Human Bio:

**HORMONES IN THE PITUITARY GLAND**

**Homeostasis** - Maintaining a stable internal environment

**Negative feedback** - A situation in which feedback brings about a change opposite to, or reduces the effect of, the original stimulus.

**Exocrine glands** - A gland that secretes into a duct that carries the secretion to the surface of the body cavities

**Endocrine glands** - A gland that secretes hormones directly into adjacent tissues; also called ductless gland

Hormones

* Produces by endocrine glands
* Carried in the blood
* They effect target cells or target organs
* 3 types - Protein, amine & steroid
* They are specific to receptors
* Saturation can occur

Protein & Amine Hormones

* Water soluble (polar)
* Combine with their receptor on the cell membrane
* Triggers a secondary message to diffuse through the cell
* This activates particular enzymes

Steroid

* Lipid soluble (non polar) (cell membrane = phospholipid bilayer)
* Enter the target cell & combine with the receptor inside the cytoplasm
* Hormone-receptor complex activates genes controlling the formation of a particular protein

How hormones work:

* Activate genes to produce proteins/enzymes
* Change shape/structure of enzymes (turn on/off)
* Change rate of production of enzyme/protein

Anterior lob of the pituitary

* Controlled by releasing and inhibiting factors secreted by the hypothalamus
* These factors are hormones as they are secreted into the extracellular fluid around the hypothalamus and are carried by the blood to the anterior lobe of the pituitary

Posterior lobe of the pituitary

* Oxytocin and antidiuretic hormone are released by posterior pituitary but not made there
* Hormones are produced in hypothalamus and move through the nerve cells that go through the infundibulum into the posterior pituitary where they are held, ready for release into the bloodstream.
* Release of hormones is by nerve impulse from hypothalamus

Pituitary gland

|  |  |  |
| --- | --- | --- |
| Hormone | Target organ | Main Effects |
| Anterior lobe |  |  |
| Follicle-stimulating hormone (FSH) | Ovaries (female)  Testes (Male) | Growth of follicles  Production of sperm |
| Luteinising hormone (LH) | Ovaries (female) Testes (male) | Ovulation and maintenance of the corpus luteum  Secretion of testosterone |
| Growth hormone (GH) | All cells | Growth and protein synthesis |
| Thyroid-stimulating Hormone (TSH) | Thyroid glands | Secretion of hormones from the thyroid |
| Adrenocorticotropic hormone (ACTH) | Adrenal cortex | Secretion of hormones from the thyroid |
| Prolactin (PRL) | Mammary Glands | Milk production |
| Posterior lobe |  |  |
| Antidiuretic hormone | Kidneys | Reabsorption of water |
| Oxytocin (OT) | Uterus  Mammary Glands | Contractions of the uterus during childbirth  Release of milk |

**RECOMBINANT DNA TECHNOLOGY**

Recombinant DNA Technology: Frequently referred to as genetic engineering, involves the introduction of DNA is foreign to that organism or has been modified in some way

Transgenic organisms: those whose genome has been altered by the transfer of a gene or genes from another organism. The  introduced genes become part of the transgenic organism's DNA and can be passed on from one generation to the next

Blunt ends: The ends produced by a straight cut of a sequence of nucleotide bases

Ligase: An enzyme capable of combining two smaller components of single-strand DNA into one single structure

Phage: or bacteriophage; a virus that infects bacteria

Plasmid: Small circular strand of DNA distinct from the main bacterial genome; it is composed of only a few genes and is able to replicate independently within a cell

Restriction Enzyme: Enzyme that cuts a strand of DNA at a specific sequence of nucleotides

Staggered Cut: Produced when a restriction enzyme creates fragments of DNA with unpaired nucleotides that overhang at the break in the strands; called sticky ends

Straight cut: Produced when a restriction enzyme makes a clean break across the two strands of DNA so that the ends terminate in a base pair; called blunt ends

Sticky ends: the overhanging ends produced by a staggered cut of a sequence of nucleotide bases; can be called cohesive ends

Vector:  A bacterial plasmid, viral phage or other such agent used to transfer genetic material from one cell to another

**Process:**

1. Isolate gene, cut out using restriction enzyme
2. Fragment includes gene of interest with sticky ends
3. Isolate plasmid from bacterial cell
4. Cut bacterial cell plasmid with the same restriction enzyme
5. Splice human DNA into plasmid
6. DNA ligase enzyme to join sticky ends
7. Treat bacterium so it takes up recombinant plasmid
8. Allow bacterium to multiply
9. Either use human gene or product of gene

**Examples of use:**

1. Replacing faulty genes with healthy ones
2. Cystic fibrosis, rheumatoid arthritis, certain cancers, diabetes
3. Mutation identification

Homeostasis: A condition on which the internal environment of the body remains relatively constant despite changes in the external environment.  The ability to maintain the body's optimal working environment is called homeostasis.

Examples would be the maintenance of body temperature and levels of glucose in the blood.

Tolerance Limits: The range of conditions in which the body can function properly

Negative feedback: The response is opposite to the original stimulus

Stimulus: The change in the environment that causes the system to operate.

