B5: HOMEOSTASIS & RESPONSE

Homeostasis

Homeostasis	an organism's ability to regulate/control its internal conditions so crucial reactions (including those involving enzymes) can happen at optimal rates

What needs to be regulated?

- Blood glucose concentration
- Internal temperature
- Water levels

The Nervous System

CNS	Central Nervous System (brain and spinal cord)
PNS	Peripheral Nervous System (all other nerves)
Normal Response	Stimulus Receptor Sensory Neurone Relay Neurone CNS Motor Neurone Effector
Synapse	the gap between two neurones - electrical messages get converted into chemical neurotransmitters which diffuse across the synapse to the other neurone
Reflex Arc	Stimulus Receptor Sensory Neurone Relay Neurone Motor Neurone Effector Response

The Nervous System (cont)

Effectors	glands or muscles

Mnemonic for Reflex Arc = SRSRMER
Remember that a reflex arc BYPASSES THE CNS. It is an UNCONSCIOUS ACTION.

Reaction Time Practical

- drop ruler between finger and thumb
- measure distance fallen before caught
- repeat and calculate mean

Independent Variables	- stimulant (eg coffee) which increases neurotransmission - depressant (eg alcohol) which decreases neurotransmission

The Brain

Cerebral Cortex	- higher function - memory - speech - problem-solving TOP PART THAT IS FOLDED
Cerebellum	- motor skills - movement - balance - coordination BACK PART THAT LOOKS LIKE A LUMP
Medulla	- unconcious actions - heart and breating rate - signals to adrenal glands to release adrenaline PART THAT CONNECTS TO AND INCLUDING BRAIN STEM
MRI Scans	allow doctors to see brain activity without surgery

The Brain (cont)

Issues with the brain are difficult/impossible to treat safely due to:
- limited knowledge about the brain
- delicate nature of the brain

The Eye

To view near objects, **ciliary muscles CONTRACT** and **suspensory ligaments SLACKEN** which leads to a thick lens

To view far away objects, **ciliary muscles RELAX** and **suspensory ligaments SLACKEN** which leads to a thin lens

Retina Cells	- rods only detect light intensity - cones are sensitive to red, blue or green wavelengths of light and provide colour information - these signals travel to the brain via the optic nerve
Myopia	short-sightedness
Hyperopia	long-sightedness

To remember which way round it is for accomodation:
- near objects => **C**iliary muscles **C**ontract and **S**uspensory ligaments **S**lacken
and the opposite must be true for far away objects

Thermoregulation

The brain detects blood temperature and then sends nervous and hormonal signals to effectors

TOO HOT	- vasodilation - sweating - hairs lie flat on skin
TOO COLD	- vasoconstriction - shivering - hairs stand up

Thermoregulation (cont)

Vasodilation/constriction	increases or decreases blood flow to the skin which leads to more or less heat dissipated to the surroundings respectively

To remember which way round it is, think about what happens when someone has a fever (too hot) or is very very cold. Fever = hot to touch = vasodilation. Cold = cold to touch = vasoconstriction

Endocrine System

A system of glands that secrete hormones to send signals to effectors, transported via blood making it slower than the nervous system

Pituitary gland	"master gland" which sends hormonal signals to other glands
Thyroid	controls growth and basal metabolic rate
Pancreas	secretes insulin and glucagon to control blood sugar
Adrenal Glands	release adrenaline
Ovaries	release eggs and secrete hormones
Testes	produces sperm

Menstrual Cycle

FSH	- follicle stimulating hormone - produced by pituitary gland - causes an egg to mature - causes ovaries to produce oestrogen

Menstrual Cycle (cont)

Oestrogen	- produced by ovaries - causes uterus lining to thicken - inhibits FSH so no more eggs mature until next cycle - causes production of LH
LH	- luteinising hormone - produced by pituitary gland - causes egg to be released - inhibits oestrogen - causes the production of progesterone
Progesterone	- produced by ovaries - maintains uterus lining - inhibits LH - causes production of FSH

REMEMBER FOLP
FSH and LH are both acronyms so both produced in the same place (pituitary)
Oestrogen and Progesterone sound similar so both produced in the same place.
Oestrogen and pr**o**gesterone so produced in **o**varies

Plant Hormones

These can be used to our advantage when growing plants

Gibberllins	- induces germination - promotes flowering - increases fruit size
Ethene	- causes ripening
Auxins	- control root and shoot growth - weedkillers - rooting powders - promoting growth in tissue cultures

Plant Hormones (cont)

Phototropism	- auxins are destroyed by sunlight - they gather on the shaded side of a shoot making it grow more quickly - shoot bends towards Sun
Geotropism	- auxins gather on the bottom of roots - inhibits growth - causes downward growth of the roots

Adrenaline and Thyroxine

Adrenal Glands	- release adrenaline into body - increases blood flow and breathing rate - prepares you for fight or flight
Thyroid	- secretes thyroxine - controls body's metabolic rate
TOO LOW	- hypothalamus releases TRH - causes pituitary to releasea TSH - causes thyroid to release more thyroxine

Fertility Treatments

FSH/LH Injections	simple and relatively cheap
IVF	- in-vitro fertilisation - hard and expensive - relatively low success rate - can cause multiple embryos to develop

Fertility Treatments (cont)

Process of IVF	- eggs collected after inducing release with LH - fertilised in a lab (in-vitro = in glass) - viable embryos inserted back into woman's uterus

