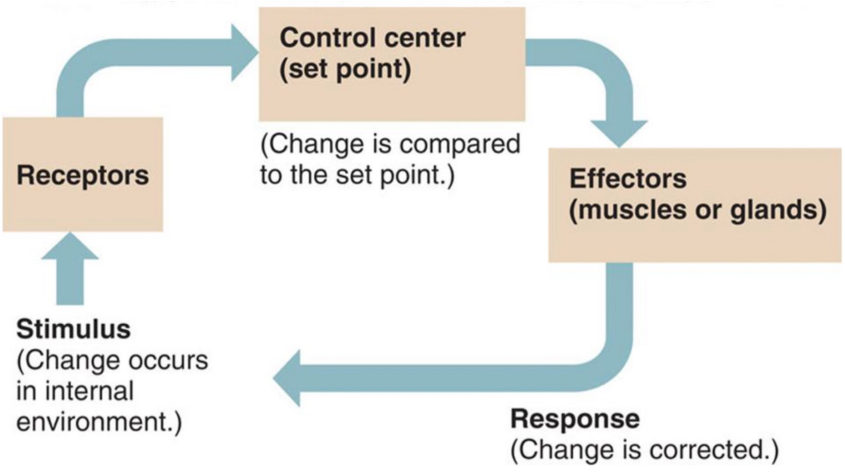
Homeostasis:

The regulation of internal conditions in response to external changes to maintain a stable environment for cell & enzyme function

Automatic control systems use negative feedback cycles:

1. Receptor cells detect stimulus
2. Coordination centre organises response
3. Effector produces response which counteracts the change 2 restore it to optimum level
4. Effectors continue producing the response for as long as they're stimulated by the coordination centre (the level can decrease/increase too much & the CYCLE repeats again)

E.g to maintain temperature, water content & blood glucose levels



Nervous system:

Multicellular organisms adapted to have a central hormonal communication system

Parts:

CNS: brain & spinal cord (in vertebrates), connected to body via sensory & motor neurones

Sensory neurones: carry info as electrical impulses from receptors -> CNS

Motor neurones: carry info via electrical impulses from CNS -> effectors

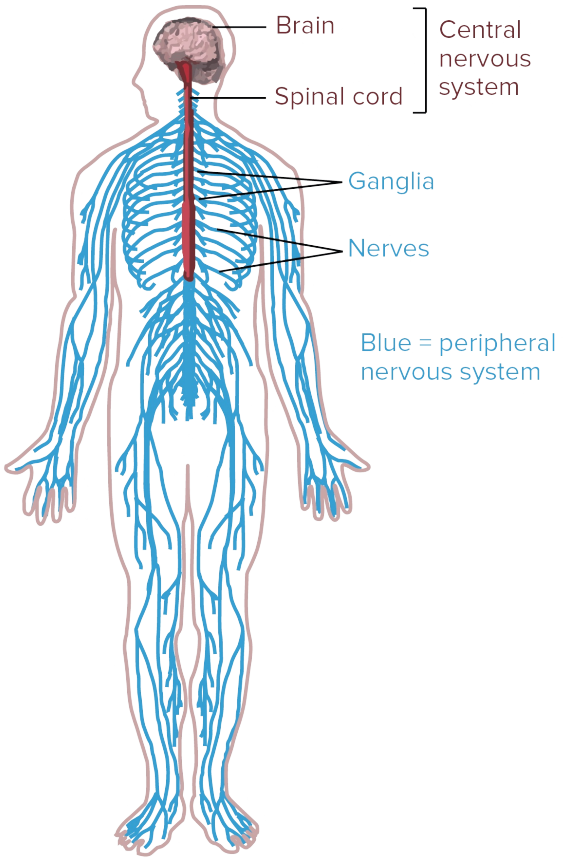
Effectors: muscles & glands, respond to nervous impulses

