THE CHEAT SHEET

Grade **12**

CAPS

LIFE SCIENCES



Miss Angler

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THE CHEAT SHEET:

GR. 12 LIFE SCIENCES

Miss Angler

2ND EDITION
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CONTENTS PAGE

TOPIC	PAGE
question words in life sciences	5
dna replication	11
transcription	14
translation	16
meiosis	18
reproduction in vertebrates	26
human reproduction	28
menstrual cycle	32
monohybrid	36
sex-linked disorders	42
dihybrids	46
genetic engineering	50
nervous system	52
reflex arc	55
eye structure	58
hearing	64

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TOPIC	PAGE
amplification	65
posture	66
balance	67
endocrine glands	69
thermoregulation	74
osmoregulation	76
salt homeostasis	78
carbon dioxide homeostasis	79
blood glucose homeostasis	80
thyroid regulation	82
phototropism	84
geotropism	85
mechanisms of evolution	88
natural selection	92
speciation	93
evolution today	96
ape and human skeletal anatomy	98
fossil evidence for human evolution	101
hominid evolution	104
scientific method	109

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HOW TO USE THIS STUDY GUIDE

PLEASE REMEMBER: This study guide does not replace your textbook or the instruction of your teacher. Its purpose is to make learning and revision EASY!

1. The headings are hyperlinks

THE EYE

- Hover over **ANY** heading at the top of the page and click it.
- This will take you to one of my YouTube videos that match what you are learning OR Exam questions to practice.

2.

PRO-TIPS

- Use these pro-tips for exam success!
- These tips are often the reason why my students get 80%+ in their exams and finals.
- They also point out common mistakes you should be careful of when answering questions.

3. HOW WILL THEY ASK THIS?

- These pages are dedicated to answering questions correctly.
- Insight into how to get **FULL MARKS** every time.
- Points out what you should expect to see as a question in a test or exam.
- **BONUS**: I have also included the trickiest questions you may come across.

Click on the **SHORT**,**LONG** or **TRICKY** questions sub-headings and be taken to an **EXAM PRACTICE QUESTION** video on my YouTube.

REMEMBER: ALWAYS USE YOUR EXAM GUIDLINE WHEN PREPARING FOR AN EXAM OR TEST!

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QUESTION WORDS IN LIFE SCIENCE

ENGLISH	ISIXHOSA	AFRIKAANS	DEFINITION	HOW TO ANSWER	EXAMPLE Q
ANALYSE	Hlalutya utolike	Analiseer	Examine and interpret.	Often you will need to examine a diagram/graph and explain what you see by providing reasons from the image. You must use what you observe in your answer.	Analyse the trend of the graph.
CALCULATE	Bala	Bereken	A numerical answer is needed.	In general always show your working out and give a unit of measurement in your answer.	Calculate the average.
CLASSIFY	Hlela / beka ngokwamaqela	Klassifiseer	Group things based on common characteristics.	Often we will ask to classify based on a diagram, so use what you can see. Sometimes you will not always be able to see a structure so you will need to know these characteristics.	How do we classify plants?

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ENGLISH	ISIXHOSA	AFRIKAANS	DEFINITION	HOW TO ANSWER	EXAMPLE Q
COMPARE	Thelekisa	Vergelyk	Show either similarities or differences.	Often this will be a table answer but when writing the comparison your answers must complement each other.	Compare animal cells with plant cells.
DEFINE	Chaza intsingiselo	Definieer	Give a clear meaning.	Give a set definition that is usually word for word.	Define homeostasis.
DESCRIBE	Cacisa	Beskryf	State in words the main points of a structure/process/ phenomenon	You must provide the How, Where, When and Why. Often these questions require lots of detail and must be answered in the correct sequence.	Describe the process of fertilisation.
DETERMINE	Qinisekisa	Bepaal	To answer by examining something.	Look at the diagram/graph provided and come to a conclusion while providing a reason for your answer.	Determine the trend of the graph.

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ENGLISH	ISIXHOSA	AFRIKAANS	DEFINITION	HOW TO ANSWER	EXAMPLE Q
DIFFERENTIATE	Ahlula	Onderskei	Use differences.	Often you will need to explain or list the differences between structures/diseases/ processes. (similar to compare)	Differentiate between active and passive transport.
DISCUSS	Xoxa	Bespreek	Consider all info and come to a conclusion.	Take the results and provide reasons for why they may have happened.	Discuss the results of the experiment.
EXPLAIN	Chaza	Verduidelik	Provide a reason.	Often this answer will have a “cause” and “effect” structure. It will contain the How and Why (often confused with "describe").	Explain fertilisation.
IDENTIFY	Chonga / Ukwazi ukuba into iyintoni	Identifiseer	Name the essential characteristics.	Select visible structures/processes from the diagram given. Normally this question requires you to label something.	Identify the process at A.