Contraception

FSH-Inhibiting Pills	stops eggs from maturing
Progesterone Injection/Implant	stops eggs from being released
Barrier Methods (eg Condom)	stops sperm entering vagina
Abstinence	not having sex
Vasectomy/Cl-amping Oviduct	stops egg/sperm from reaching uterus

Kidney Function

ADH	- anti-diuretic hormone - produced by pituitary gland - causes tubules in kidneys to reabsorb MORE water into bloods-tream
TOO HIGH	- less ADH made - more water sent to bladder - more water lost as urine (paler)
TOO LOW	- more ADH made - more water reabsorbed (less sent to bladder) - less water lost as urine (more yellow)

Kidney Function (cont)

Dialysis	- blood filtered by machine - must be done regularly due to toxic urea - takes a 4-6 hours 2-3 times a week - diet must be watched - expensive - doesn't work forever HOWEVER - keeps patient alive until a transplant is possible - no shortage - no need for drugs
Transplant	- rejection is common - immunosuppressant drugs must be taken - shortage of organ donors - standard surgical risks - only last 8-9 years on average HOWEVER - diet doesn't need to be watched - cheaper overall

Controlling Water and Nitrogen Levels

Water is lost through processes like	- exhalation - sweating - urination

Excess water is removed from the blood by the kidneys to the bladder

Water + Urea --> Urine

Urea	- contains ammonia - ammonia produced through the deamination of digested proteins in the liver

Controlling Water and Nitrogen Levels (cont)

Kidneys selectively reabsorb	- glucose - useful minerals - useful ions

Controlling Blood Sugar

TOO HIGH	- pancreas secretes insulin - glucose moves from bloods-tream into cells to be used for respiration - excess gluxose converted into glycogen as energy store in liver
TOO LOW	- pancreas secretes glucagon - liver and muscles convert glycogen back into glucose - this leads to a negative feedback loop
Type 1 Diabetes	- pancreas cannot produce insulin - insulin injections needed
Type 2 Diabetes	- cells do not absorb glucose as they should - need to watch carbs intake in diet - exercising regularly - obesity increases risk

Glucose comes from digestion
Gluca**gon** (like gone) makes glycogen **go** away (converted into glucose)
Glycogen is just the other one

B6: INHERITANCE, VARIATION & EVOLUTION

Meiosis

Meiosis	the process by which cells that are genetically different from parent cells are made, for example, gametes

Meiosis (cont)

Process	- chromosomes in diploid cell copied - similar chromosomes pair up and genes swapped between them - cell divides to produce two diploid cells - these divide again to produce 4 haploid cells (gametes)

There are 46 chromosomes (23 pairs) in a human diploid cell

Sexual and Asexual Reproduction

Most animals reproduce sexually, while plants can reproduce both sexually (pollen and egg) and asexually.

Asexual reproduction happens by **MITOSIS** which means that the daughter cells will be identical (cloned)

Sexual Advantage:	offspring can become better adapted to the environment
Asexual Advantage:	only one organism is needed to reproduce

DNA and Protein Synthesis

Genome	the entire genetic code in an organism
DNA	double helix polymer which stores genetic code
Gene	portion of DNA that codes for a protein - mapping these allows us to identify causes of disorders
Genotype	an organism's specific genetic code
Phenotype	how this code is expressed in physical characteristics

DNA and Protein Synthesis (cont)

Monomer	- the monomers of DNA are nucleotides - they are made from a sugar/-phosphate group
Bases	A + T pair, C + G pair. - every three bases code for an amino acid
Protein Synthesis	- code is copied by mRNA (transcription) - this is taken to the ribosomes - ribosomes assemble amino acids into polypeptides then proteins (translation)

Inheritance

Characteristics are determined yb the type and quantity of proteins synthesised. Some are controlled by one gene; however most are a result of two or more genes interacting.

Alleles	different versions of the same gene
Dominant Alleles	- expressed even when the genotype contains a recessive allele (BB or Bb) - always represented by a capital letter (B)
Recessive Alleles	- only expressed when there is no dominant allele (bb) - always represented with a lowercase letter (b)
Homozygous alleles	- BB = homozygous dominant - bb = homozygous recessive
Hetero-zygous	Bb

Polydactyly is caused by a dominant allele (PP or Pp)

Cystic Fibrosis is caused by a recessive allele (only cc)

Inheritance (cont)

Females have XX chromosomes

Males have XY chromosomes

PUNNETT SQUARES ARE ALSO IN THIS SECTION

Variation, Adaptation and Evolution

Variation in offspring is a result of both genetic and environmental factors

Darwin's Theory of Evolution	- random mutations results in variation - some organisms are better adapted to environment - these compete in "survival of the fittest" - those better adapted are more likely to survive - over time, these desirable characteristics are more pronounced
Lamarck's Theory of Evolution	- mutations/adaptation are a result of the environment affecting characteristics inherited by offspring. - not a random process
Antibiotic-Resistant Bacteria	- often used as evidence for Darwinian evolution - if not all bacteria killed, those most resistant will reproduce
Species	if two organisms can breed to produce a fertile offspring, they are of the same species

Variation, Adaptation and Evolution (cont)

Selective Breeding	breeding organisms that have desired characteristics to produce offspring in which they are more pronounced

Darwin = taller giraffes can get more food and therefore survive to reproduce while the short ones die off, therefore giraffes are taller.
Lamarck = shorter giraffes keep stretching up to get food