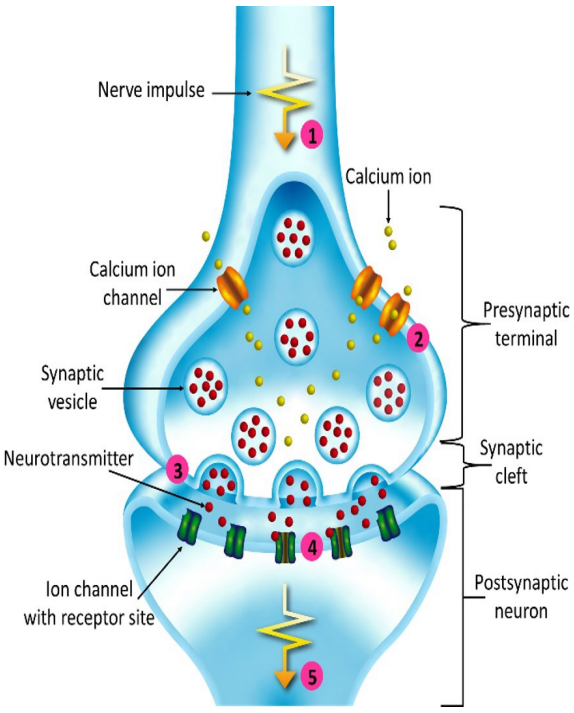
1. Receptors detect stimuli
2. Sensory neurones send info from receptors -> CNS
3. CNS coordinates a response
4. Motor neurones send info from CNS -> effectors
5. Effectors counteract the change E.g. muscles contract or glands secrete hormones

Synapses:

The connection between 2 neurones

Chemicals transfer the nerve signal across the gap via diffusion then...
Chemicals set off new signal in next neurone





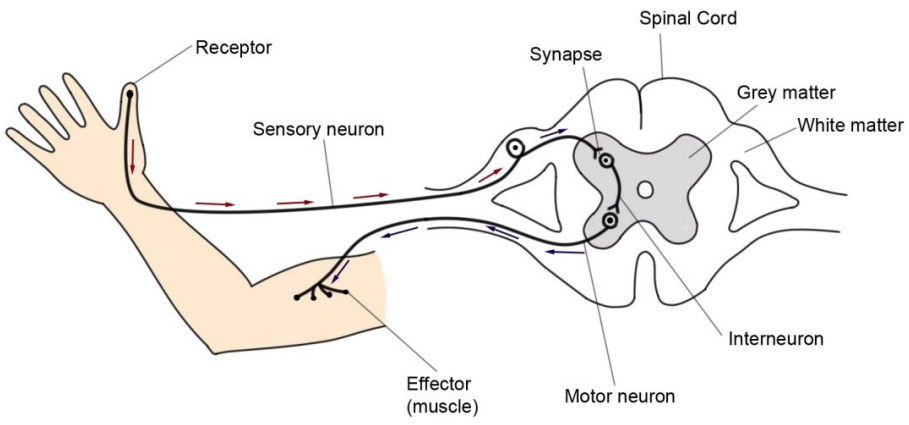
Reflexes:

Automatic effector responses that DON'T INVOLVE THE BRAIN = quick reaction = less chance of injury

E.g pupils shrink if light shone into eye or adrenaline is released automatically during a shock

Passage of info from receptor -> effector = reflex arc:

1. Neurones go through spinal cord/ unconscious part of brain
2. Receptor detects stimulus, impulses sent along sensory neurones -> relay neurone in CNS
3. Impulses reach synapse, chemicals are released along the relay neurone, then chemicals sent along the motor neurone
4. Impulses travel along motor neurone -> effector
5. Effector responds e.g. muscle contraction



Control of body temp:

Body balances energy gained & energy lost = constant core body temp

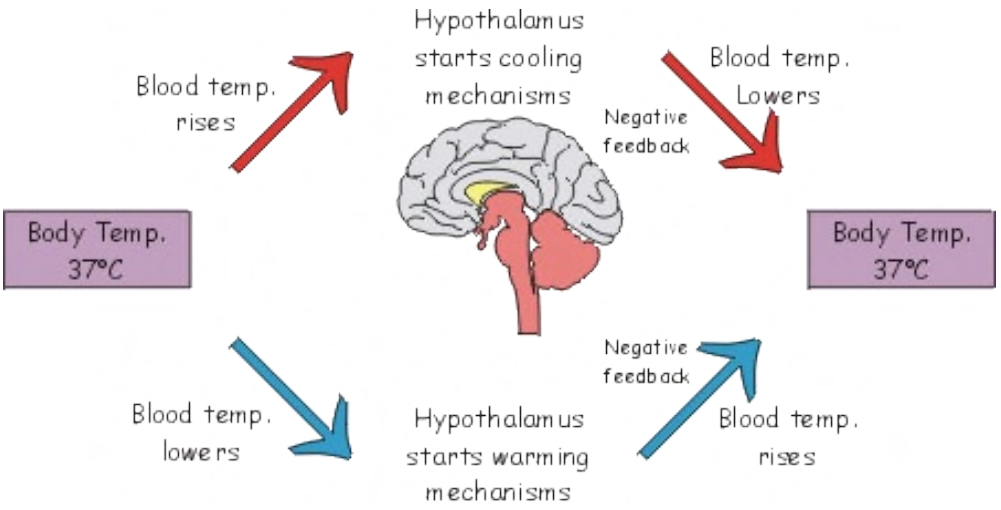
Thermalregulatory centre monitors temp of blood via receptors in the brain & impulses from receptors in the skin

1. Receptors detect temperature is too high
2. Thermoregualtory centre coordinates a response
3. Effectors e.g. sweat glands counteract the change

Effectors work antagonistically: 1 effector heats, another cools simultaneously = sensitive response

Too hot= sweat secreted, it evaporates transferring heat energy away from body
Blood vessels dilate= more blood flows to skin's surface = vasodilation (transfers energy from skin-> environment)

Too cold= hairs stand to insulate heat
Blood vessels constrict = close off skin's blood supply = vasoconstriction (retains heat)
Shivering = energy transferred via respiration



Endocrine system:

Hormones = chemicals released into blood to effect target organs
Hormones are secreted by endocrine glands within the endocrine system

Glands:

Pituitary: master gland, produces hormones that act on other glands to release hormones to create change

Ovaries: produce oestrogen

Testes: produce testosterone for puberty & sperm

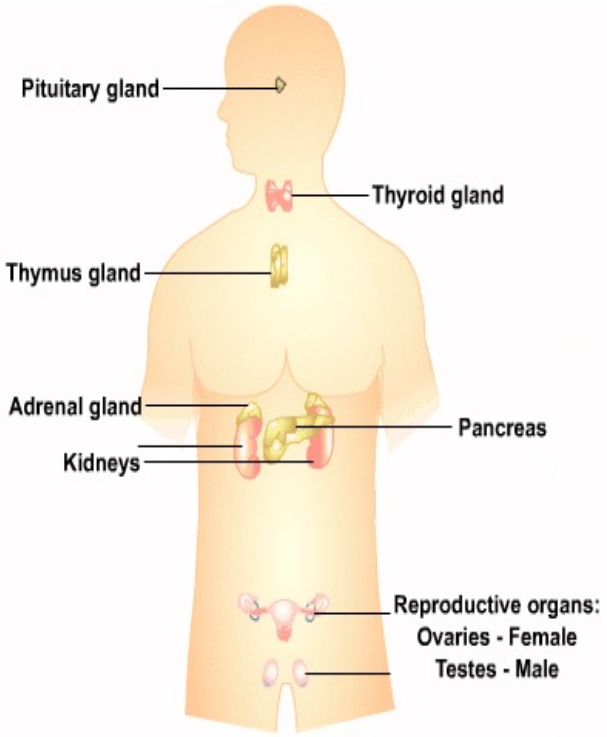
Thyroid: produces thyroxine for: metabolism rate, heart rate & temp