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ENGLISH	ISIXHOSA	AFRIKAANS	DEFINITION	HOW TO ANSWER	EXAMPLE Q
LABEL	Xela / Leyibhela	Byskrif	Identify on a diagram or drawing.	Provide names for processes, structures, regions or products.	Label the diagram of the heart.
LIST	Yenza uluhlu	Lys	List items but with no further detail.	Often these questions require single-word answers. Remember, if it asks for 2 but you give 3, they will only mark the first 2 answers.	List the requirements for gaseous exchange.
MENTION	Khankanya	Noem	Refer to relevant points	These answers require no further explanation, just a statement.	Where does photosynthesis occur and mention the organelle used.
NAME	Xela / Biza Igama / Khankanya	Noem	Give the name (proper noun) of something	One word answers. Remember if they ask to name 2 things but you name 4 they can only mark the first 2.	Name TWO organs found in the digestive system.
STATE	Xela / Chaza	Se (bracket on the "e")	Write down information without further discussion.	Short answers are given, normally one sentence or a phrase. There is no further explanation needed.	State the purpose of chlorophyll.

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ENGLISH	ISIXHOSA	AFRIKAANS	DEFINITION	HOW TO ANSWER	EXAMPLE Q
SUGGEST	Bonisa	Stel voor	Offer an explanation or solution.	These often higher-order questions require you to think above what has been provided and to make links between ideas.	Suggest TWO reasons for the results seen in the experiment.
TABULATE	Hlela ngokwemiqolo/ ngokwemihlathi	Tabuleer	Draw a table	The answers in the table must read left to right and must complement each other. In other words they must consist of the same concept.	Tabulate the differences between ligaments and tendons.

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HOW TO ANSWER QUESTIONS FOR FULL MARKS

Ever wondered why no matter how much you study you can't achieve full marks in tests and exams? It probably has to do with how you structure your answer and using "everyday" vocabulary instead of using scientific terminology.

EXPLAIN

Every explain question's answer consists of a "**statement**" and a "**reason**". This means most often the mark allocation will be out of 2. However, if it is out of 3 this requires one statement followed by two reasons.

Eg: Explain why fertilisation occurs.
Statement - Fertilisation occurs in order to form a diploid zygote.
Reason - by fusing the haploid nuclei of a sperm cell with a haploid nucleus of an egg cell.

PRO-TIPS

- Take note of the **terminology** used in each of the answers.
- **Failure** to use words like "**diploid**" and replacing them with everyday vocabulary like "all the chromosomes" will lead to marks being lost.

DESCRIBE

Describe questions often require more detail and use of terminology. With a mark allocation often ranging from 4-8 marks depending on the structure/process or observation.
Use the guide of: **WHY**, **HOW**, **WHEN** and **WHERE**.

Eg: Describe how fertilisation occurs.
Where - in the fallopian tubes.
When- after ovulation the egg waits in the Fallopian tube for the sperm cell to arrive after ejaculation.
How- when a sperm and egg cell haploid nuclei fuse.
Why- to form a diploid zygote.

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DNA REPLICATION

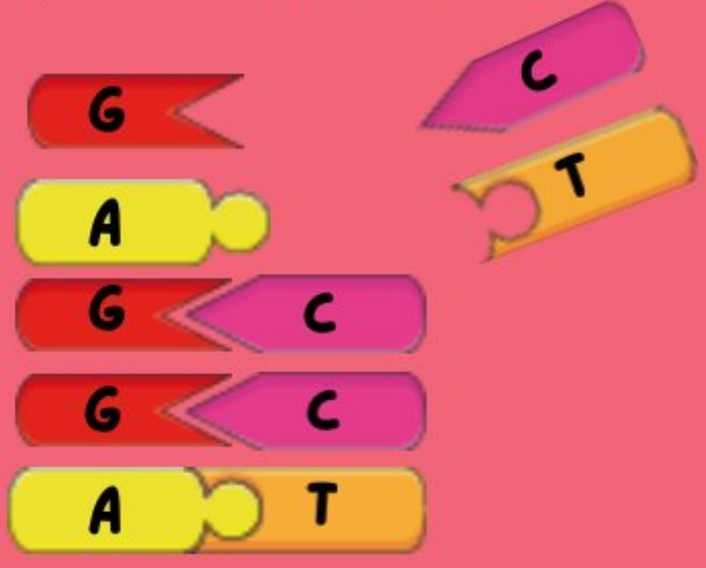
When: Interphase
Where: Nucleus
Why: To create identical copies of DNA needed for mitosis or meiosis (replace, repair or reproduce). Allows for hereditary info to be passed on. Maintains correct chromosome number.

