HSC Biology Module 8: Non-infectious Disease and Disorders

HSC is a marathon not a sprint and you're nearly there!!
I thought my notes were only ever going to be seen by my eyes only so my apologies for the messiness! :^

Textbook pdfs:
https://drive.google.com/drive/folders/1g1mSUMuHUf_1-gft4MX7QfEJKDfgkeUk?usp=sharing

P.S Dr Col Harrison Biology playlists saved my life! Find them on Youtube :)

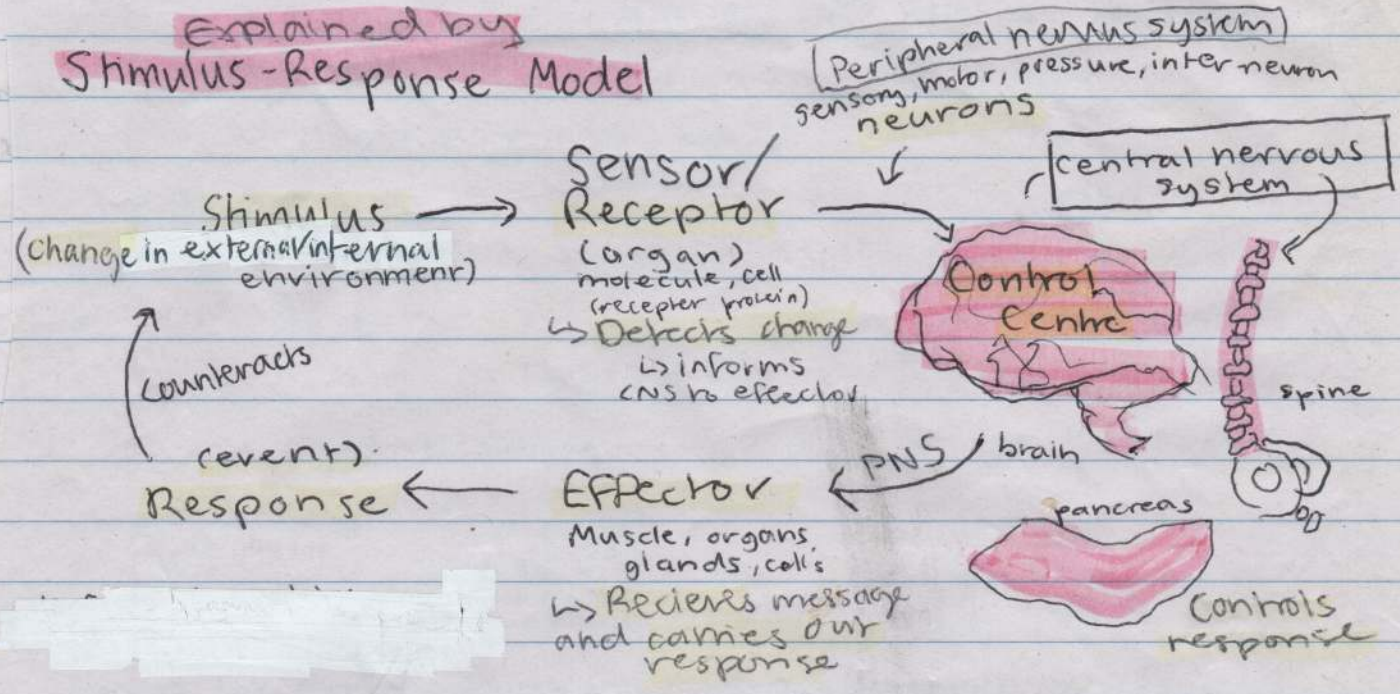
Homeostasis - Edrolo video

Internal environment: fluids internal to the organism external to the cells.

- blood plasma
  - ↳ [i.e.] of the red blood cells
- tissue fluid ↘ liver
- cerebrospinal fluid (CSF) ↓ nerve cells

Explained by

Stimulus-Response Model



Direct negation of original stimulus/event.

