



## **Edith Cowan University**

2023 ATAR Revision Seminar

### **ATAR Human Biology**

Curriculum Dot points

Examination and study tips

Revision notes Examination questions

Examination marker comments

Prepared and presented by

**Sharyn Bana**

**Year 12**  
**ATAR Human Biology**

Revision Seminar ECU September 2023

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**The Exam – 10 mins Reading Time**

- 1. Read and decide on your extended questions (need to pick 1 out of 2 for Unit 3 and 1 out of 2 for Unit 4)
- 2. Read EVERY word of the Short Answers (worth 50% of the paper)
- 3. Cover the alternates and read just the STEM of the Multiple Choice.

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**Reading Multiple Choice**

1. A boxer showered with punches to the head that force the head up and back may cause damage to the cerebellum against the back of the skull. Symptoms that a boxer would show if the cerebellum was injured in this way would include:

- a) loss of memory.
- b) inability to regulate temperature.
- c) extreme hunger.
- d) lack of coordination between muscle groups.

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### The Exam – 3 hrs Working Time

- 1. Write plans for the Extendeds (5 mins)
- 2. Do Multiple Choice – (30-35 mins) - 30%
- 3. Time check – end of multiple choice
- 4. Short Answers – (90-100 mins) - 50%
- 5. Time check – halfway through and at end
- 6. Extended Answers – (40 mins) - 20%
- 7. Time check - once after each question

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### The Exam – Doing Multiple Choice

- Cover alternates, read the stem, THINK about solutions / word association, then FIND the answer
- Cross off any alternates that you can, choose from what is left
- If two alternates are close – one is usually the answer!
- WARNING! Terms to watch out for:  
**only, always, never, except, incorrect**



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### The Exam – Doing Short Answers

- List / Name / State questions
- 1 word or term for 1 mark
- No elaboration required
- Write one item per line
- Use dot points
- Number of answers = number of marks
- Number of answers = number of lines

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### Example: List / Name / State

List two ways the hypothalamus communicates with the pituitary gland. (2 marks)

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Answer:

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### The Exam – Doing Short Answers

- Explain / Describe / Discuss / Why questions
- Requires sentences
- One idea per sentence
- One idea for 1 mark
- WARNING - *Describe* requires a description, not just a label eg: “describe 2 factors” requires more than “list 2 factors”! It wants to know HOW! *Explain* wants to know WHY?

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### Example: Describe / Explain

Describe two ways in which the hypothalamus communicates with the pituitary gland. (2 marks)

\_\_\_ The hypothalamus communicates with the anterior pituitary through hormones called releasing or inhibiting factors in the bloodstream (1). It communicates with the posterior pituitary through nerve impulses sent through axons to release hormones from axon terminals (1) \_\_\_\_

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### The Exam – Doing Short Answers

- Compare / Contrast / Differentiate between
- Compare – how are they similar?
- Contrast – how are they different?
- Differentiate – how are they different?
- You MUST match criteria on both sides eg: number of neurons in pathway for autonomic? Must state the same concept for somatic!
- Use a table / venn diagram to avoid missing things!
- Mark allocation can vary – 1 mark for both sides OR 1 mark for each – use lines and knowledge base to guide you

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### Example: Differentiate / Compare / Contrast

Show the differences between the structure and function of sensory and motor neurons. (4 marks)

	Sensory	Motor
Structure	Cell body to one side of the neuron (1)	Cell body at one end of the neuron (1)
Function	Conducts impulses towards the CNS (1)	Conducts impulses away from the CNS (1)

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### The Exam – Doing Extended Answers

- Read question and decide where the marks are going to come from
- ALWAYS use a format that SUITS the question: annotated diagram, table, venn diagram, dot points, paragraphs
- Do NOT do introductions or conclusions
- Always use appropriate terminology
- Label AND annotate any diagrams
- Use subheadings to signpost for your marker

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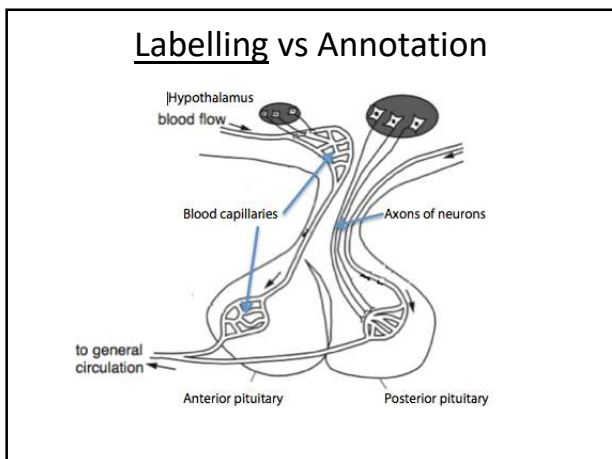
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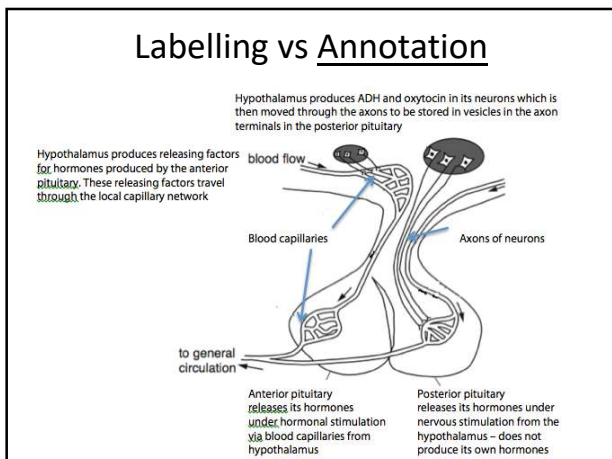
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### Finished the Exam Early? - Final Checks

- 5 mins – scan that you have one multiple choice answer for each question, scan short answers looking for questions that have not been addressed or where number of marks don't match answers - and put in your best guess; make sure extended questions have been numbered on all pages
- 10 mins – as above, and read short answers carefully to ensure mark allocations have been met, especially questions worth 2 or more marks
- 15 mins – as above, and read over extended answers

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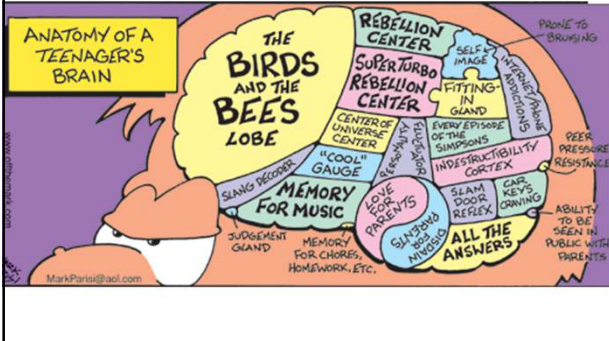
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# The Nervous System



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## Diagrams

- Brain labelling - structure and function
- Three different types of neurons
- Reflex arc
- Action potential graph
- Action potential across myelinated and unmyelinated axons
- Transmission across synapses

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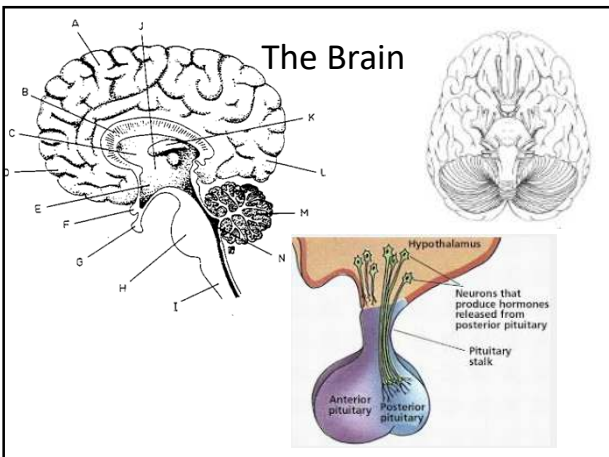
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## The Brain



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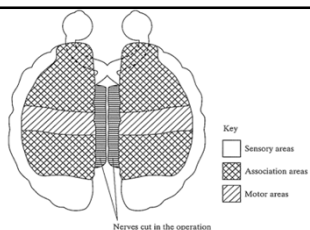
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**Quick Test!**



- A small electric shock was used to stimulate part of the brain. This caused a muscle in the left leg to contract.
- Label the diagram with the letter X to show the part of the brain that would cause the muscle to contract when stimulated. (1 mark)
  - During a surgical operation, the nerves connecting the two hemispheres were cut. What is the name of this structure that was cut? (1 mark)
  - The diameter of the pupil is affected by bright light. Describe the part played by the autonomic nervous system in altering the diameter of the pupil. (2 marks)