How:

- Double helix unwinds
- DNA unzips/weak **hydrogen bonds** break into **TWO SEPERATE** strands
- BOTH strands act as a template.



- Free floating **DNA** nucleotides from nucleoplasm
- join to their **COMPLEMENTARY** DNA base triplets **OR** A-T and G-C



- Hydrogen bonds reform
- DNA rewinds and rezips
- Forms **TWO IDENTICAL** strands



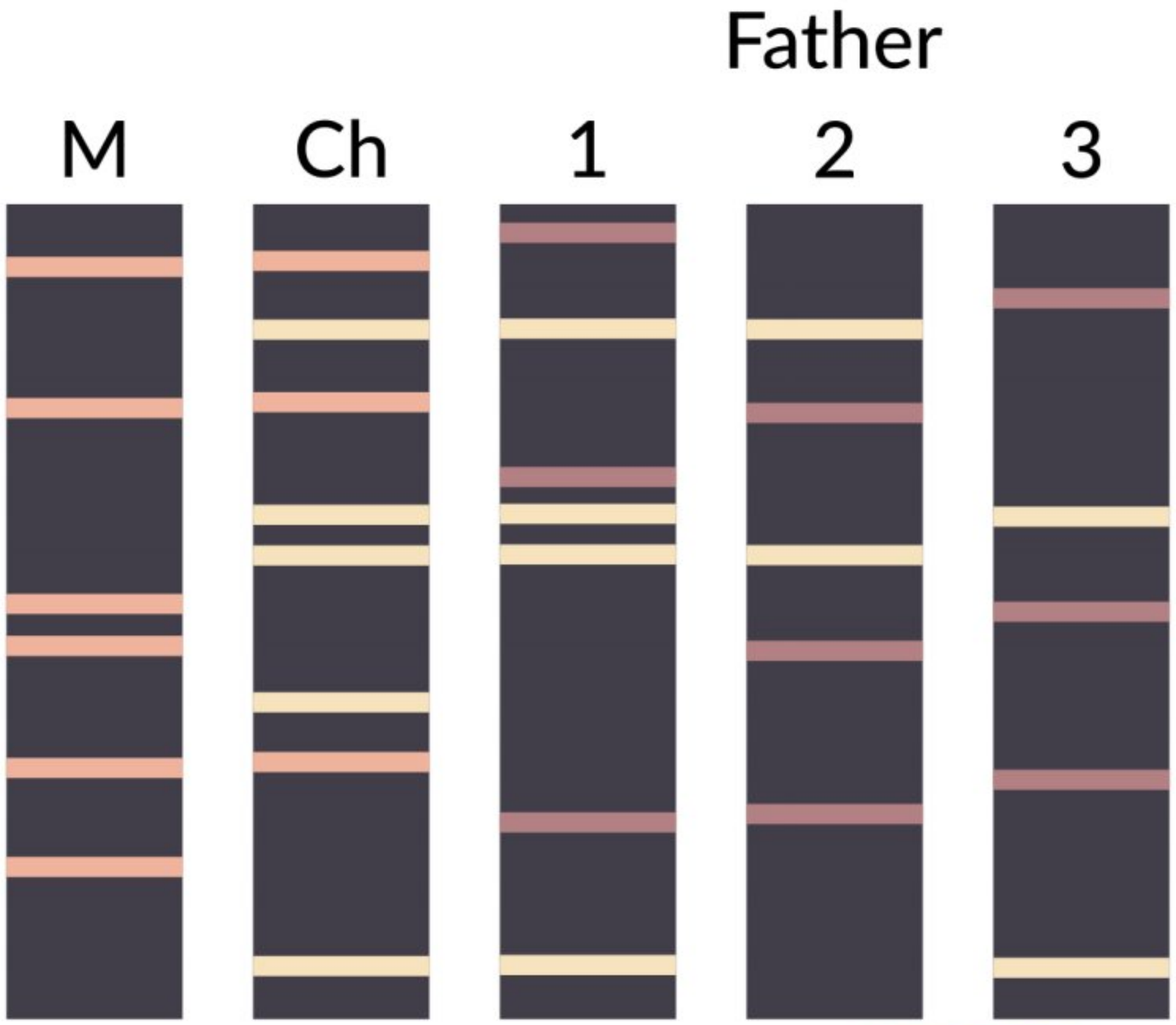
PRO-TIPS

- **ALWAYS** mention the type of nucleotide (DNA or RNA).
- **ALWAYS** speak about BOTH strands acting as a template.
- **DO NOT** confuse with TRANSCRIPTION as its very similar.
- **KNOW** the purpose of this process very well!