- Maintenance of homeostasis - narrow limits

Temperature Regulation: - Termoregulation

- constantly measured by hypothalamus.
- physiological (metabolic rate, sweat, shivering, body uncons.)
- behavioural (feel like doing something)
- e.g of 'narrow limits' 3°C +, life-threatening
  - ↳ enzyme activity

Glucose Regulation

- Achieved Hrough

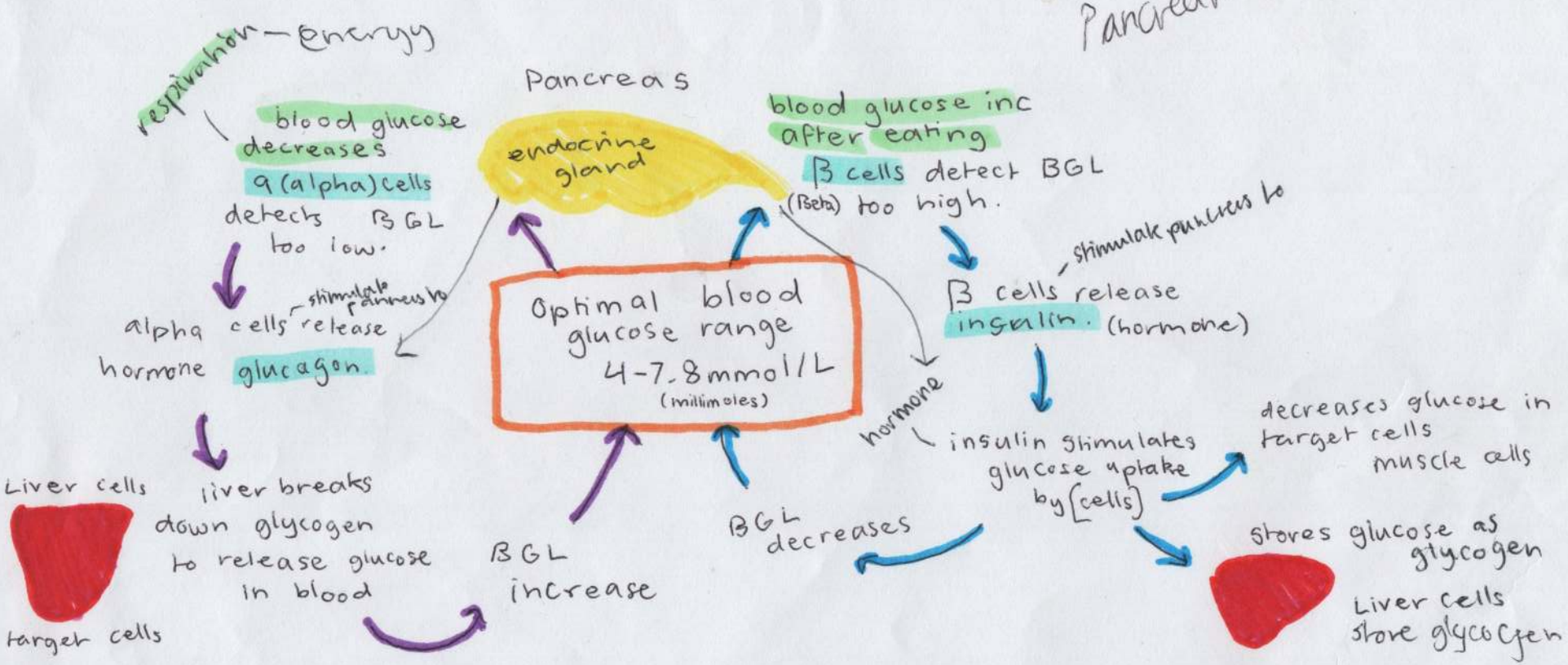
Beta Cells • insulin → Absorbs glucose (liver + muscle) ↓

Alpha cells • glucagon → Release glucose from glycogen (liver) ↑

Negative Feedback Loop

Blood Glucose Regulation

Pancreatic α/β cells



Homeothermy - Homeostasis of Temperature

Homeothermic:
Animals that keep their body temp within narrow limits despite external temperature. (Mammals, birds → endotherm)