Adrenal gland: produces adrenaline for 'fight of flight' response

Pancreas: produce insulin to regulate blood glucose level

Nerves vs Hormones:

Nerves act faster, shorter response over precise area
Hormones act slower, with a longer response & over wider area



Controlling blood glucose:

Eating carbohydrates = glucose goes into blood from the gut
Normal metabolism removes glucose from blood, exercising does so at a faster rate

Excess glucose stored as glycogen in the liver & muscles
Steady blood glucose levels maintained by pancreas in a negative feedback cycle:

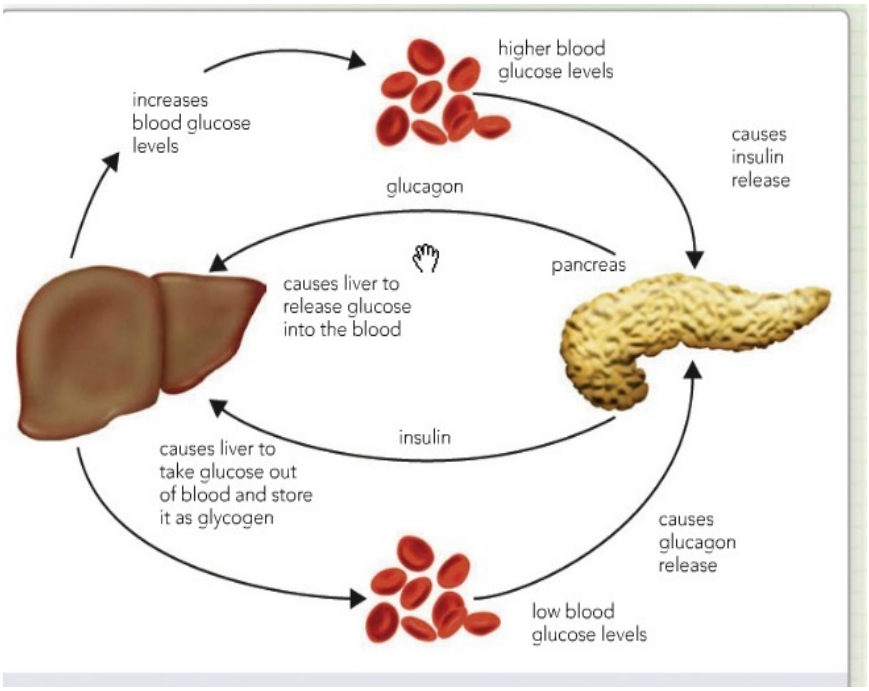
1. BGL = high
2. Pancreas secretes insulin
3. Glucose moves from blood-> liver + muscle cells

1. BGL = low
2. Pancreas secretes glucagon
3. Glucose released into blood by liver

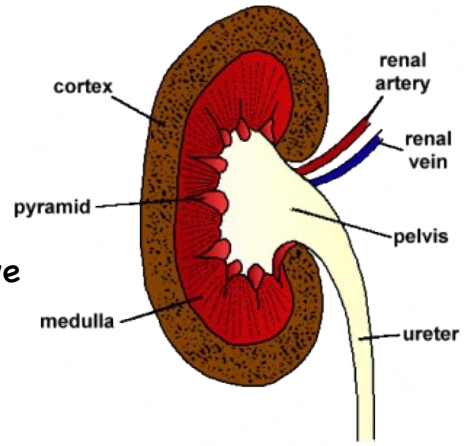
Diabetes:

Type 1: pancreas produce too little insulin = blood glucose levels can rise & kill a person
Treatment: insulin therapy (removes glucose from blood rapidly after digestion)
Exercise & limiting carbohydrate intake useful too

