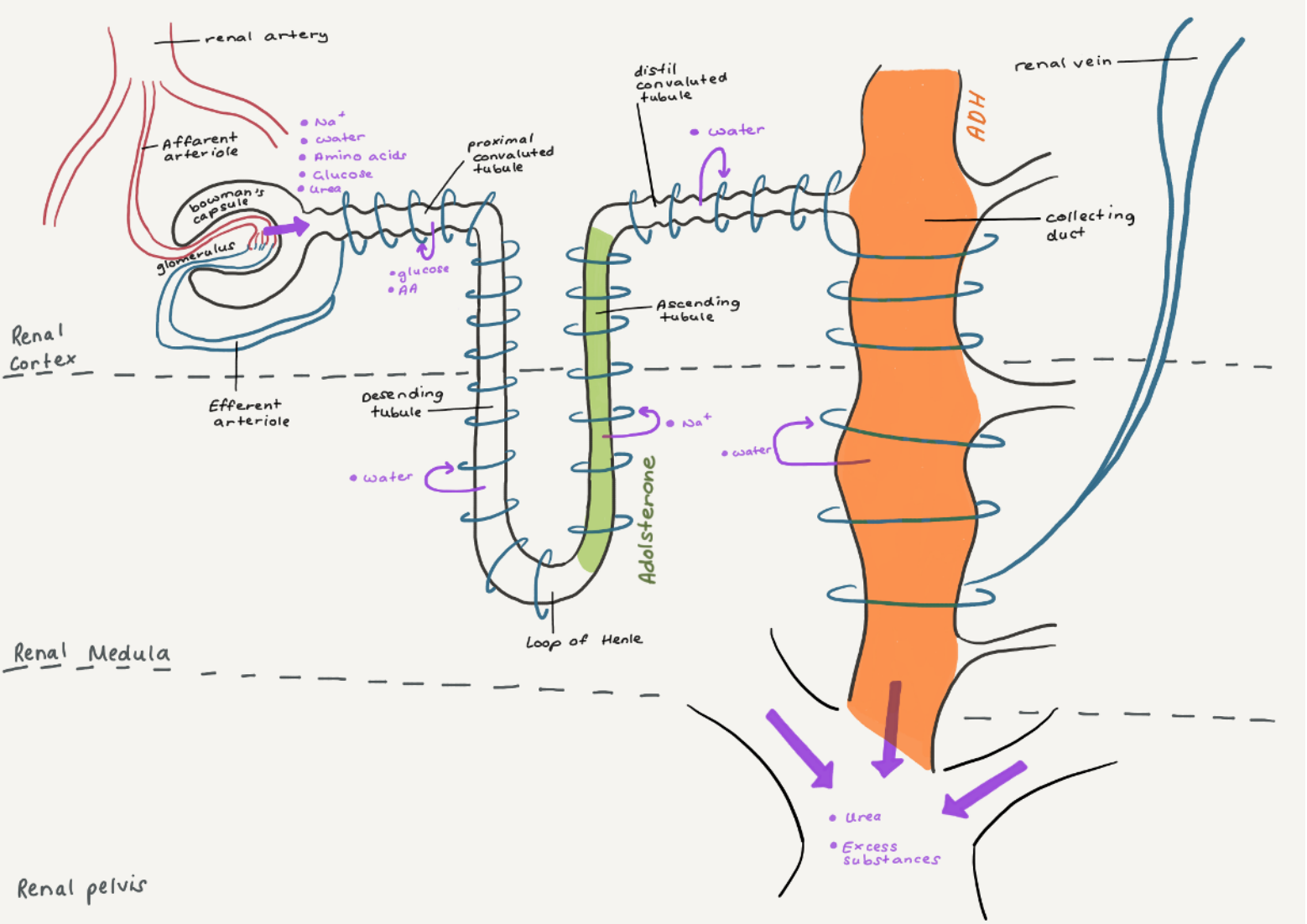
Technologies

	Hearing aid	**Cochlear implant**	**Bone conduction implants**
Disorder	Conductive hearing loss - Outer ear - Middle ear	Sensorineural hearing loss - Inner ear damage	Conductive hearing loss - Middle ear
Position	External ear behind or within folds of pinnia.	Inside skull, near auditory nerve.	Part outside the skull and part inside it
Components & function	Microphone picks up sound. ↓ Amplifier increases sound energy. ↓ Earphone transmits into auditory canal.	Microphone picks up sound. ↓ Speech processor converts into digital display. ↓ Electrode surgically implanted near auditory nerve to stimulate electrical impulses.	Sound processor detects soundwaves and converts into vibrations. ↓ Internal implant transmits vibrations through bone into the inner ear ↓ Hair cells stimulated as normal
Energy transformations Normal path Altered path	Sound ↓ Electrical ↓ Sound ↓ Mechanical ↓ Electrochemical	Sound ↓ Electrical ↓ Electrochemical	Sound ↓ Mechanical ↓ Electrochemical
Advantages	✅ Non-invasive ✅ No side effects ✅ Cosmetically acceptable ✅ Relatively inexpensive	✅ Fixes total deafness ✅ Gives normal hearing range ✅ Wider range than hearing aids ✅ Expensive	