Structural adaptations

- Surface Area to Volume ratio
  - e.g hot areas - small animals • large SA:V
    cold areas - large animals • small SA:V
    (amount of skin vs muscle)
- Insulation
  - e.g blubber, thick layers of wool [physiological that can shed]
    e.g whale, yak

Physiological adaptations unconscious

- Sweating, panting, shivering, vasodilation/constriction
  - vasodilation: ↓ bring blood closer to skin to let heat be lost
  - constriction: ↓ blood away from skin
- Counter-current flow
  - veins alongside artery
  - keeps the heat through exchange
  - → veins warm up from artery to heart warm
  - e.g penguins, orca

Behavioural conscious

- Huddling, swimming, burrowing, nocturnal
  e.g bats, penguins, wombats, hippo (small SA:V in hot enviu)

- Exchange of heat w/ environment
- Metabolic heat production

Ectotherms - regulated by surroundings
fish, frogs, reptiles

Endotherms: regulated within body
bird, mammals

Regulatory Adaptations

- Hormones
- Neural pathways
- Plant water balance

Nervous System

- Travels through nerves

Nervous messages are called 'action potentials'.

- Happens rapidly + specifically
- Na^+ & K^+ particles run along - charged neuron in and out of membrane, Pushing along in ↑↓→ movement.

Endocrine/Hormonal Sys.

- Produced in endocrine glands.
- General circulation
  - ↳ Only target cells respond due to receptors
- Happen slowly + generally
- chemical based

CNS - brain, spinal cord, (peripheral nerves - PNS)

Reflex Arc e.g hot surface

Temp receptors detect change → along sensory neuron → spinal cord ↓ connector neuron → Motor Neuron → Muscle Contracts

Plant Water Balance

Structural Adaptations: Curled leaves + Sunken stomata (within leaf partially covered by cuticles)

- ↳ Dry out side
- ↳ Wet humid air between curls + in curl creating separation
- Trichomes

Physiological:

- Drop leaves if water stress / winter less stoma
- Thin leaves SA:V with waxy cuticle ↳ retain water

Leaf Mods.

- ↳ vertical hanging · small SA to sun cooler
- ↳ small SA:V Reduced leaves e.g cactus · modified Stems - photosynthesis cladodes

Spines, Scales

Physiological Stomata:

- Flaccid - closes to when not enough water
- Turgid - open when high water pressure

Lose/gain turgor

- **Reduce transpiration**
  - ↳ evaporation of water

Genetic Disease

NID is leading cause of death.

Disease: Condition of part/body that impairs normal functioning. - Known cause: known gene, pathogen.
Genetic Disease: Abnormality in genome.
Disorder: Abnormal physical or mental condition.

Chromosomal Abnormalities

- Chromosomal number mutation - + or -
- Structural mutations - translocations, deletions, duplication of part

★ Syndrome: cluster of common symptoms

Single Gene Mutation

- Single addition, substitution, + deletion
- Dominant or Recessive

e.g down syndrome (trisomy 21)
PKU - phenylketonuria
↳ prevention examples relevant.
(genetic Single gene mutation)
haemophilia

Multifactorial Genetic Diseases

- Combination of factors
  ↳ genetic component e.g. increasing susceptibility
- environment, diet, etc.

Other Causes

- Environment
- Nutritional
- Cancer

1

Environment: Chemical exposure - toxicity, asbestos, cadmium (mesothelioma)
UV Radiation
Smoking

★ Does not include pathogens / viruses

Nutritional: Deficiences in vitamins, minerals, nutrients
Inadequate / excessive nutrition - lack of Vitamin C
e.g Type 2 diabetes, scurvy, etc.
rash / bleeding gums / tooth loss.

Cancer:

Benign - localised
Malignant - Spread through blood/lymph

Multifactorial
- genetic predisposition
- Mutations -> Chemicals, radiation
- Fail in killing itself (apoptosis)
- virus + gene becomes cancerous and spreads

prevent enzymes that repair DNA
genes that prevent cancer mutated / damaged

Data of Diseases

Incidence: % of a population which develops a disease (new cases) in a particular time period.