Type 2: resistance to insulin (body cells dont respond to the hormone) = blood glucose level rises. Obesity = major risk factor.
Treatment: Eating carbohydrate controlled diet & regular exercise



Kidneys:



Filter waste products out of blood to make urine
Glucose, ions & water are absorbed back into blood = selective reabsorption

Waste products in urine:

Urea:
proteins -> amino acids -> fats -> ammonia -> urea = deamination (in the liver)
(Fats can be stored, proteins cannot be, thus they're broken down)
Ammonia is toxic, so is converted into urea then transported to the kidneys to be filtered out in urine

Ions:
Sodium taken in & absorbed into the blood
Ion inbalance = water content is disrupted (more/less than needed is drawn in via osmosis)
Ions are lost in sweat (unregulated) so ion content is maintained by kidneys: the correct amount is reabsorbed into blood after filtration, then the rest is excreted in urine

Water:
Lose water via sweat & exhalation (unregulated) so kidneys removes enough

ADH = hormone that controls urine concentration; it's released into the bloodstream by the pituitary gland

Brain monitors water content of blood & secretes ADH via pituitary glands as needed

Negative feedback cycle:
1. Receptor detects water content is too high
2. Brain coordinates a response
3. Pituitary gland secretes less ADH so less water is reabsorbed from kidney tubules

Kidney failure:

Faulty kidneys = waste products build up = level of ions & water in body are uncontrolled = death

Treatment:

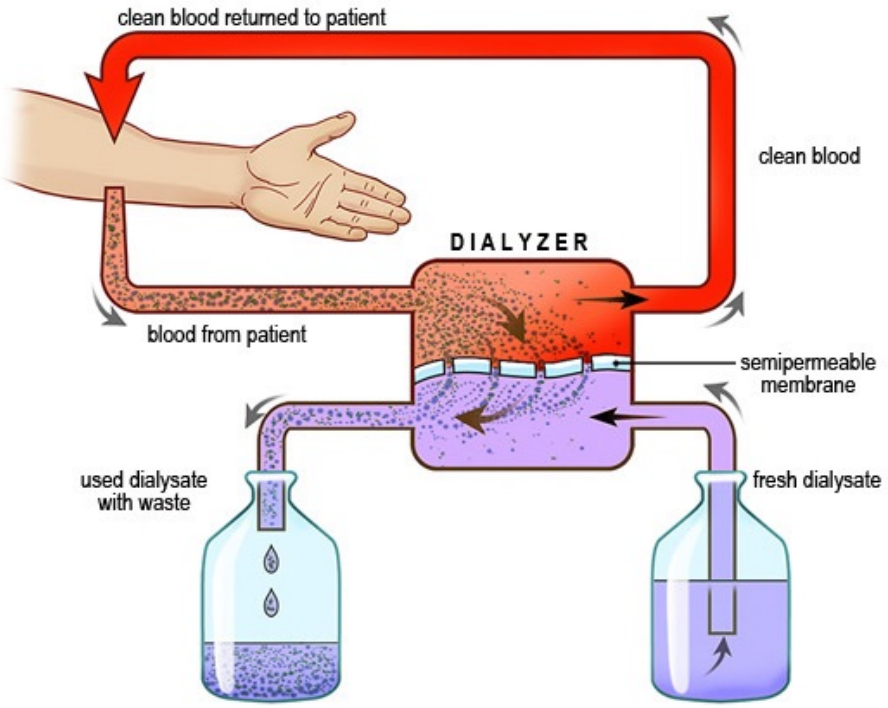
Dialysis:

Regularity done (3-4 times weekly at 4 hours at a time) 2 keep concentration of dissolved substances normal to remove waste products
Can cause blood clots & infection, is costly for the NHS but gives the patient time until a transplant