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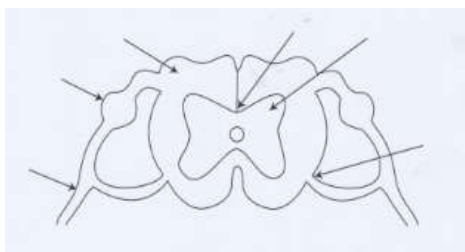
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**The Spinal Cord**




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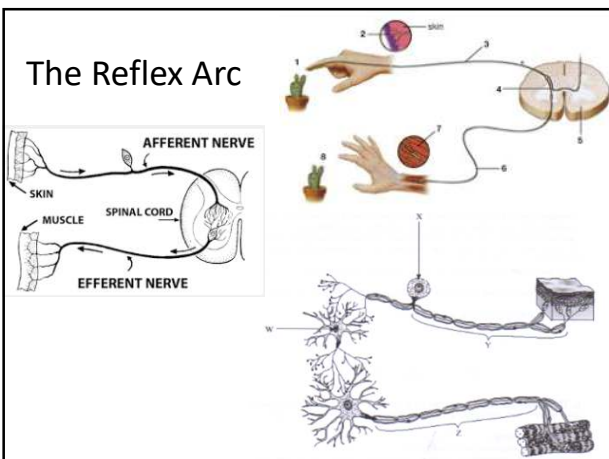
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**The Reflex Arc**




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### Nervous - Extended Questions

- Compare and contrast the somatic and autonomic nervous systems
- Compare and contrast the sympathetic and parasympathetic nervous systems
- Describe a reflex arc
- Transmission of nerve impulses
- Transmission across synapses

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### Quick Test!

Compare and contrast the somatic and autonomic nervous systems in terms of both structure and function. (6 marks)

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### SYMPATHETIC vs PARASYMPATHETIC NERVOUS SYSTEM

- **Division of the nervous system it belongs to** – both autonomic
- **Neurotransmitter used** – noradrenalin vs acetylcholine
- **Overall general effect** – stimulates vs returns to homeostasis
- Specific effect on the heart – increase vs decrease
- lungs - increase vs decrease
- Liver - increase vs decrease
- Iris - pupil increase vs decrease
- sweat glands – increase vs decrease
- **salivary glands – decrease vs increase**
- skeletal muscle blood vessels – increase vs decrease
- adrenal medulla – increase vs decrease
- **digestive system – decrease vs increase**

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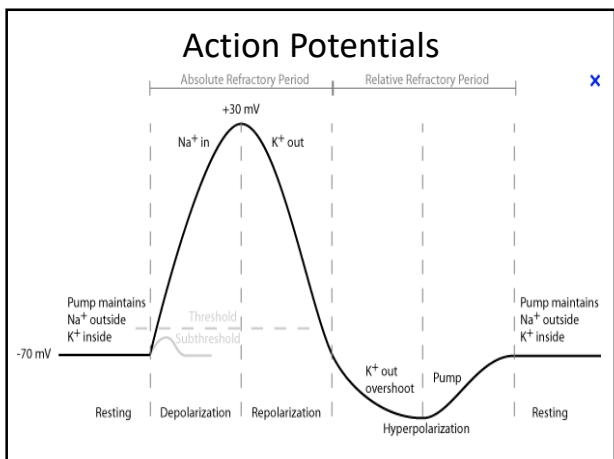
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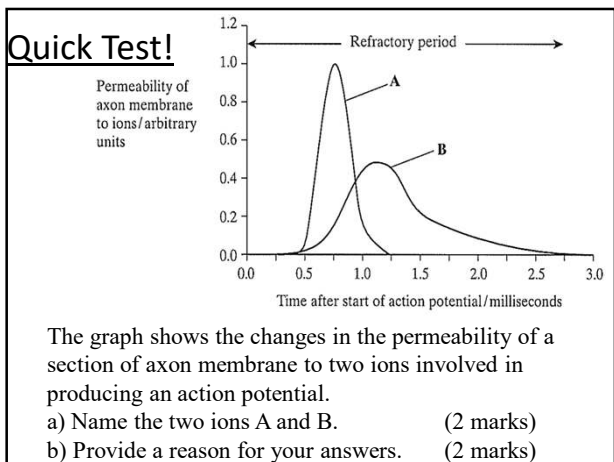
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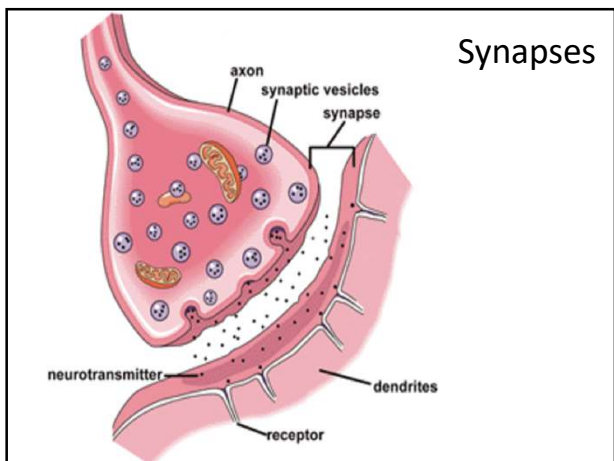
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- **Calcium** floods in
- Vesicles move towards axon surface
- Release by exocytosis
- Neurotransmitters move across by diffusion
- Neurotransmitters attach to receptors
- Cause **sodium channels** to open in that neuron
- Action potential continues
- Acetylcholinesterase breaks neurotransmitter down
- Reuptake channels move broken neurotransmitter back into presynaptic axon for reuse
- Active transport and ATP required

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**Quick Test**

It is reasonable to suggest that

- a) structure M secretes neurotransmitter molecules.
- b) an electrical message travels from cell X to cell Y.
- c) structure P supplies energy to transmit a nerve impulse.
- d) neurotransmitters diffuse from cell Y to cell X.

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**Alzheimer's and Parkinson's**

- **Differences**
- **Acetylcholine**
- Plaques/tangles
- Memory loss
- Mood swings
- Personality changes
- **Dopamine**
- Stoopd posture
- Tremors
- Rigidity
- Shuffling gait
- **Comparisons**
- Can't be cured
- **Loss of neurotransmitters**
- associated with older age
- **Treatment – stem cell therapy**

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### Break!



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### The Endocrine System



"Except for his testosterone level being out of whack, Frankie is a normal 7-year-old."

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### Diagrams

- Endocrine glands in the body
- Hypothalamus and pituitary relationship
- Thyroxine feedback loop (homeostasis)
- Lipid soluble and water soluble hormones
- Hypo and hyper thyroidism

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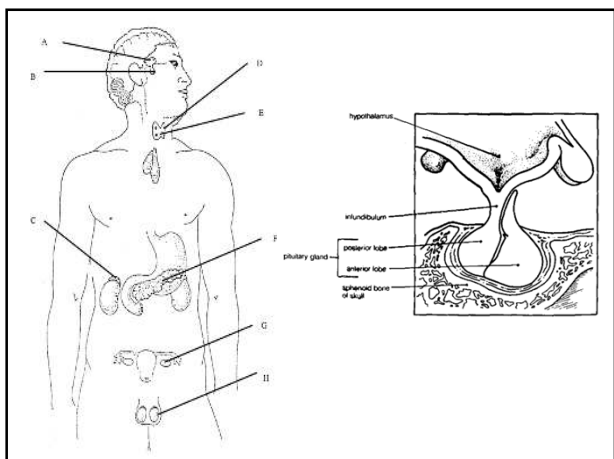
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### Endocrine - Extended Questions

- Differentiate between lipid soluble and water soluble hormones
- Relationship between hypothalamus and pituitary
- Thyroxine feedback loop
- Hypo and hyperthyroidism
- Compare/contrast nervous and endocrine systems

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### Water Soluble Hormones

- Protein / amines
- Act for a short period of time
- Carried dissolved in plasma
- Attach to receptors on cell membranes
- Do not enter cells
- Activate a secondary messenger inside cell
- Affect enzyme action in cytoplasm
- Eg: ADH, adrenalin (most hormones)

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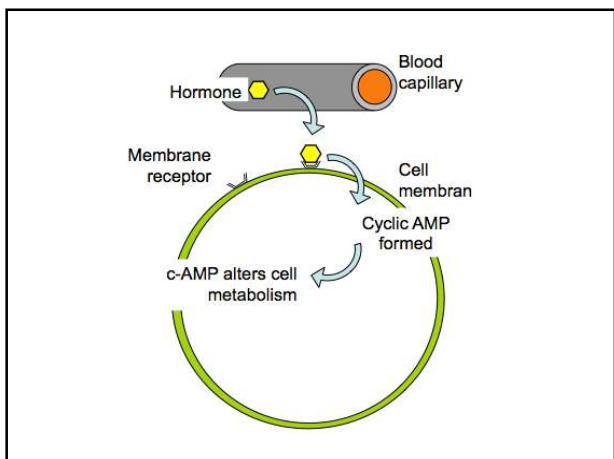
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### Lipid Soluble Hormones