Prevalence: % of population that has a disease at a given time.

Mortality Rate: % of population that dies due to disease within a time period.

Rate of Incidence: How frequent a disease occurs within a population. e.g 10/100 = 0.1 or 10%.

Morbidity: No. of people affected by the disease. (number of cases)

Reasons for increase in prevalence:

- Earlier diagnosis
  - ↳ Better diagnostic tools
- Aging

Differences in prevalence / mortality:

- Location: low socioeconomic ares / remote regions
  - ↳ No appropriate facilities / treatment
  - Exposure
    - ↳ Chemicals → bad drinking water
    - → Pollution
- Jobs that risk exposure ; increased susceptability
- Attributes / habits. e.g smoking, decision-making, etc.
- Gender: Males / Women
  - Risky behaviour
  - Lack of medical care
  - Smoking
  - Lack of diet concern
- Genetic differences in gender + ethnicity

Epidemiological Studies.

Aim: · Collect data → disease patterns
↳ How it occurs, making connections - factors
· Causes of disease - Causation
· Data for management, planning + prevention.

Requires: Large sample size, control group
Longitudinal
Extensive data collection.

(2)

Treatment + management, Possible Future directions
- Area of research in order to manage + prevent disease.

Methods:

informs

Descriptive Study	Analytical Study
- First study conducted · Research ↳ Patterns of disease ↳ Form a hypothesis	· Comparative study ↳ Compare groups · Test hypothesis · Identify + quantify relationship btwn exposure and health outcome · Incidence, mortality & prevalence

frequency + demographic

E.g Types of data collected in a descriptive study of lung cancer and smoking.
· People w/ lung cancer.
↳ Determine:
- If smoker?
- How long?
- Cigarettes per week?
· When diagnosed.
· Age, gender + genetics
· Previous disease
· Environment → occupation, diet
· Study against group w/out disease.

Case Control	Cohort
Compare 2 groups. 1. With disease 2. W/out disease Study difference in exposure to certain factors	· 2 or > groups w/out disease. · Only one group exposed to factor. · Study differences in outcome.

Errors:
· selection bias
information bias

Prevention - Reduce, eliminate the onset, causes, complications or recurrence of disease.

Why is prevention better than treatment?
- Targets the cause of disease
  ↳ Stops the disease at early stages
- Treatment will not 100% work
  ↳ Invasive + side effects
- Reduced costs

e.g 'Slip, slop, slap, sleek, slide'

3

Health Campaigns + Education
- Target groups

e.g Smoking campaigns:
- Gory visual imagery on packaging
- Legislation: taxing + bans + age + advertising
- Smoking rates decreased since 1990.

Quit Campaigns

Lung cancer decrease

Skin cancer campaigns
- visual ads and posters
- target young women about tanning

4

Examples of prevention: (Genes)
1. Pre-symptomatic screening
2. Pre-implantation screening
3. Carrier testing
4. Gene Therapy
5. Education - Health campaigns, professional advice.

Population-based Approach	Life-course Approach
Focuses on whole population - Protection + interventions applicable to all.	Diseases are the result of specific risks that can accumulate. - reduction and prevention individual focused throughout all stages of life

AS

e.g obesity, bulimia, anorexia nervosa.