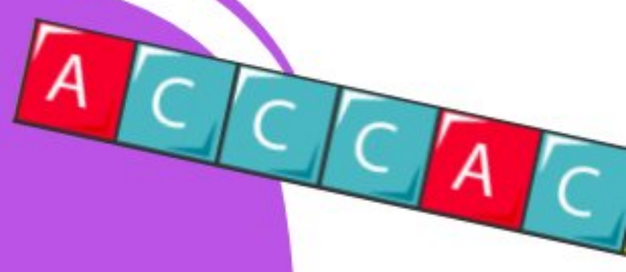
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DNA PROFILING



HOW TO USE AND EXPLAIN DNA PROFILES



PATERNITY TEST

- determining the father of the child
- take a ruler and highlighter an highlight all the markers (bands) that the child shares with the mother (M) and any of the potential fathers
- slowly drag the ruler down and ONLY highlight the marks that line up EXACTLY in position and thickness

HOW TO EXPLAIN IN EXAMS:

- 50% of the markers match the mother and 50% of the rest of the markers match the father
- this links to how the child will inherit 50% of their DNA from each parent



FORENSICS

- determine who the criminal is
- ALL the markers on the DNA profile must match

NOTE: DNA profiling may NOT be called DNA finger printing.

DNA profiling can also be used for:

1. identifying genetic disorders
2. species diversity

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Describe the process of DNA replication.**

1. A question with "describe" requires lots of details, so in your answer you must say:

- **Where** it happens
-**When** it happens
- **How** it happens
- **Why** it happens

- **Explain the process of DNA replication.**

2. This is a shorter answer where you make a statement and then provide a reason:

- **What** is transcription
-**Why** it happens

- **Explain the significance of DNA replication.**

3. You will need to explain why DNA replication takes place or its importance.

- **State** why it happens: to create identical DNA copies.
- **Explain** the reason why we need identical copies: ensure correct chromosome number, passes on hereditary info.

SHORT QUESTIONS

1. **Give the complementary DNA base triplet.**

- provide the correct DNA letters A-T and G-C.

2. **State when this process takes place.**

- during interphase (this question is asked VERY OFTEN) .

3. **Tabulate the difference between DNA replication and transcription.**

- simply draw a table of their functional differences and structural differences.

TRICKY QUESTIONS

- **Describe the significance of mutations that occur during DNA replication.**

- this question requires you to explain what would happen if DNA replication did not take place and what possible outcomes could be produced.
- you will need to mention things like:

*incorrect chromosome number
*mutations in somatic cells
*mutations in gametes
-

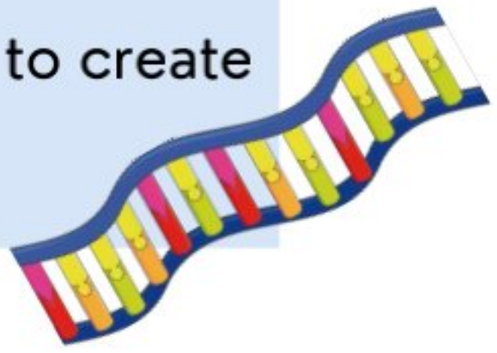


P: phosphate
S: sugar
T: thymine
A: adenine
C: cytosine
G: guanine

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TRANSCRIPTION

When: Protein synthesis
Where: Nucleus
Why: To transport code from DNA to ribosome to create proteins.



How:

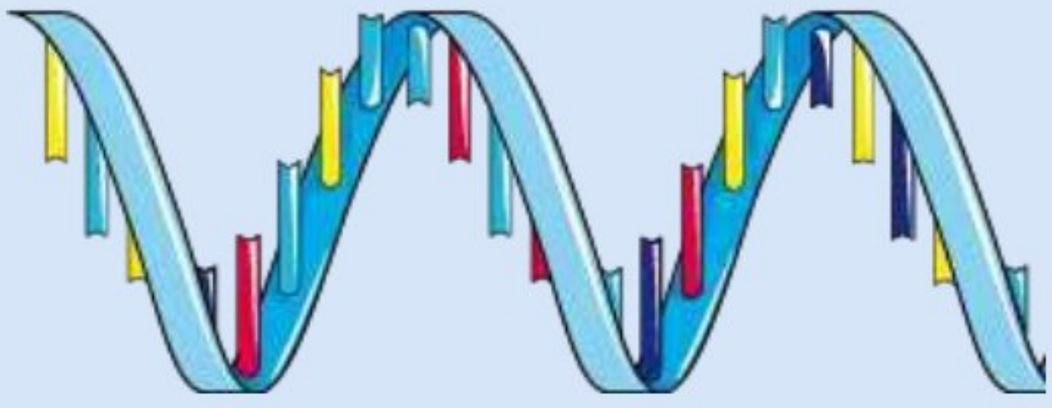
- Double helix unwinds
- DNA unzips/weak **hydrogen bonds** break into **TWO SEPERATE** strands
- **ONE** strand acts as a template