- Steroid hormones
- Lipid soluble (not water soluble)
- Last longer
- Cause permanent changes
- Carried in blood attached to a protein
- Move through cell membranes
- Enter cells
- Attach to receptors in cytoplasm, on organelles such as mitochondria, in nucleus
- Can activate a secondary messenger
- Activates the genes to control production of proteins by altering mRNA transcription
- Eg: testosterone, cortisol, oestrogen, progesterone, aldosterone

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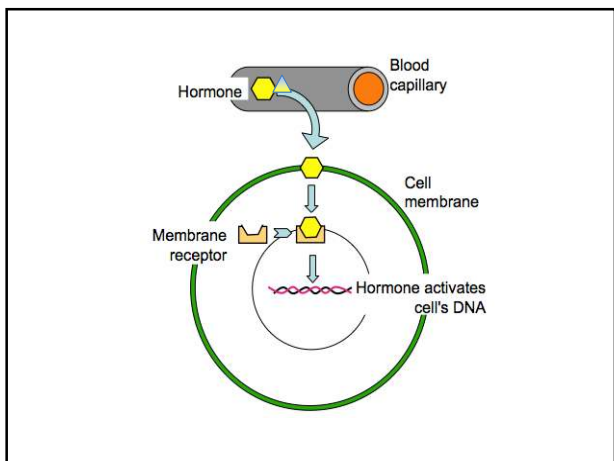
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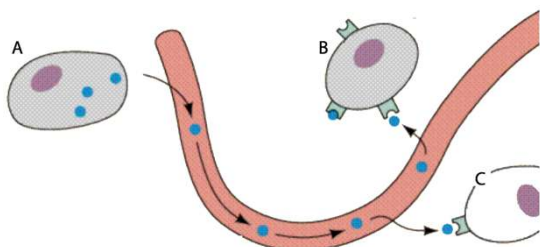
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**Quick Test!**

- a) What category of hormone is shown here? (1)
- b) How do you know? (1)
- c) What would Cells B and C be called? (1)



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**Relationship between the hypothalamus and pituitary – The ANTERIOR pituitary story**

- Hypothalamus produces r.f and i.f which are hormones
- These factors travel through the local bloodstream to the anterior pituitary
- These factors cause the anterior pituitary to release / stop releasing its own hormones into the blood
- In a diagram – look for blood vessels connecting the hypothalamus and anterior pituitary

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**Relationship between hypothalamus and pituitary – The POSTERIOR pituitary story**

- Hypothalamus *produces* two hormones: ADH and oxytocin
- These two hormones are passed in vesicles down long axons to axon terminals in the posterior pituitary where they are *stored*
- Nervous impulses from the hypothalamus cause the *release* of these hormones from the posterior pituitary into the bloodstream
- In a diagram – look for nerve fibres connecting the hypothalamus and posterior pituitary

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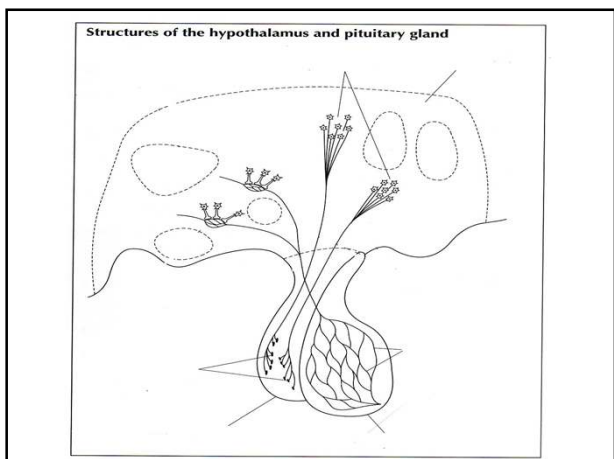
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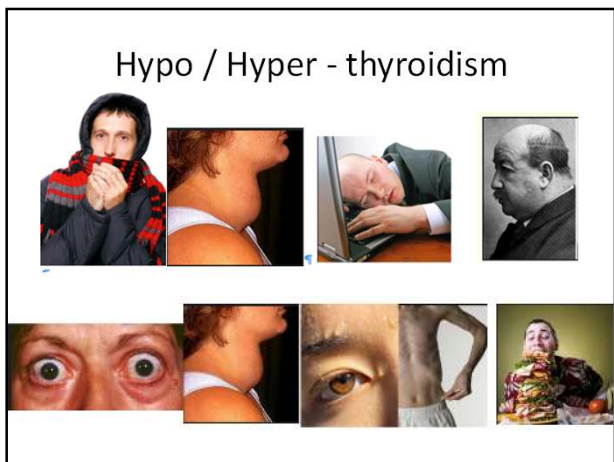
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**Differentiate between the Nervous and Endocrine Systems**

- Components – what is it made up of?
- Mode of transmission – how does it communicate with parts of the body?
- Specificity – how many different targets can it talk to at the same time?
- Speed of transmission – how quick does the message travel?
- Response time – how long does the action occur for?
- Persistence - how long does the actual stimulation last?

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### Homeostasis



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### Homeostasis - Diagrams

Feedback loops for:

- Glucose
- Carbon dioxide
- Water and thirst
- Temperature (including Thyroxine)

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### Homeostasis – Extended Questions

- Feedback loops: glucose, temperature, carbon dioxide, water, thirst, thyroxine
- Mechanisms of heat loss / heat gain: vasoconstriction, vasodilation, sweating, excretion, breathing, cell respiration, shivering, behavioural
- Mechanisms of heat transfer: conduction, convection, radiation, evaporation
- Diabetes

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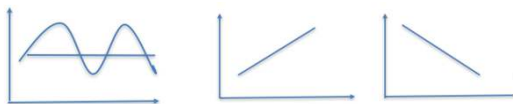
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### Positive and Negative Feedback

- Negative –
- feedback OPPOSES original stimulus



- Positive –
- feedback ENHANCES original stimulus

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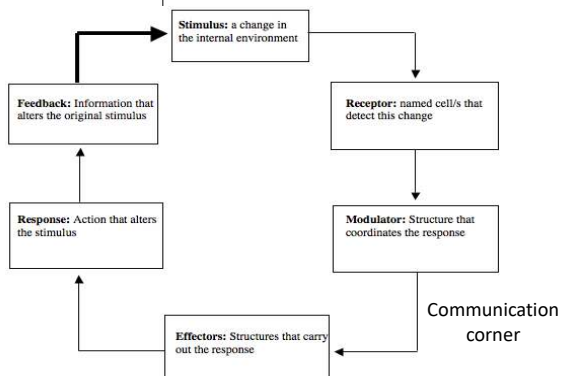
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### The Basic Cake




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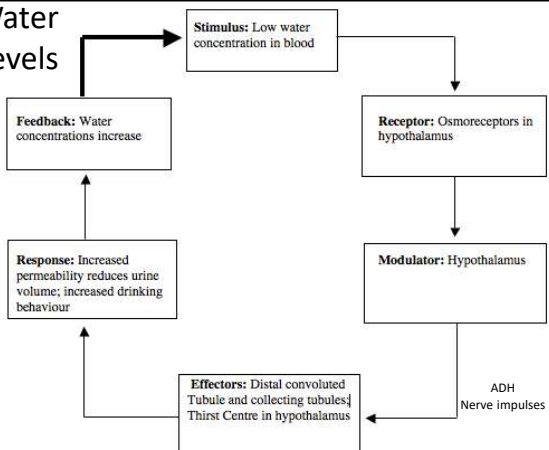
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### Water Levels




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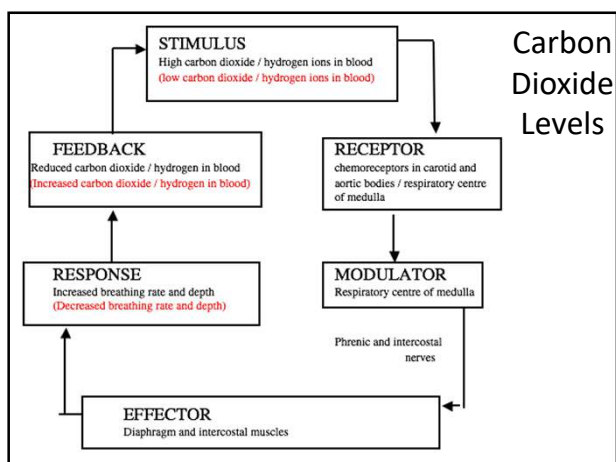
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### Heat Transfer