Breast cancer, Lung cancer

1

Environment: Melanoma
↳ Skin cancer

lead poisoning
mesothelioma

Benefits
- Identifies risk factors
- Resources needed for health care (treatment) + prevention resources
  ↳ education
  Further research

2

E.g Cervical cancer 4th common
- Sex infection HPV
- Pap smears, vaccination, screening
- Early warning

e.g 'Slip, slop, slap, sleek, slide'
(Community-wide approach)
'Quit smoking' + 'I can quit'
Education, mass media campaigning
↳ Targets older individuals at things such as RSL's or clubs, sport
- Aboriginal communities ↳ higher smoking rates

3

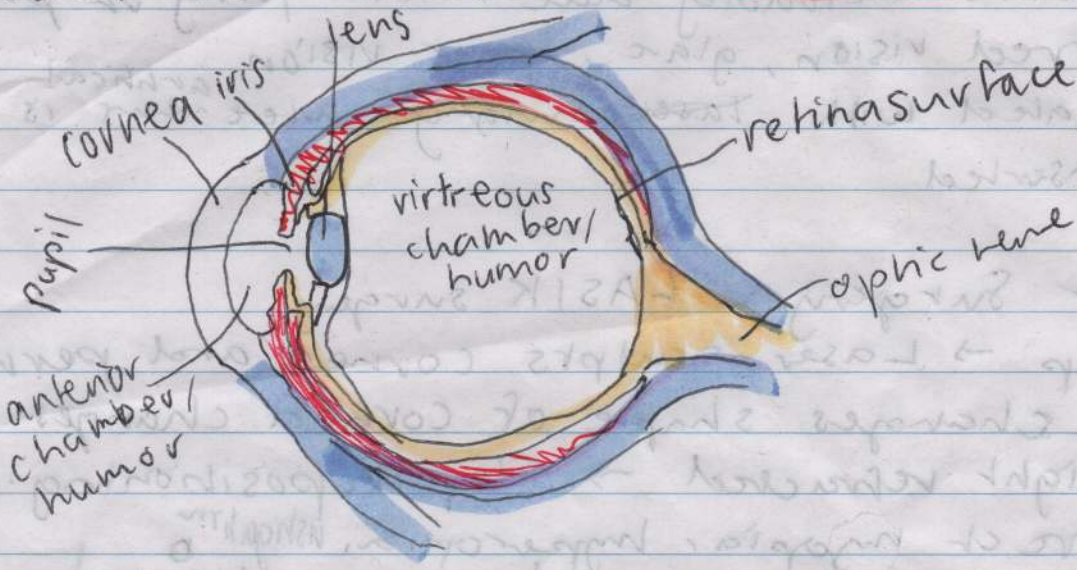
e.g PKU - Phenylketonuria
1. Screen for high levels of phenylalanine
2. Gametes combined in vitro and tested for PKU.
3. Parents determine carrier status
4. Person w/ 100% recessive disease normal allele inproduced → PKU → creates the hormone needed.

e.g Golden Rice

4

Synthesise more vitamin A for deficiency

Visual Disorders



Cornea - transparent protective covering, curved and refracts light

Pupil - hole that allows light to pass through

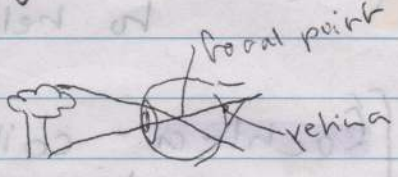
Iris - muscular part of choroid layer that regulates the size of the pupil in response to light.

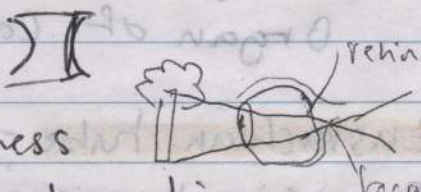
lens - refracts light to focus on retina to accomodate

Retina - photo receptor cells - Rods - grey/black
- Cones - colour forea

Optic Nerve - sends electrical signals from retina to brain.

Myopia - short-sightedness
focal point lies in front of the retina
eyeball is too long.
- concave lens which lengthens focal point to hit retina





Hyperopia - long-sightedness
focal point lies behind retina
eyeball is too short
- convex lens creates a shorter focal point

Cataracts - cloudy due to clumping of proteins
blurred vision, glare, poor vision
- treated with ~~laser~~ surgery where artifical lens is inserted

Laser Surgery - LASIK surgery.
Flap → Laser sculpts cornea and permanently changes shape of cornea changes way light refracted → Flap repositioning.
correct myopia, hyperopia, astigmatism
↓ flatter ↓ round
A debris under flap → weak dry eye | B fast healing + safety.