Limitations	❌ Can not restore hearing, only manage hearing loss ❌ Amplifies all sounds ❌ Limited range ❌ Can't manage inner ear damage	❌ Invasive ❌ Requires surgery which leads to side effects ❌ High cost ❌ Amplifies background noise ❌ Effectiveness decreases if surgery is done after 5 years of age	

THE KIDNEY

Structure and function

The functional unit of the kidneys is the nephron. The nephron filters and reabsorbs so that the kidneys can excrete and osmoregulate.



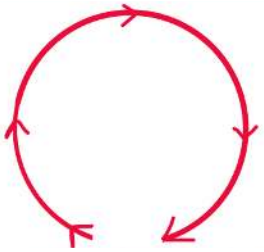
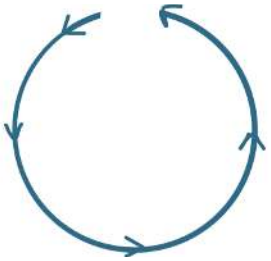
Blood enters the kidney through the renal artery (afferent arteriole → capillaries in glomerulus) and micromolecules diffuse into the tubule.

The glomerulus becomes the efferent arteriole which branches into another network of capillaries which surround the tubules.

Reabsorption of micromolecules occurs at different parts of the nephron. Capillaries converge into renal vein and clean blood is returned to the body.

Excess substances not reabsorbed and urea mix with water to form urine. Urine moves through the ureter → urinary bladder → urethra and is excreted.