**GAIN or LOSE:**

- Conduction – contact of solid to solid, solid to still liquid  
Eg: lying on cold ground, standing in pool
- Convection – solid to moving gas / solid to moving liquid  
Eg: swimming, riding a bike in wind
- Radiation – no contact  
Eg: sun's rays, losing heat to the air around you

**LOSE only:**

- Evaporation – liquid converted to gas  
Eg: sweating

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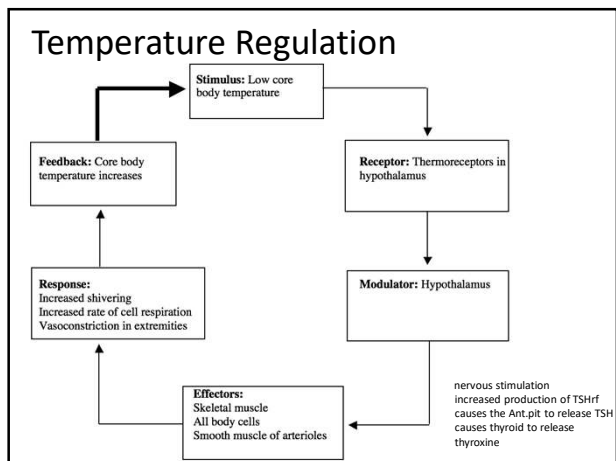
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### Quick Test!

A hiker got lost in the Tasmanian bush during winter, when conditions dropped to -5°C and snow was 30cm deep. The hiker

- a) should bury himself in snow to increase heat gain through convection.
- b) will lose most heat through radiation.
- c) will shiver and vasodilate vessels in the skin to maintain core body temperature.
- d) should sit down on the ground to gain heat through conduction.

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### Glucose Homeostasis

- Glucose
  - smallest unit of sugar
  - can move in and out of cells
  - is required for cell respiration
- Glycogen
  - medium term storage form
  - found in all body cells, esp. muscle
- Fat
  - long term storage form
  - found around organs, subcutaneously



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### Daily Glucose Hormones

- Glucagon
  - alpha cells
  - increases blood glucose  
(by breaking glycogen down into glucose)
- Insulin
  - beta cells
  - decreases blood glucose  
(causes glucose to move into cells, store it as glycogen, increases protein synthesis – which requires energy)



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### Serious Glucose Hormones

- Cortisol – from adrenal cortex  
- increases blood glucose  
(converts glycogen to glucose, breaks down fat)
- Adrenalin – from adrenal medulla  
- increases blood glucose  
(converts glycogen and lactic acid to glucose)

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### The processes

- Glycogenesis- Glyco = glycogen  
Genesis = creation  
Creation of glycogen (insulin)
- Glycogenolysis - Glyco = glycogen  
Lysis = destroy  
Destruction of glycogen (glucagon)
- Gluconeogenesis - Gluco = glucose  
Genesis = create  
Neo = new  
Creation of glucose from new sources (cortisol, adrenalin)

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Watch out for....



The modulator – this is the one case where the modulator is NOT in the CNS!! Where is it?

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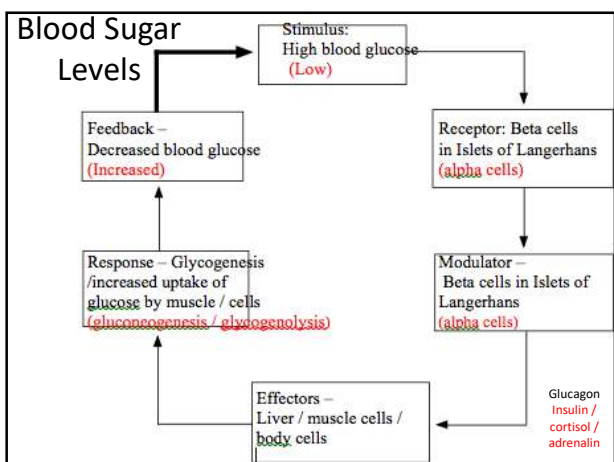
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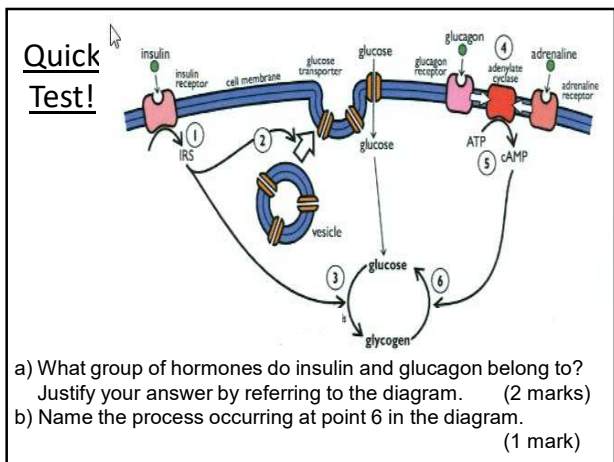
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a) What group of hormones do insulin and glucagon belong to? Justify your answer by referring to the diagram. (2 marks)  
 b) Name the process occurring at point 6 in the diagram. (1 mark)

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### Diabetes Type I and II

Type I (insulin dependent)	Type II (insulin independent)
The body is unable to produce insulin	The body cannot produce sufficient insulin
This may be due to an autoimmune response, where the body's immune system attacks its own B cells in the islets of Langerhans	May also be due to the target cells losing their responsiveness to insulin
Normally begins in childhood (also called juvenile-onset diabetes)	Usually arises in people over 40 years old (late-onset diabetes)
Develops quickly, normally over a few weeks	Develops slowly
Symptoms: a high blood glucose level, glucose present in the urine; increased thirst and hunger; weight loss; the need to urinate excessively; tiredness	Symptoms are normally less severe and may be put down to 'overwork' or 'old age'

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**Quick Test!**

Who is diabetic?  
Give three reasons for your choice.

**Table 3.3** The blood glucose levels of two people after consuming the same quantity of glucose.

Time after drinking juice (min)	Blood glucose level (mg/100 mL)	
	Matthew	Ely
0	86	85
15	110	125
30	140	170
45	115	190
60	90	210
75	80	210
90	84	200
105	85	180
120	85	145

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**Break!**




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**Immunity**




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### Immunity - Diagrams

- Phagocytosis process
- Inflammation
- Ways antibodies work
- T and B cell cloning and action
- Primary and secondary response graphs

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### Immunity - Extendeds

- Types of microorganisms
- Ways in which diseases can be transmitted
- Non specific immunity
- External vs internal immunity
- B cells
- How antibodies work
- T cells
- Types of immunity: natural, artificial, active, passive
- Sizes of immune response: primary, secondary, tertiary
- Vaccination programs / the ethics of vaccinating

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### Types of Microorganisms

Bacteria	Viruses
Seen using a light microscope	Seen using an electron microscope
Classified according to their shape	Classified according to their nucleic acid
Outer cell wall, cell membrane, DNA in cytoplasm, plasmids of DNA, form spores	DNA or RNA surrounded by a protein coat
Reproduce by simple fission	Reproduce by taking over host cell DNA

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### Other microorganisms and Examples

- Fungi – typically affect the skin eg: thrush, tinea, ringworm
- Parasites – ectoparasites (fleas, ticks) or endoparasites (tapeworms)
- Bacteria – tetanus, whooping cough
- Virus – COVID, HIV, chickenpox, cold

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### Transfer Mechanisms

- Transmission by contact – direct or indirect
- Transfer of body fluids – blood, semen, saliva
- Infection by droplets – sneezing, coughing, talking
- Ingestion – through food or drink
- Airborne transmission – dehydrated particles
- Vector – other organism transmits it (but is not affected itself)

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### Quick Test!