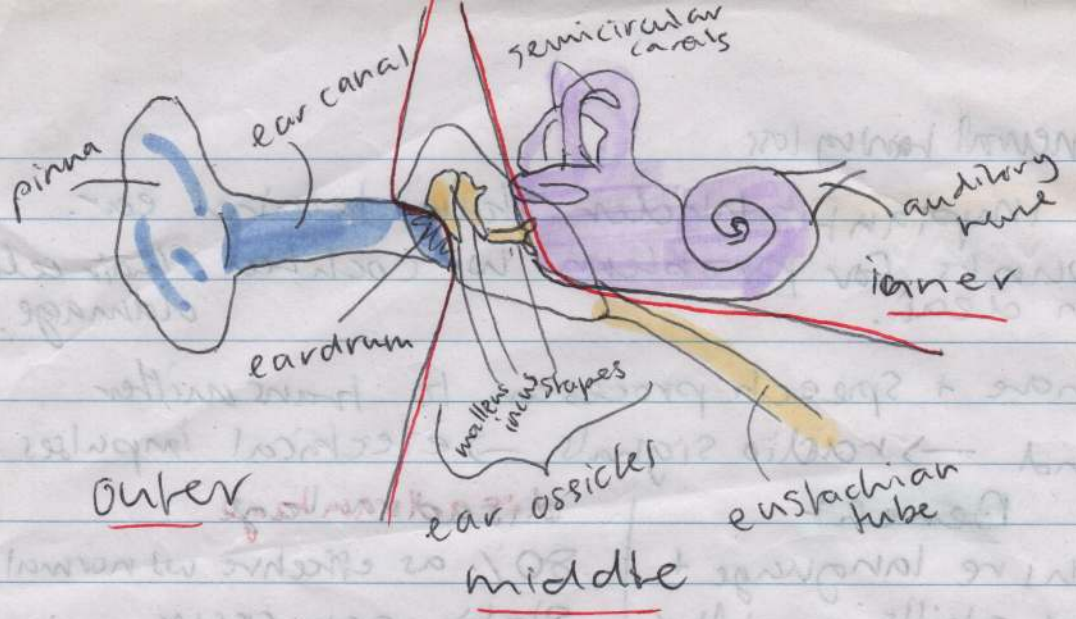
Hearing Loss

outer ear
- Pinna - concentrate sound waves and direct them through ear canal to the ear drum.
- Tympanic membrane (eardrum) - magnifies vibrations and passes them to inner ear

middle ear
- Ear Ossicles (malleus hammer, incus anvil, stapes stirrup) - transfer ↳bones vibrations from ear drum to inner ear.
- Oval window - vibrates in sympathy with eardrum to help move fluid in cochlea.

inner ear
- Cochlea - coiled tube w/ fluid which moves vibrations to sensory haircells in organ of Corti
- Auditory Nerve - sends electrical signals from Organ of Corti to brain.

middle ear
- Eustachian tube - equalise pressure
- Semicircular canals - balance.



Disorders:

Conductive Hearing Loss - outer/middle ear
- ear wax, infection, punctured ear drum, fluid, abnormal bone growth.

can be treated easily

Auditory processing Disorders - cannot process sound

Sensorineural hearing loss - cochlear/auditory nerve
- damage/malfunction not able to send electrical signals to the brain. (noise/drugs; damage to hairs)

permanent.

Mixed Hearing Loss

Technologies:

Hearing Aid: fit to outer ear

microphone that picks up sound waves

Sound → electrical —amplifier→ sound (louder)

- must have hearing ability

Benefit	Disadvantage
- Improve comprehension speech and pick up low frequency sounds	- Limited assistance w/ high freq. - Loud noises + feedback - battery dies

Bone Conduction: titanium device within skull behind ear
- low frequency hearing loss but func cochlea
- repair function of midle ear enabling vibrations to reach cochlea

sensorineural hearing loss

Cochlea implant - under skin behind ear.
- accounts for problem w/ cochlea / hair cell damage.
+ born deaf.