Homeostatic process for osmoregulation

<table>
<tr><td>Messenger:
Sensory neurons</td><td>CNS:
Hypothalamus</td><td colspan="2">Messenger:
Motor neuron</td></tr>
<tr><td>Receptor:
Chemoreceptor</td><td rowspan="2">  </td><td>Effectors:
Pituitary gland</td><td>Adrenal gland</td></tr>
<tr><td>Stimulus:
Decrease in water conc/ increase in salt conc due to dehydration</td><td>Response:
Secretes ADH
↓
Increases water reabsorption in collecting duct</td><td>Secretes aldosterone
↓
Increases Na^+ reabsorption in ascending loop to maintain conc. gradient</td></tr>
<tr><td colspan="4">Normal salt-water balance in body</td></tr>
<tr><td>Stimulus:
Increase in water conc/ decrease in salt conc due to overhydration</td><td rowspan="2">  </td><td>Reponse:
Decreases ADH secretion
↓
Reduces water reabsorption in collecting duct</td><td>Decreases aldosterone secretion
↓
Decreases Na^+ reabsorption in ascending loop to shallow conc. gradient</td></tr>
<tr><td>Receptor:
Chemoreceptor</td><td>Effectors:
Pituitary gland</td><td>Adrenal gland</td></tr>
<tr><td>Messenger:
Sensory neurons</td><td>CNS:
Hypothalamus</td><td colspan="2">Messenger:
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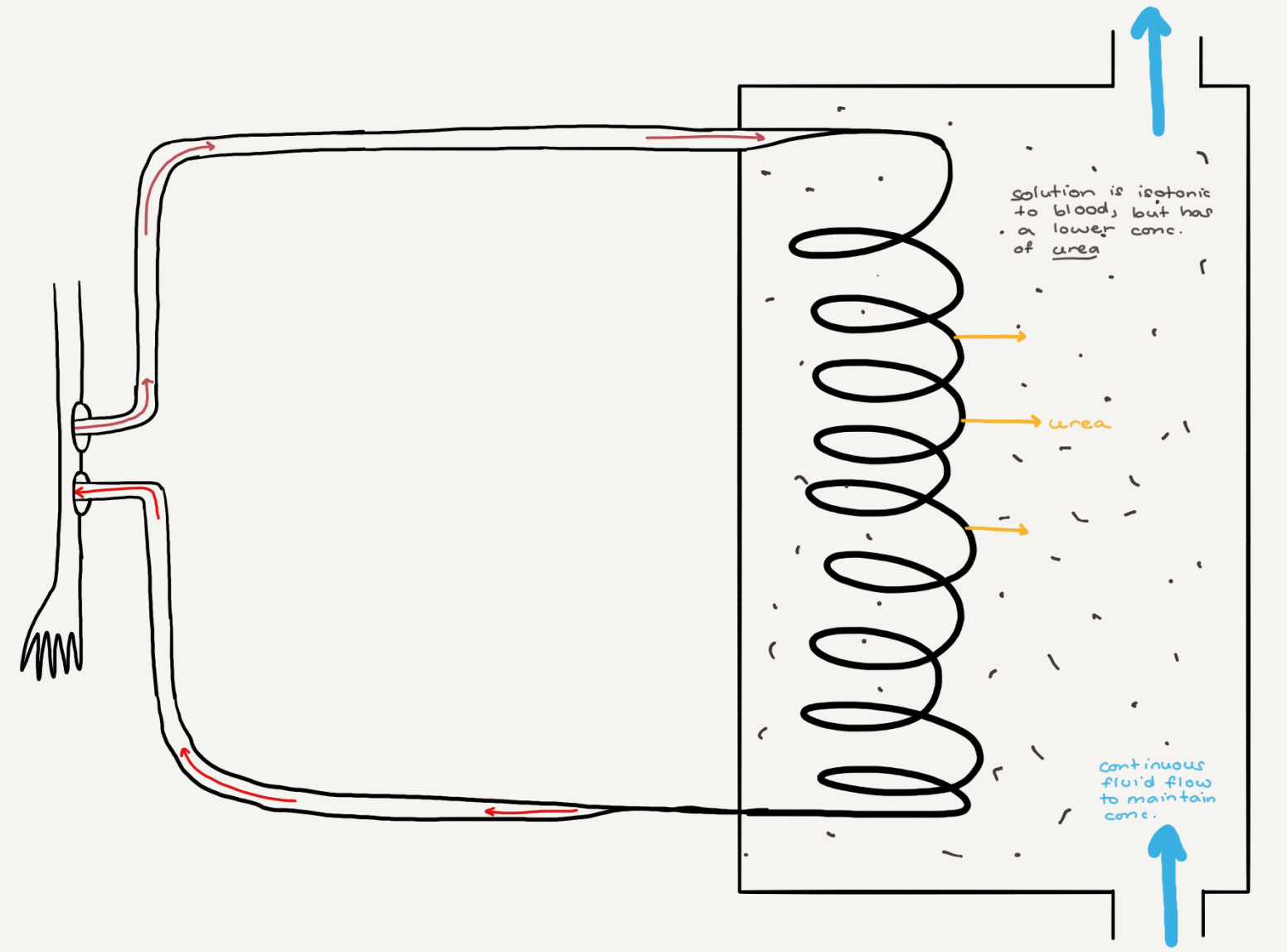
</table>

Renal dialysis



SOCIETAL IMPACTS

All technologies used to treat disorders are based on a natural process.

The societal impact of a technology depends on how much it increases a patient's independence and quality of life.

Disorder	Technology	Societal impact
Cataract blindness (vision)	Phacoemulsification	Very positive ✅ Very safe ✅ Fast recovery time ✅ Restores vision to give patient independence
Conductive hearing loss	Hearing aids	Somewhat positive ✅ Cosmetically acceptable, which increases QOL by preventing standing out ❌ Picks up background noises ❌ Low hearing range, prevents full independence ❌ Not a permanent solution rather a management strategy
Sensorineural hearing loss	Cochlear implants	Somewhat positive ✅ Independence and QOL by giving hearing to totally deaf people, across a normal human range ❌ Side effects (eg. infection) due to surgery ❌ Expensive ❌ Fully effective if implanted before 5 years of age
Kidney failure	Renal dialysis	Neutral ● Only provides management to prevent blood toxicity until a transplant occurs ❌ Have to revisit the hospital at increasingly frequent intervals ❌Time consuming and uncomfortable, lowers QOL ❌ Increases patient dependence ❌ Can only regulate urea levels, not other substances. Osmoregulation doesn't occur, so the patient must be put on a low-salt diet