- Free floating **RNA** nucleotides from nucleoplasm
- join to their **COMPLEMENTARY** DNA base triplets **OR** A-U and G-C
- This produces **mRNA**



- mRNA now has the **coded message** for protein synthesis
- moves from **nucleus to cytoplasm**
- attaches to **ribosome**



PRO-TIPS

- **ALWAYS** mention the type of nucleotide (DNA or RNA).
- **ALWAYS** speak about ONE strand acting as a template.
- **DO NOT** confuse with DNA replication as its very similar.

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Describe the process of transcription.**

1. A question with "describe" requires lots of details, so in your answer you must say:

- **Where** it happens
-**When** it happens
- **How** it happens
- **Why** it happens

- **Explain the process of transcription.**

2. This is a shorter answer where you make a statement and then provide a reason:

- **What** is transcription
- **Why** it happens

- **Explain/Describe the effects of a mutation during transcription.**

3. This question overlaps knowledge from genetics and DNA (you may not be able to answer this yet).

- **State** the type of mutation
- **Explain** how the change may/may have not changed the amino acid/protein it's coded for

SHORT QUESTIONS

1. P**rovide the complementary bases.**

- write either the DNA or RNA bases that are complementary to the ones given.

2.**State the amino acid coded for codon** (X).

- here you will use the codon table they have provided and read the three letters to find which one matches.

3.**Tabulate the difference between mRNA and tRNA.**

- simply draw a table of their functional differences, locations and structures.

TRICKY QUESTIONS

- **State and explain the effect the mutation had on the production of a protein.**

- this question can be tricky because sometimes they change the mRNA codon HOWEVER the new codon codes for EXACTLY the same amino acid, therefore the SAME protein will form and no change had occurred (see below codon table).

Original codon : U<u>C</u>A = Sernine
Mutated codon: U<u>G</u>A = Sernine
The mutation had no affect on the type of amino acid.

CODON	AMINO ACID
UCA	SERNINE
GCA	PROLINE
UGA	SERNINE

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TRANSLATION

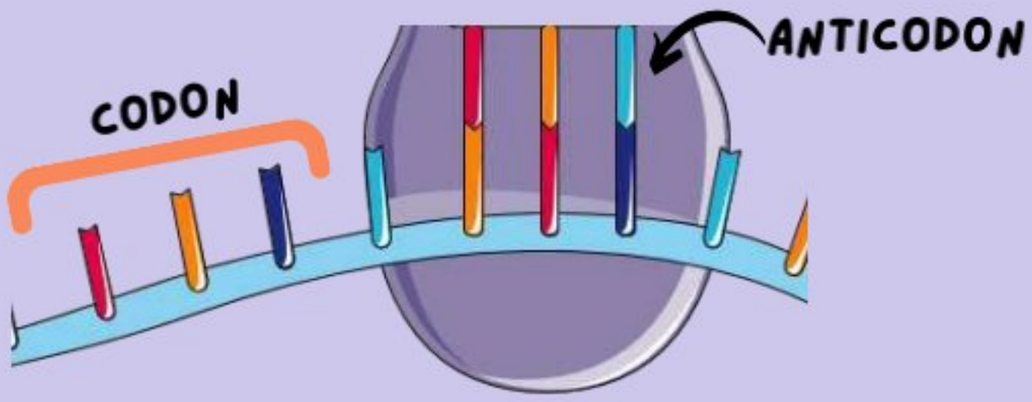
When:Protein synthesis
Where: Ribosome in cytoplasm
Why: To translate the mRNA into a functional set of amino acids joined by peptife binds forming a protein.