Microphone + speech processor to transmitter
Sound → radio signals → electrical impulses to brain

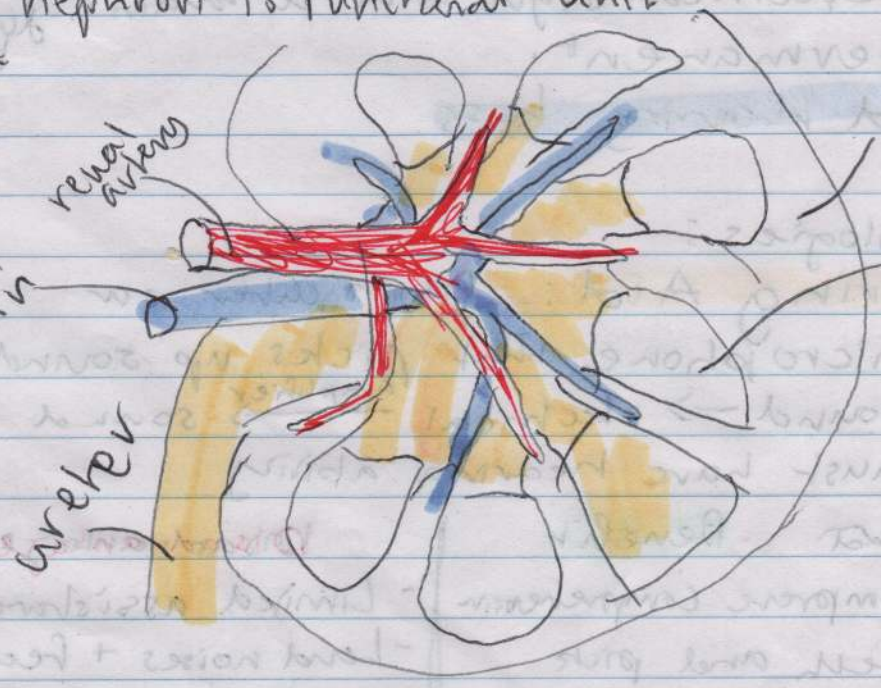
Benefit	disadvantage
acquire language + social skills rapidly	80% as effective w/ normal hearing
	Static can occur
	Surgical risks

Loss of Kidney Function

Kidney function:
- Regulate osmotic pressure of blood
- filters and purifies blood through osmoregulation - regulation of water + salt in blood.

filtrate is urine eliminating waste ←

- nephron is functional unit



Through passive diffusion/ active transport

Oxygenated blood enters through the renal artery
blood → ball of capillaries (glomerulus)
↳ enclosed in Bowman's capsule
↳ water, waste, etc. transferred from blood to bowman's capsule.
↳ filtrate moves through long ~~tubules~~ tubules - get back important molecules

glucose reabsorbed

Amount of water (and salts) reabsorbed is due to monitored by receptors in body homeostasis.

Water is passive - osmosis ~~Potassium ions~~
~~Potassium passive~~

Loop of Henle (convoluted) - water passively
- NaCl actively at lowest point

- Loss of kidney funct.
  ↳ when kidneys lose the ability to filter waste from blood.

short term { Acute - prerenal - insufficient blood flow
Intrinsic - trauma to kidneys ↳ hit, toxins, oxygen

long term { Chronic - prerenal - insufficient blood flow → shrinkage
intrinsic - severe bleeding, oxygen
post-renal - blockage of urinary tract e.g kidney stones

Technologies:

Renal Dialysis: (urea/uric acid)
- Blood is extracted and filtered through a machine outside the human body.
  ↳ through semi permeable membrane

Haemodialysis $$
Connect to vein/arteries to directly circulate blood from body, outside then back.
Entire blood volume filtred within 4-5 hours 3x a week.
catheter or fistula

Peritoneal $
Done at home
tube put into stomach to use the stomach lining as semi permeable membrane.
Dialysis bag w/ fluid drained + replaced