Positive Feedback: The response reinforces or intensifies the causing stimulus

**INTRO TO HOMEOSTASIS**

**Homeostasis:**

* The body works best within a narrow range of conditions
* This means the body has to maintain this environment
* Homeostasis maintains conditions under which cells perform most efficiently
* Examples of things we regulate in the body:
  + Body temperature
  + Blood Pressure
  + Fluid concentrations (osmotic, diffusion and electrochemical gradients)
  + Acidity (pH)
  + The concentration of nutrients, wastes and gases

**Tolerance Limits**

* If conditions change beyond the tolerance limits, body systems  cannot function properly and we get sick or may even die
  + E.g. Too cold, too hot, too much glucose, too little glucose, etc

**The Feedback Model**

* Steady state control processes are regulated by feedback mechanisms
* Feedback mechanisms are self-regulating control processes (i.e. We do not control them consciously) because the response continually modifies the stimulus.
* The feedback processes are called feedback loops
* Homeostasis is maintained by means of negative feedback
  + E.g. when we are too hot, sweating will cool us down and once we get cool there is nothing left to stimulate sweating glands
* **Negative feedback loop:**
  + Stimulus: The change in the environment that causes the system to operate
  + Receptor: Detects the change
  + Control centre/ Modulator: Responsible for processing the information given by the receptor and sending it to the receptor
  + The Effector: carries out the response which counteracts the effect of the stimulus.
  + The Response: The action that is then carried out by the effectors
  + Feedback: is achieved because the original stimulus has been changed by the response.
* **Positive feedback**
  + Must be completed quickly
  + E.g. Childbirth - oxytocin from the posterior pituitary initiates childbirth -> causes contractions -> babies head is pushed out -> nerve impulse from cervix to brain intensifies contractions -> more of baby is  pushed out -> more impulses -> baby delivered -> nerve impulse to brain cease and cycle stops
  + E.g. Fever (small temp rise helps fight infection, but too much can increase metabolic rate too much, therefore body gets too hot, and can lead to death (45 degrees Celsius)

**ALZHEIMER'S VS PARKINSON'S**

|  |  |  |
| --- | --- | --- |
|  | Alzheimer's | Parkinson's |
| Causes | * + Less than 1% of the time it is caused by a combination of genetic changes   + Brain proteins fail to function normally, disrupt the work of neurons and neurons get damaged and end up losing connection to each other, and eventually die   + If plaques cluster together they have a toxic effect on neurons and disrupt cell to cell communication   + Tangles in tau proteins disrupt the transport system and are detrimental to neurons   + Increasing age increases you risk   + Family history and genetics can increase your risk   + Down syndrome increases your risk   + Past head trauma can increase your risk   + Mild cognitive impairment can cause you to develop the disease   + Poor sleeping patterns can increase your risk   + Poor lifestyle and heart health can increase your risk     - Lack of exercise     - Obesity     - Smoking or being around second hand smoke     - High blood pressure     - High cholesterol     - Poorly controlled type 2 diabetes   + Involvement in cognitive activities can LOWER your risk | * + Your genes can determine the likelihood of you getting Parkinson's   + Environmental factors can trigger this disease   + The presence of Lewy bodies.   + Age can increase your risk of getting Parkinson's   + Hereditary - your genes can be the reason you get Parkinson's   + Sex - men are more likely to develop Parkinson's   + Exposure to toxins can increase your risk of developing Parkinson's |
| Symptoms | * + Memory loss   + Difficulty organising thoughts   + Routinely misplace possessions   + Get lost in familiar places   + Forgetting the name of family members and everyday objects   + Have difficulty thinking and listening especially thinking about abstract concepts   + Multitasking becomes especially difficult   + Difficulty making decisions and judgement   + Difficulty performing familiar tasks   + Changes in personality and behaviour   + Some skills are often preserved | * + Tremors or shaking often in the limbs   + Slowed movement making simple tasks difficult and time consuming   + Rigid muscles, muscle movement may occur in part of your body   + Impaired posture and balance   + Decreased ability to perform automatic movements such as blinking and swallowing   + Speech changes - such as slurred, quick or slow speech   + Writing difficulties |
| Treatment | * + Drugs:     - Cholinesterase inhibitor - boosts cell to cell communication     - Memantine (Namenda).   + Management of the disease and creating a supportive environment     - Always keep keys, wallets, mobile phones and other valuables in the same place at home, so they don't become lost.     - Keep medications in a secure location. Use a daily checklist to keep track of dosages.     - Arrange for finances to be on automatic payment and automatic deposit.     - Carry a mobile phone with location capability so that a caregiver can track its location. Program important phone numbers into the phone.     - Make sure regular appointments are on the same day at the same time as much as possible.     - Use a calendar or whiteboard in the home to track daily schedules. Build the habit of checking off completed items.     - Remove excess furniture, clutter and throw rugs.     - Install sturdy handrails on stairways and in bathrooms.     - Ensure that shoes and slippers are comfortable and provide good traction.     - Reduce the number of mirrors. People with Alzheimer's may find images in mirrors confusing or frightening.     - Make sure that the person with Alzheimer's carries identification or wears a medical alert bracelet.     - Keep photographs and other meaningful objects around the house. | * + Medication:     - Carbidopa-levodopa helps to prevent side effects such as nausea     - Dopamine agonists mimics dopamine effects on the brain but isn't as good as Carbidopa-levodopa     - MAO B inhibitors help prevent the breakdown of brain dopamine by inhibiting the brain enzyme monoamine oxidase B     - Catechol O - Methyltransferase inhibitors - stop the destruction of dopamine     - Anticholinergics - controlled tremors - not used often anymore     - Amantadine - short term relief from symptoms   + Procedures     - Deep brain stimulation - Stimulates the brain via electrodes planted deep inside your brain as well as one in your chest |