PRO-TIPS

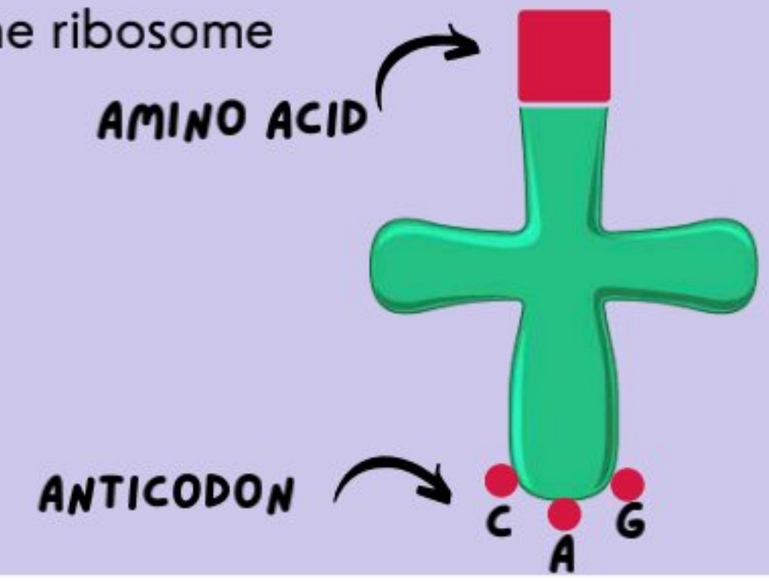
- **ALWAYS** refer to the protein as the REQUIRED protein.
- **ALWAYS** speak about the codons as COMPLEMENTARY to the anticodons.
- **DO NOT** call the bond a "polypeptide bond" there is NO SUCH THING!
- **IDENTIFY** all the structures in a diagram of this process.

How:

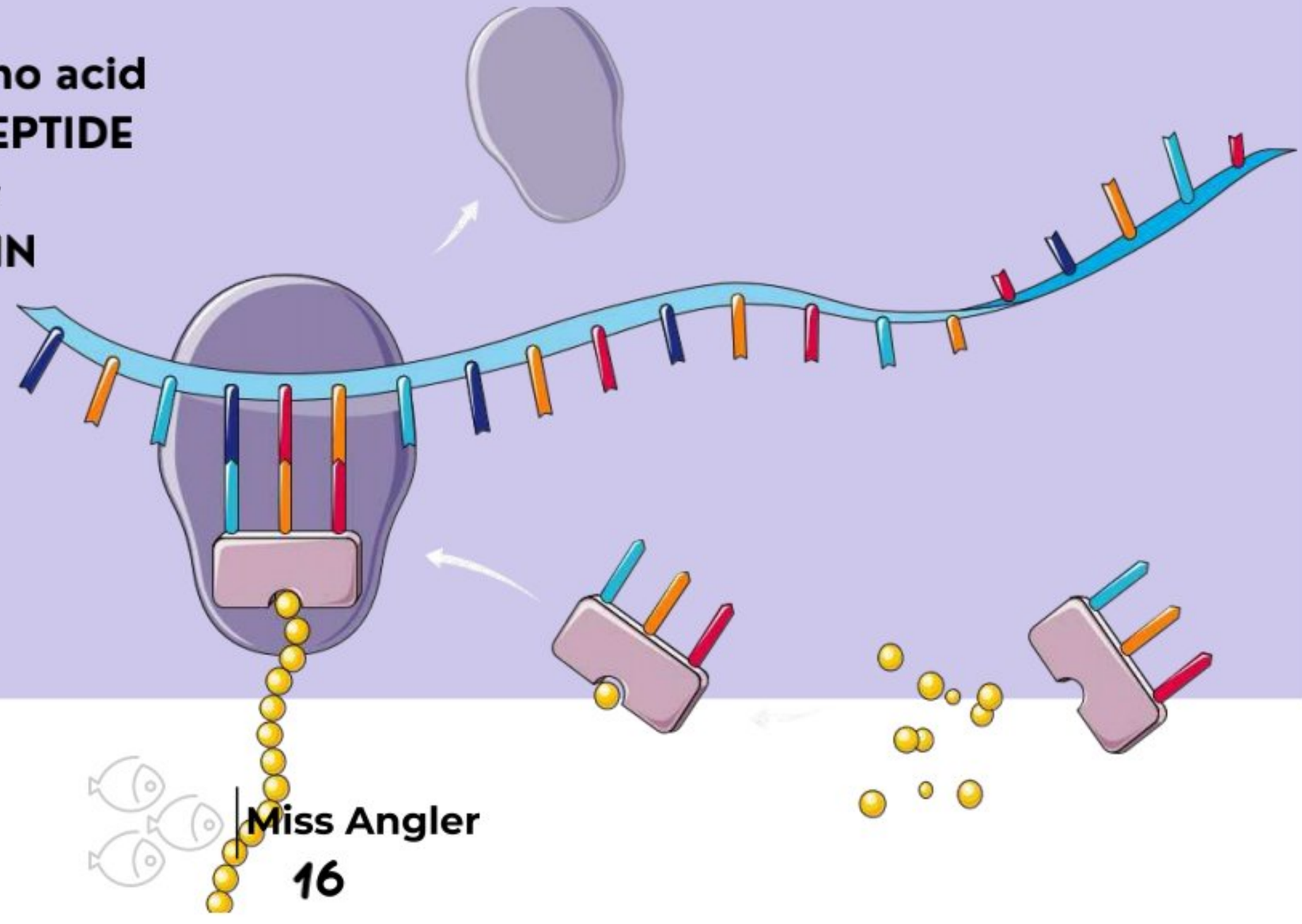
- mRNA inserts itself into the ribosome
- the ribosome reads 3 letters at a time called a CODON
- this codon matches with the ANTICODON found on the tRNA