- Tuberculosis is a disease that results in bacterial growth in the lungs. It causes the sufferer to cough and find it difficult to breathe properly. How would tuberculosis be spread most effectively?
- a) Direct contact
- b) Vector
- c) Ingestion
- d) Droplets

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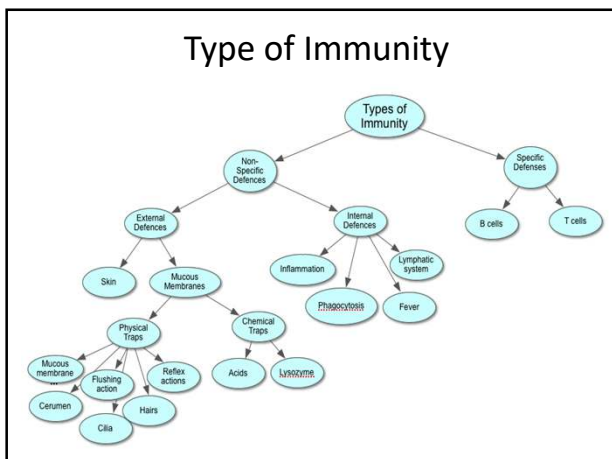
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### Primary Defence - External Non-Specifics

- Skin – physical barrier, sebum (lysozyme and waterproofing)
- Mucous membranes –
- 1. Physical – turbinate bones in nose, hairs, cilia, mucous physically traps particles, cerumen
- 2. Chemical – acid (stomach, vagina), lysozyme (in most body fluids)
- Reflex actions – sneeze, cough, vomit
- Flushing actions - urine, tears

74

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### Secondary - Internal Non-Specifics

- Phagocytosis – chemotaxis, adherence, ingestion, digestion, excretion
- Inflammation – mast cells release histamine, heparin, with vasodilation causes redness, pain, swelling, heat, phagocytes result in pus

75

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### Internal Non-Specifics (con't)

- Fever – interleukins and prostaglandins (pyrogens) cause the hypothalamus to reset higher (feel cold, shiver, vasoconstriction). When fever breaks, hypothalamus resets down (feel hot, sweat, vasodilate). Aspirin prevents prostaglandins being produced.
- Lymphatic system – lymph nodes filter lymph, macrophages and phagocytes do phagocytosis

76

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### Tertiary - Specific Immunity

- Immune responses that combat one particular type of pathogen / antigen / species of organism
- All lymphocytes arise in bone marrow – half migrate to the thymus and mature there (now called T cells), half remain in the bone marrow or migrate to the spleen and mature there (now called B cells)
- Once mature B and T cells migrate around the body to reside in all lymphoid tissue

77

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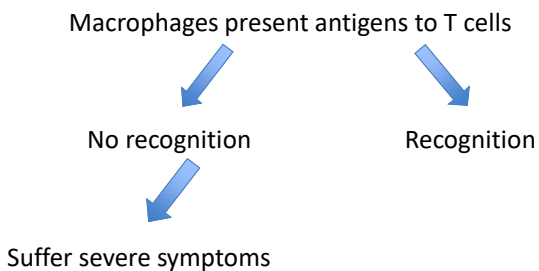
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### Cell Mediated Immunity – T cells



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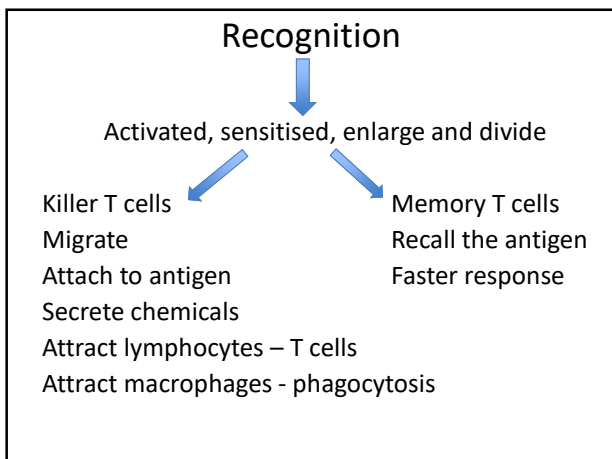
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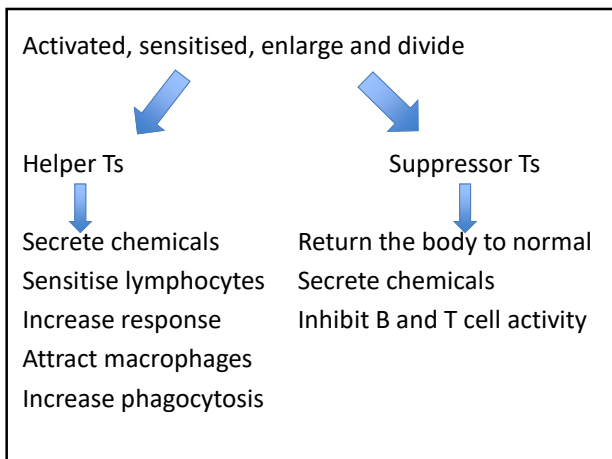
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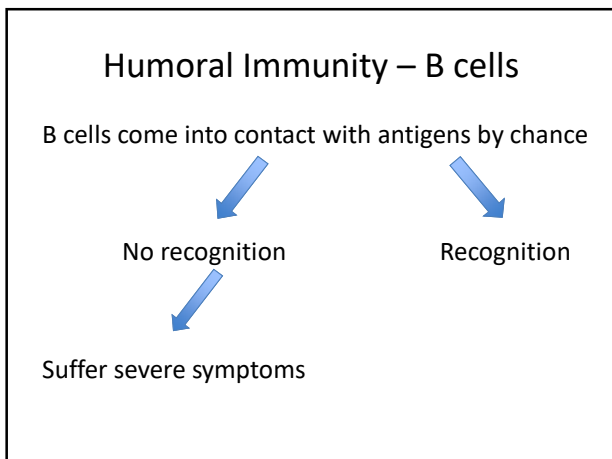
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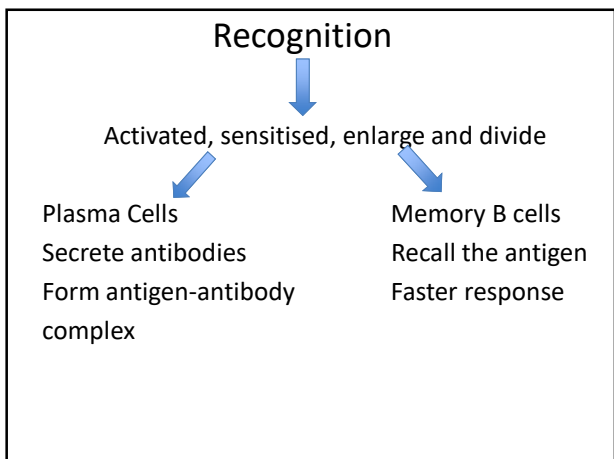
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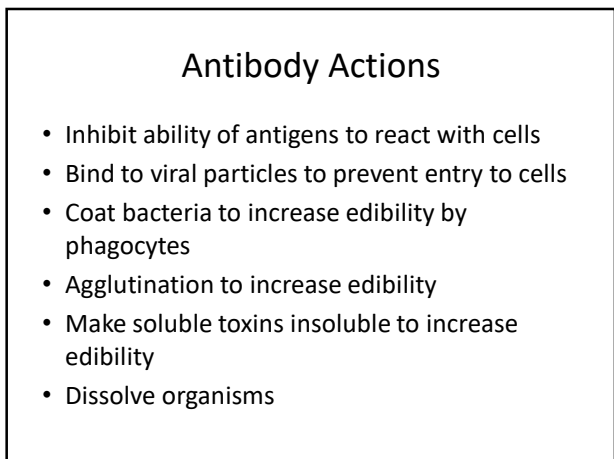
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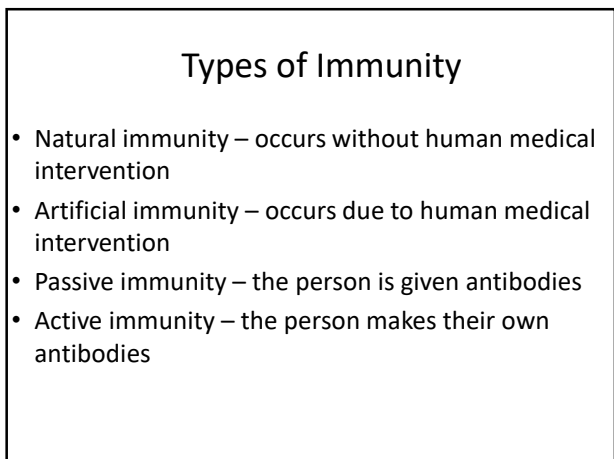
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### Types of Immunity - Examples

- **Natural passive** - antibodies enter a baby across the placenta or via breast-milk
- **Natural active** - we catch a disease from somebody and make our own antibodies eg: catch a cold
- **Artificial passive** - we are injected with antibodies after we have caught the disease eg: tetanus
- **Artificial active** - we are injected with an antigen so we make our own antibodies eg: vaccination

85

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### Quick Test!

A park ranger was injected with an anti-venom serum to treat a snakebite. The treating doctor explained that the injection would not protect him against future snakebites. This is because anti-venom serum is used to achieve immunity that is

- a) active natural.
- b) passive natural.
- c) active artificial.
- d) passive artificial.