Machine:
Blood flows between partially permeable membranes (surrounded by dialysis fluid)
Fluid has same concentration of dissolved ions as healthy blood (useful ions & glucose aren't lost)
Waste products diffuse across the barrier

Transplants:

Taken from recently deceased or alive donors (minimal risk as we have 2 kidneys)
Risk of immune system rejecting the kidney
Cheaper than dialysis in long-run but massive waiting lists



Puberty & menstrual cycle:

Sex hormones cause secondary sexual characteristics to develop during puberty
Men: testosterone (produced by testes) for sperm production
Women: oestrogen (produced by ovaries)

Menstruated cycle:

1. Uterus lining sheds for 4-7 days
2. Lining builds up (vessels thicken to receive a fertilised egg)
3. Egg develops & is released from the ovary (ovulation)
4. Wall is maintained, if egg hasn't landed in the uterus, lining sheds again

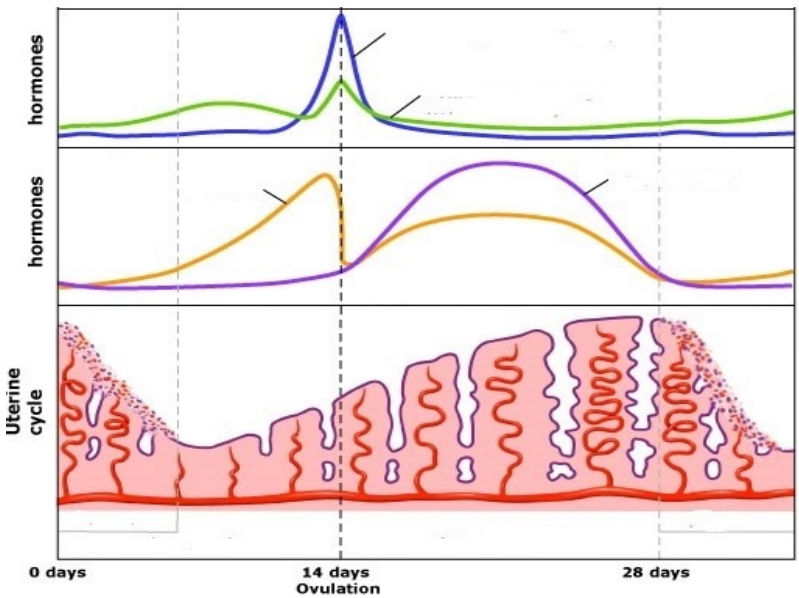
Hormones in menstrual cycle:

Oestrogen: produced in ovaries, causes uterus lining to grow, stimulates release of LH & inhibits release of FSH

Progesterone: produced in ovaries, maintains uterus lining then breaks it down, inhibits release of LH & FSH

FSH: produced in pituitary gland, causes ovum to mature in ovaries' follicle, stimulates production of oestrogen in ovaries

LH: produced by pituitary gland, stimulates release of an egg



IVF:

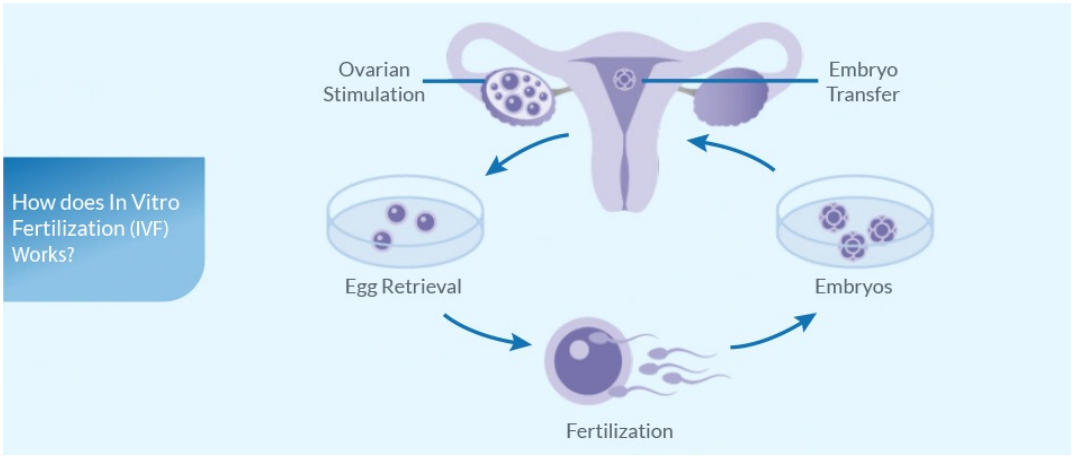
Help infertile couples have babies

1. Take ovum from woman
2. Mix with man's sperm in a lab
3. Embryo grows in incubator (time lapse imaging monitors growth)
4. Implant fertilised egg into uterus to mature

FSH & LH taken prior to help eggs mature

Cons: multiple births (miscarriages & stillbirth risks), 26% success rate in UK, side effects of hormones

Objections: discarded embryos,
genetic testing (removes cells from embryo to check health) = unethical as babies aborted if 'undesirable' & abusing tests to get desired characteristics = unethical

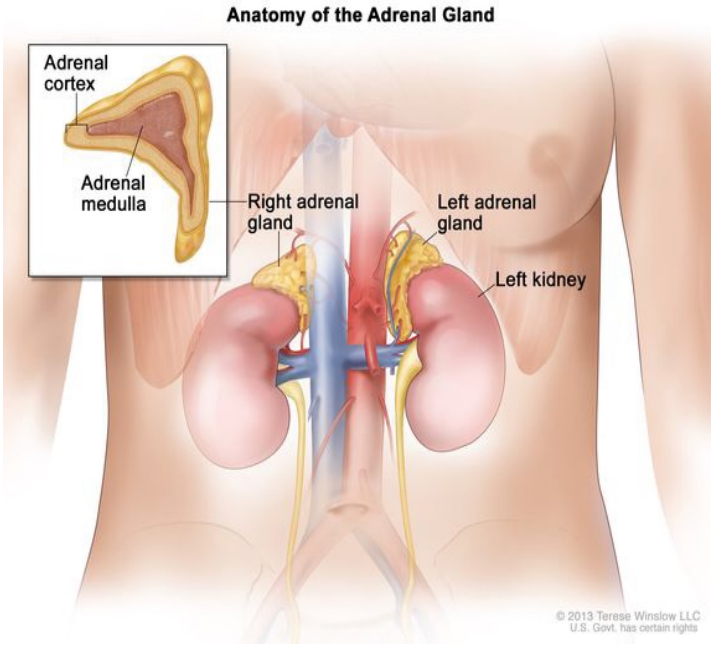


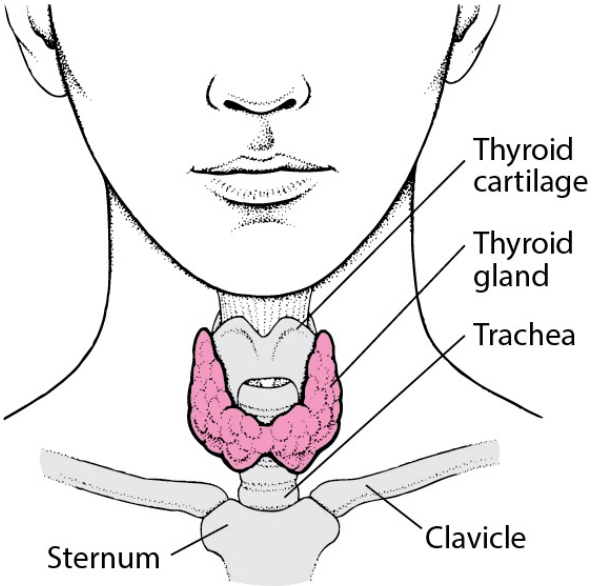
Adrenaline & Thyroxine:

Adrenal glands secrete adrenaline during 'fight or flight' responses
Brain detects fear -> nervous impulses-> adrenal glands -> secrete adrenaline
Increases heart rate (gets more oxygen & glucose to brain & muscles)

Thyroxine:

TSH released by thyroid gland in neck
Regulates basal metabolic rate
Negative feedback loop keeps thyroxine levels constant
Thyroxine levels too high = TSH release is inhibited (stopped) so it falls back 2 normal

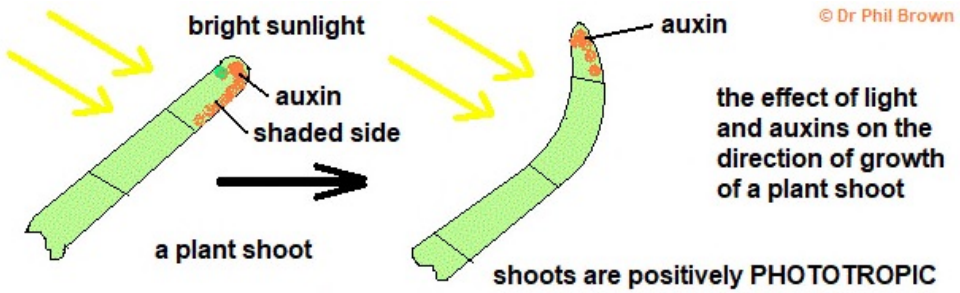




Plant hormones:

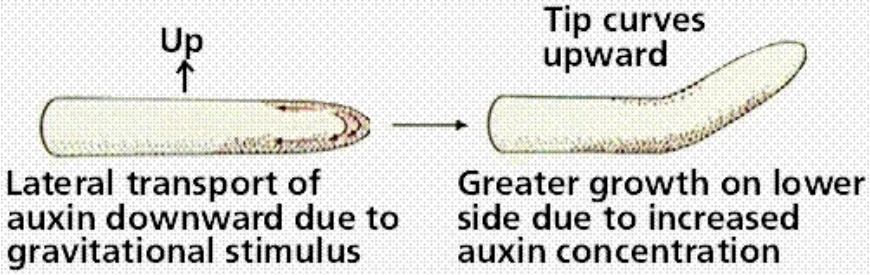
Auxin controls growth near tips & shoots of roots
Produced in tips & moves backwards, stimulating cell elongation (behind tips)
Tip of root removed = no auxin so no tip growth

Phototropism:
Shoot tip exposed to light = more auxin accumulates on shaded side
Cells grow faster on shaded side = shoot bends towards light



Geotropism:
Shoot grows sideways = gravity produces unequal distribution of auxin in the tip (more auxin on lower side)
Lower side grows rapid, shoot bends upwards

Root growing sideways has more auxin on its lower side but extra auxin inhibits growth = root bends downwards as cells on top elongate faster



Commercial uses of plant hormones:

Killing weeds: selective weed killers only kill broad-leaved plants, not grass

Growing from cuttings with root powder: add rooting power (with auxins) to cuttings (plant that's been cut off) = roots produced rapid & grow as new plants = clones produced rapid

Growing cells in tissue culture: to grow clones, add auxins to a growth medium = stimulates cell division from roots & shoots

Gibberellin:

Controlling dormancy: alter dormancy so plants germinate all the time (not just after a period of coolness/dryness) = all seeds germinate at the same time

Inducing flowering: plants grow without certain conditions e.g. low temps/ long days, grows bigger flowers too

Larger fruits: seedless fruits + gibberellin = big fruits

Ethene: gas produced by ageing parts of plants, controls cell division for growth & stimulates enzymes to ripen fruits
Fruit can be picked unripened & ripen on transport to supermarkets
Can delay ripening too by blocking ethene/ using chemicals that react with ethene to remove it from the air