- each tRNA carries a specific amino acid
- the tRNA anticodon matches with the complementary mRNA codon
- the tRNA brings the REQUIRED amino acid to the ribosome



- the **tRNA** delivers the **amino acid**
- these amino acids form a **PEPTIDE BOND** between each other
- to form the require **PROTEIN**



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16

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Describe the process of translation.**

1. A question with describe requires lots of details, so in your answer you must say:

- **Where** it happens
-**When** it happens
- **How** it happens
- **Why** it happens

- **Explain the purpose of translation.**

2. This is a shorter answer where you make a statement and then provide a reason:

- **What** is translation
-**Why** it happens

- Describe **how a protein is formed**

3. You will need to describe the formation of a protein with a focus on complementary codons/anticodons.

- **Where** is this happening: cytoplasm
- **How**: tRNA delivers an amino acid, amino acids join via peptide bonds
-**Product**: creates a polypeptide for the required protein

SHORT QUESTIONS

- **Give the amino acid that is complementary to the anticodon given (CUC).**

- here you will look at the amino acid table they have given you and work out the correct answer:

CODON	AMINO ACID
UUC	PROLINE
GUG	ALANINE
ACU	SERNINE

ANSWER: GUG- ALANINE

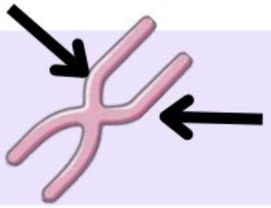
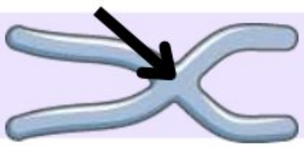
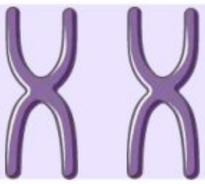
TRICKY QUESTIONS

- **Describe the outcome if a mutation occurs during translation and a single nitrogenous base changes.**

- **What** the mutation did: changed the letter (from U to A)
- **Result**: Now explain regular translation as before but substitute in:
  - a <u>different</u> tRNA with a d<u>ifferent anticodon</u> will join to the altered mRNA
  - therefore a <u>different amino acid</u> will be brought to the ribosomes
  - possibly resulting in a <u>different protein</u> being formed

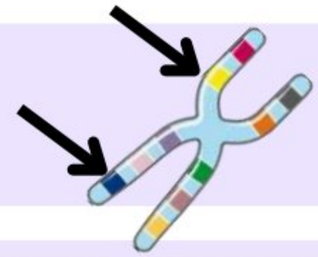
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MEIOSIS TERMINOLOGY

TERM	DEFINITION
CHROMATIN NETWORK	intertwined DNA strand only visible during interphase
CHROMOSOME	condensed piece of DNA can be single stranded can be double stranded 
CHROMATID	formed after DNA replication have two per chromosome 
CENTROMERE	joins two chromatids 
HOMOLOGOUS PAIR	two chromosomes carrying similar genes one paternal and one maternal 
SYNAPSIS	when homologous pairs move towards each other
BIVALENT	when homologous pairs are touching 

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18

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TERM	DEFINITION
CHIASMATA	point at which homologous pairs touch
LOCUS	gene location 
CENTRIOLES	organelles that grow spindle fibres
SPINDLE FIBRE	thread that pulls chromatids/bivalent apart
CENTROSOME	temporary organelle that houses centriole
RECOMBINANT CHROMOSOME	when homologous chromosomes exchange genes and become different 
CROSSING OVER	where homologous pairs exchange genes to increase variation

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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