86

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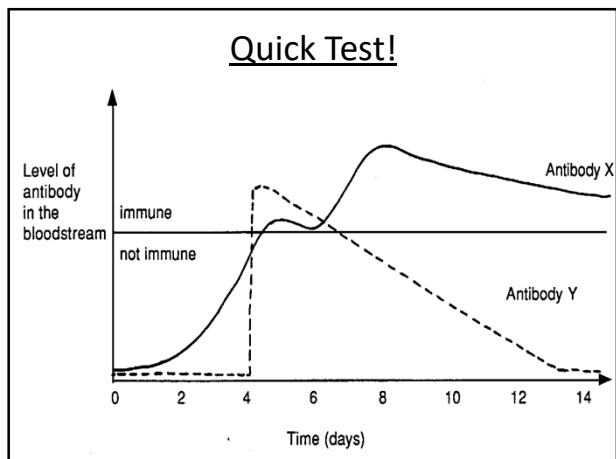
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### Quick Test!



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### Vaccines

Vaccines – artificially produced by humans

- Attenuated living – only weakened, give a stronger longer lasting immune response
- Attenuated dead – killed outright, do not give as strong or long lasting an immune response
- Toxoids – made from chemicals produced by bacteria
- Sub-unit vaccine – made with part of the coat of a microorganism
- Conjugated – weak antigen joined to a strong antigen to produce a stronger immune response

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### Antibiotics

Antibiotics – produced by fungi to kill bacteria and fungi

- Bacteriostatic – prevents bacteria from reproducing
  - Bacteriocidal – kills bacteria
- OR
- Broad spectrum – kill lots of different types of bacteria
  - Narrow spectrum – kills only one /a few specific types of bacteria

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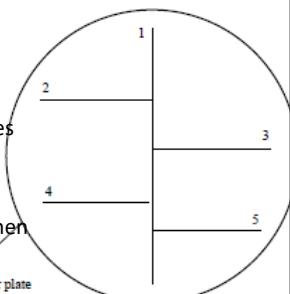
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### Quick Test!

The diagram shows a screening test to find out if a newly discovered microorganism secretes an antibiotic. The organism was first placed onto a nutrient agar plate along line 1. Four different known species of bacteria were then placed along lines 2,3,4 and 5.



- What results would you expect to see if the microorganism
- i) had no antibiotic activity? (1 mark)
  - ii) secreted a broad spectrum antibiotic? (1 mark)
  - iii) secreted a narrow spectrum antibiotic? (1 mark)

90

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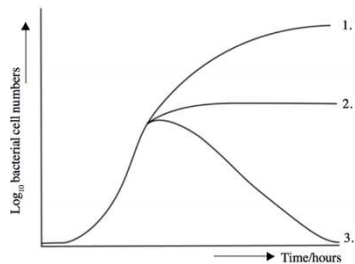
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**Quick Test!**

The graph shows the number of bacteria formed over time for three different types of treatment for bacteria: 1, 2 and 3.



Which line depicts the least effective treatment? (1)  
Which line shows a bacteriostatic treatment? (1)

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91

**Biotechnology**



"I don't need to check anything with 'the boys in forensics', I know it was you."

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92

**Biotechnology - Diagrams**

- DNA electrophoresis
- PCR process
- Recombinant DNA (genetic engineering)

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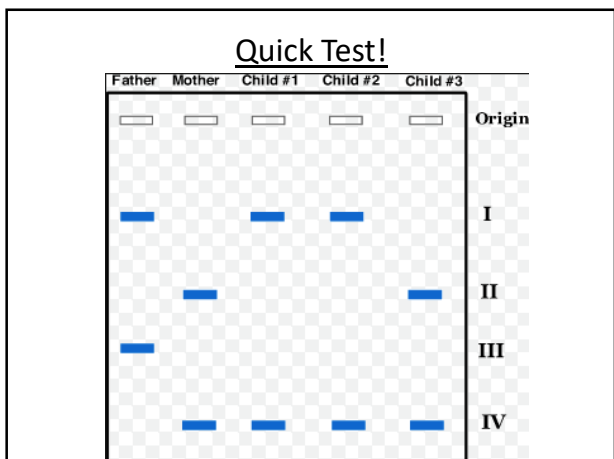
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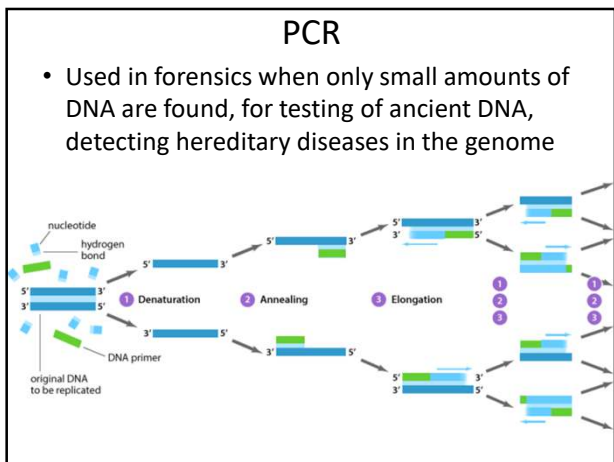
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### PCR

- Step 1: Denaturing - DNA is denatured at 96°C
- Step 2: Hybridization / annealing – Cooling occurs down to 50-65°C when primers are added which anneal to the DNA.

Primers - complementary sections of DNA, initiate replication by DNA polymerase

- Step 3: DNA synthesis / elongation - Raised back up to 72°C. DNA (Taq) polymerase is added and this substance builds a copy of each of the two single DNA strands. Each cycle takes about 3 – 5 minutes.

Requires abundant nitrogen bases for replication  
 This series of steps is replicated so that each time the whole process occurs, the DNA is doubled: 1 strand to 2 strands, 2 strands to 4, 4 to 8, 8 to 16 and so on.

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**Quick Test!**

a) What must be done between stages 1 and 2 to separate the strands of the DNA molecule?  
(1 mark)

b) Complete and label the diagram at stage 2.  
(2 marks)

100

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**Recombinant DNA  
(genetic engineering)**

- Introduction of new DNA into cells of an organism who normally doesn't have that DNA
- Used for gene replacement technology, production of hormones (insulin, growth hormone), vaccines, proteins, Factor VIII
- Requires restriction enzymes, DNA ligase

101

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102

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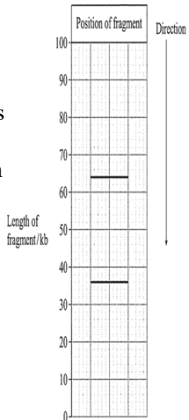
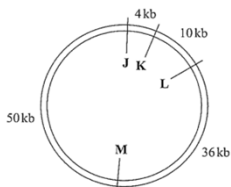
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**Quick Test!**

Fig 1 below shows the position of four restriction sites: J, K, L and M, in a single plasmid. The distances between these sites is measured in kilobases (kb) of DNA. A plasmid was cut using only two restriction enzymes and then the fragments were separated by gel electrophoresis as shown to the right.




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103

**Break!**




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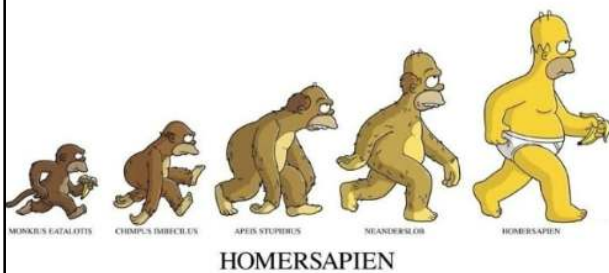
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104

**Natural Selection and Evolution**




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105

### Evolution – Diagrams

- The fossilisation process
- Dating techniques - Stratigraphy / superposition, C14 graph interpretation
- Evidence for evolution - DNA / amino acid sequences
- Hominin skulls
- Hominin vs great apes (pongid) skeletons
- Tools
- Other cultural artefacts

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### Evolution - Extendeds

- Sources of variation
- Mutations
- Heterozygote advantage (sickle cell)
- Natural selection process
- Speciation process
- Random genetic drift and founder effect
- Fossilisation
- Evidence for evolution (fossils, DNA, amino acids)
- Dating techniques – compare / contrast
- Pongid – Hominin comparison
- Hominin species comparison
- Tools over time

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107

### Sources of Variation

- Meiosis
- Crossing over
- Random assortment of chromosomes
- Mutation (germ line, somatic)
- Sexual reproduction
- Epigenetics

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108

### Natural Selection

- **Variation exists** in a population
  - Birth rate is higher than can be sustained
  - Size of population maintained over time
- Therefore:
- there must be a **struggle for existence**
  - Those with characteristics most suited to the environment are more likely to survive and reproduce (**survival of the fittest**)
  - Over time the allele frequency of that characteristic increases in the population and the population becomes more alike in that feature

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109

### Random Genetic Drift

- Occurs in small populations
- Non directional variation in allele frequencies that occurs by chance
- May not provide a selective advantage
- Eg: Dunkers (Blood type A 60% vs 45% in Germany)

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110

### Founder Effect

- Occurs in small populations
- Not representative of the original gene pool
- Due to natural disaster, geographical barrier, religious isolation
- Eg: Pitcairn Island, Pingelap Island (total colour blindness) , Ashkenazic Jews (Tay Sachs)

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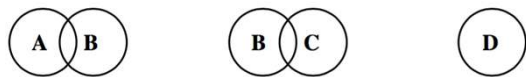
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111

**Quick Test!**

A, B, C and D are four populations of one organism. Overlapping circles indicate interbreeding of the populations concerned.



- a) Give two possible explanations as to why population D is not able to reproduce with the other populations. (2 marks)
- b) If conditions in the environment change rapidly, which population would be least likely to survive? Explain your answer. (2 marks)

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112

**Heterozygote Advantage**

- Sickle cell – malaria
- AA dies from malaria
- aa dies from sickle cell anaemia
- Aa does not die from malaria OR sickle cell
  
- Symptoms Aa – fatigue, pain, clotting under times of stress

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113

**Evidence for Evolution - Fossils**

- Things to know about fossils:
- How are they made?  
Alkaline / sedimentary / buried / rapid cover / no scavengers / no bacteria / no oxygen if wet acidic soil (peat bogs = soft tissue kept)
  - Why can't we find them?  
Look in the wrong places / not recognised / too deep / destroyed by pressure or heat / not accessible
  - How do they support evolution?

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### Evidence for Evolution - Fossils

- Types of fossil found in various strata are different.
- Further back in time, the more simple fossils are.
- Some fossils are completely unlike any species alive today.
- Present day forms are not preserved in the fossil record and so presumably did not exist in the past.
- Changing structure over time allows us to see the development of the species. Eg: horse leg.
- Some 'missing links' (transitional forms) have been found - eg: Archaeopteryx (birds and reptiles)

115

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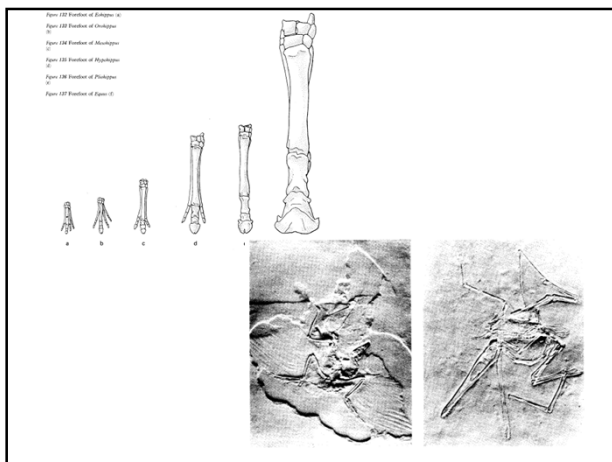
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### Comparative Proteins

- The type and number of amino acids in the sequence for similar proteins are compared between species.
- The greater the similarity - the closer the relationship.
- The greater the time between the common ancestor and the divergence into different species - the greater the difference in the amino acid sequence.
- Eg: cytochrome C used for respiration, haemoglobin.

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Quick Test!

	human	monkey	pig	cow	sheep	horse	dog	rabbit	kangaroo
human	0								
monkey	1	0							
pig	10	9	0						
cow	10	9	0	0					
sheep	10	9	0	0	0				
horse	12	11	3	3	3	0			
dog	11	10	3	3	3	6	0		
rabbit	9	8	4	4	4	6	5	0	
kangaroo	10	11	6	6	6	7	7	6	0

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**Comparative DNA**

- The more similar the DNA sequences of **nitrogen bases**, the more closely related the species are and the more recent the common ancestor.

Mitochondrial DNA

- Inherited through the mother / maternal line
- Is only 16,500 base pairs large
- Has a higher rate of mutation than that of nuclear DNA
- Used to identify relationships
- The greater the number of mutations the more distant the relative ancestor
- Eg: Neanderthals and using cytochrome C

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**Dating Techniques - Relative**

- Relative – will only identify whether a specimen is **older or younger** than another
- Eg: superposition (further down is older), stratigraphy / correlation of rock strata (compares different areas), index fossils (eg: pollen, short temporal and wide geographical distribution)

120

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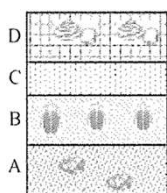
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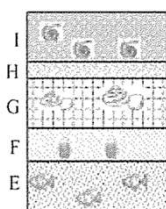
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**Quick Test!**

rock strata from site 1



rock strata from site 2



- a) Which layer is the youngest? (1 mark)
- b) What specific technique have you used to answer a) above? (1 mark)
- c) What technique would be used to say the fish found in layers A and E are the same age? (1 mark)

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121

**Dating Techniques - Absolute**

- Absolute – identifies the **actual age in years** of a specimen
- **Eg: Potassium argon –**
- $K40 \rightarrow Ca40 + Ar40$  (so Ar increases, K decreases)
- Half life 1,300 m.y
- Must be buried by volcanic ash (no argon)
- Dates 100,00-200,000 years **and older** (as not enough Ar to detect up to this point)
- Requires a rock of the same age

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122

**Dating Techniques – Absolute (con't)**

- **Eg: Carbon 14 -**
- C14 formed from action of radiation on Nitrogen
- Measures the ratio of C14 to C12 (decreases)
- Half life 5730 yrs
- Only dates up to 70,000 yrs  
(amount of C14 too small after this point)
- Must be organic (contain carbon)
- >3g in size
- Fossil must be destroyed to analyse
- Issues: C14 not the same everywhere in world / at different times through history

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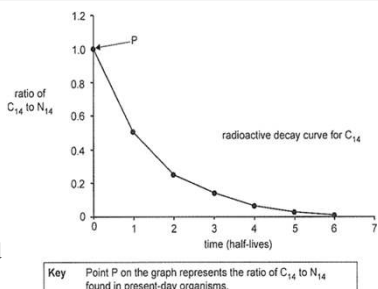
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123

### Quick Test!

A fossil kangaroo skull was found to contain one quarter of the carbon 14 of a kangaroo that died in 2012.



- Place an X on the curve to show the fossil's C<sub>14</sub>:N<sub>14</sub> ratio. (1 mark)
- Given the half life of carbon is approximately 5,730 years, what is the approximate age in years of the fossil kangaroo skull? (1 mark)

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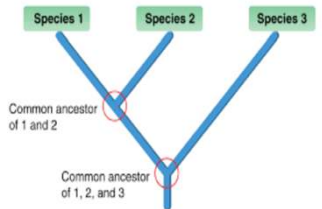
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124

### Phylogenetic Trees

- Show relationships between species over time
- Nodes depict common ancestors
- The longer the branch the more time has elapsed




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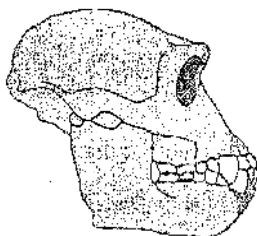
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125

### Australopithecus afarensis

- 4-2 mya
- 400cc
- No manufactured tools
- Herbivorous
- Prognathic, projecting canines. V shaped dental arcade, large cheek teeth, anterior foramen magnum




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126

### Australopithecus africanus



- 3-2 my
- 400-500cc
- Prognathic jaw
- large cheek teeth
- Small brow ridge
- Reduced prognathism
- V shaped dental arcade
- Herbivorous
- USED Oldowan tools

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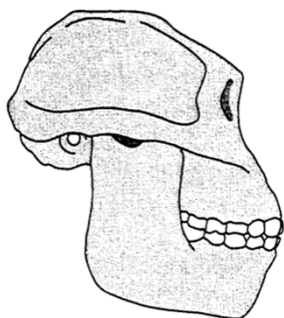
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### Paranthropus robustus

- 2 – 1 mya
- 520 cc
- No tools
- Sagittal crest, large zygomatic arches, large molars, large ramus



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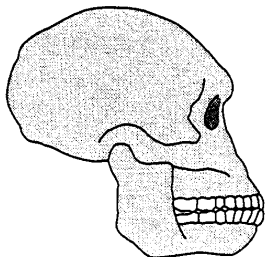
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### Homo habilis

- 2 – 1.5mya
- 500-800cc
- Oldowan tools
- Omnivorous
- Smaller brow, broca's area, less prognathic, smaller teeth, parabolic dental arcade, central foramen magnum



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### Quick Test!

This skull most likely belongs to

- a) *Australopithecus afarensis*.
- b) *Australopithecus africanus*.
- c) *Paranthropus robustus*.
- d) *Homo habilis*.



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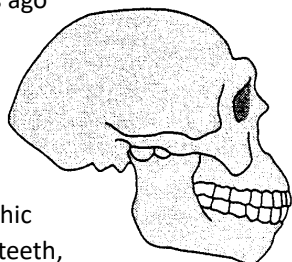
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130

### Homo erectus

- 1.8mya – 200,000 yrs ago
- 1000 cc
- Acheulean tools
- Omnivorous
- Fire
- Shelters - built, caves
- Sagittal keel, prognathic upper jaw, large cheek teeth, weak forehead



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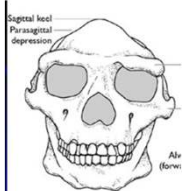
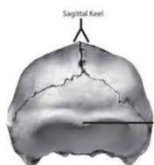
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131

### Homo erectus – sagittal keel



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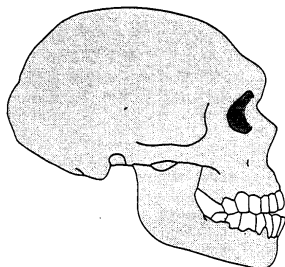
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132

### Homo neanderthalensis

- 300,000-30,000 yrs ago
- 1500cc
- Europe
- Mousterian tools
- Nomadic hunting groups
- Shelters – built / caves
- Complex speech
- Buried dead, rituals
- Occipital bun, swept back face, no chin, curved brow ridge, weak forehead




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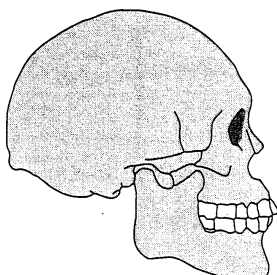
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133

### Homo sapiens (Cro Magnon)

- 30,000-10,000 yrs ago
- 1330cc
- Aurignacian, Solutrean, and Magdalenian tools
- Mural and portable art
- Nomadic hunting groups
- Shelters – built / caves
- Religious rituals
- Domesticated animals, cultivated crops
- Chin present, strong forehead, weak brow ridge




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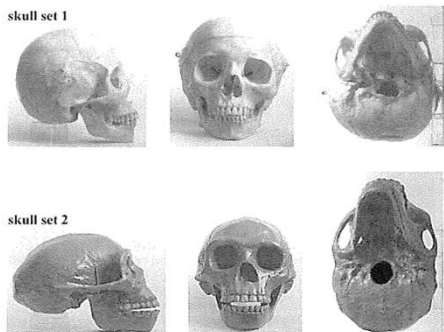
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134

### Quick Test!



With reference to the images provided, which skull set represents the oldest species? Justify your choice. (3 marks)

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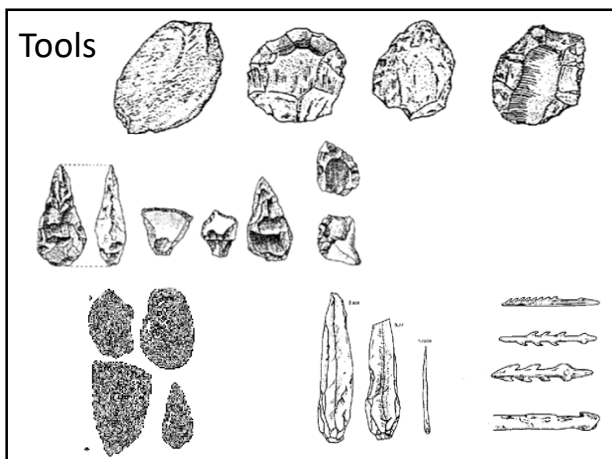
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**Changes in Tools Over Time**

- Few flakes/chips – many flakes / chips
- Large flakes / chips – small flakes / chips
- Used core as the tool – used flakes as the tool
- Chipped one edge – chipped all edges
- One tool for all tasks – tool specialised for task
- Only used rock – used rock, antler, bone
- Not attached - hafting
- No tools to make tools – burin used to make tools

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**Quick Test!**

Which species is most likely to have created this tool?



- a) *Australopithecus afarensis*
- b) *Australopithecus africanus*
- c) *Paranthropus robustus*
- d) *Homo habilis*

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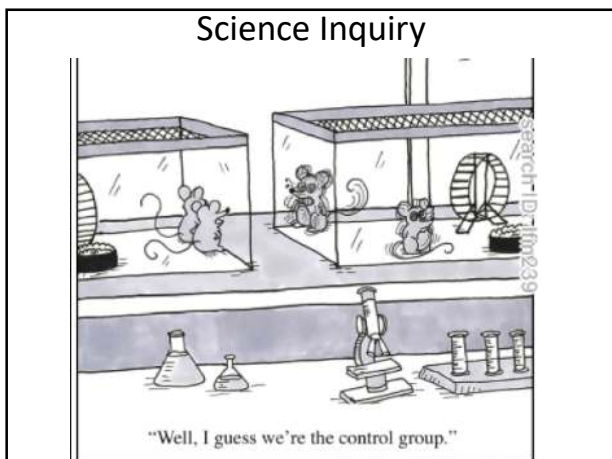
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### Drawing up Results Tables

- Title – one sentence that states the variables described by this data
- ALL trials and averages must be shown
- Use a ruler
- The first row / column should be the independent variable
- The second / other rows / columns will be the dependent variable
- Headings for rows/columns – what it is and its units
- No units should be shown in the actual cells with the numerical data

140

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### Graphing

Title - include information from both axes  
Headings on each axis - titles with units  
Scales - take up at least half the graph paper  
Do not go outside the graph paper  
Use a ruler to connect points / draw bars  
Show actual data points clearly as dots or crosses  
Independent variable – on horizontal axis  
Dependent variable - on the vertical axis  
Can use pen!

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### Types of Graphs

- Line graphs – used when the data is continuous  
eg: time, volume, mass  
dots are connected by straight lines
- Bar graphs – used when data is discrete eg:  
method of transport, seasons, car model  
bars are separate
- Histograms – used when plotting data using frequencies  
bars are joined together

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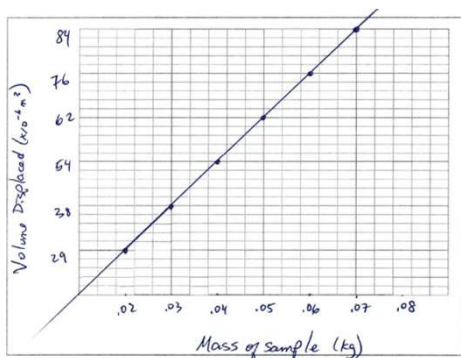
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142

### Quick Test!




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### Tricky Bits

- **Accuracy** – Is how well the data is actually measured at the time, free from parallax error etc.  
Improved by - Electronic devices, increasing the number of timers, having only one person read off the data, trained people collecting data
- **Reliability** – is the extent to which the experiment gives the same results each time it is performed.  
Improved by – Large numbers of subjects, repetition of trials
- **Validity** – when an experiment tests what it was meant to test (experiment is fair)  
Improved by - all variables being controlled except the independent variable

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**Quick Test!**

Scientists randomly selected 90 active women who had been diagnosed as being osteoporotic and placed them into two different groups.

Group One received 1400mg of calcium via a tablet every day.

Group Two received 1400mg of calcium via the food they ate as a normal part of their daily diet.

Individuals in both groups were assessed for their average bone density prior to commencing the investigation and every two months thereafter for the 6 months of the investigation.

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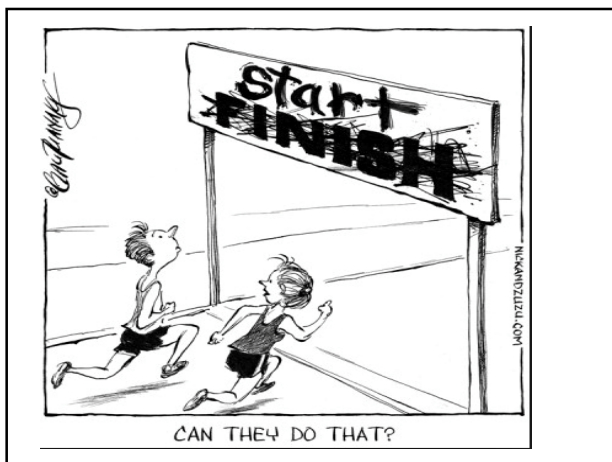
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Congratulations! You have now completed your revision booklet!

Edith Cowan University would like to wish all students the best of luck with their future exams!