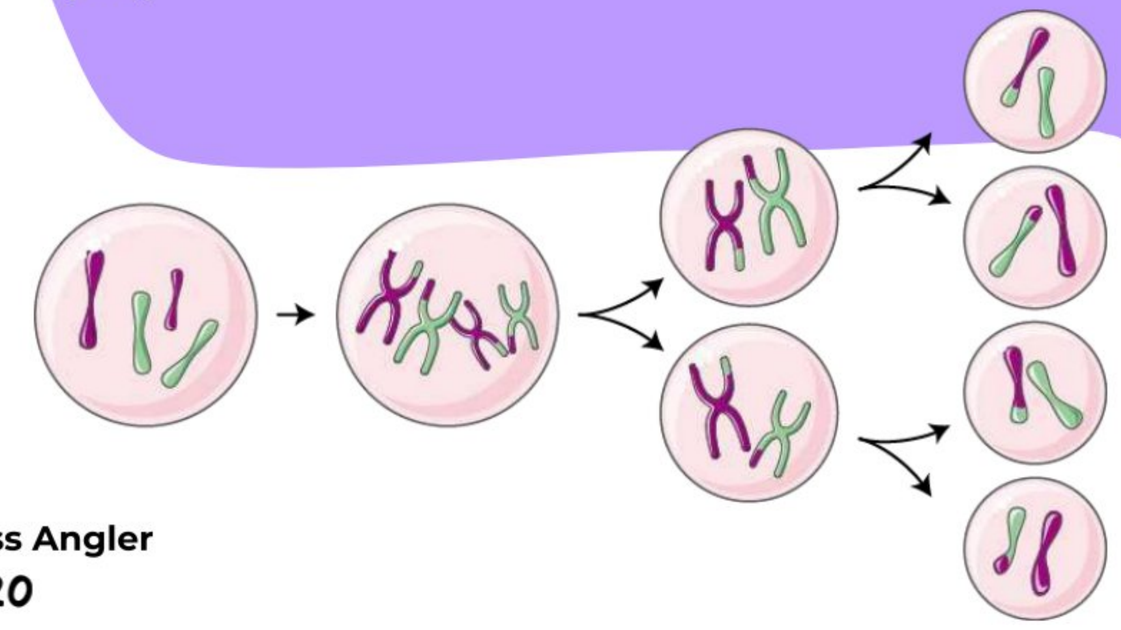
1. **Draw and label stages of meiosis.**
-provide at least 3 labels.
2. **State the function of the structures.**
-be able to state the functions of each of the structures found during meiosis.
3. **State the number of chromosomes present in the cell at the end of meiosis.**
- give the number of SINGLE-stranded chromosomes and only of the cell in the diagram - don't assume its human.
4. **State ways variation occurs during meiosis.**
- crossing over
- random arrangement

MITOSIS	MEIOSIS
identical cells	non-identical cells
1 cell = 2 cells	1 cell = 4 cells males: 4 sperm cells females: 1 ovum and 3 polar bodies
occurs in somatic cells	occurs in testes and ovaries

IDENTIFYING THE DIFFERENT STAGES OF MEIOSIS

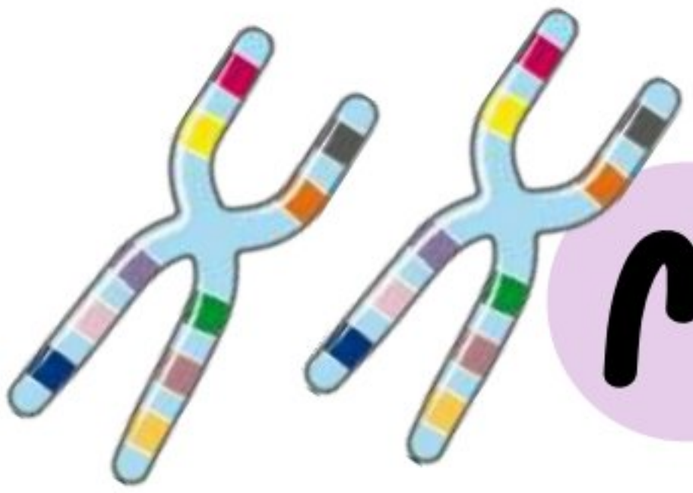
Meiosis 1
- chromosomes are visible (interphase)
- **double-stranded** chromosomes
- **crossing over** is taking place (chromosomes are touching)
- homologous **pairs line up** at the equator

Meiosis 2
- **recombinant** chromosomes visible
- **no** crossing over takes place
- **single chromosomes** line up at equator (no longer in homologous pairs)



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20

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MEIOSIS

When: Gametogenesis
Where: Ovaries or testes
Why: To halve the chromosome number (haploid) in order to maintain the correct chromosome number and to introduce variation.

PRO-TIPS

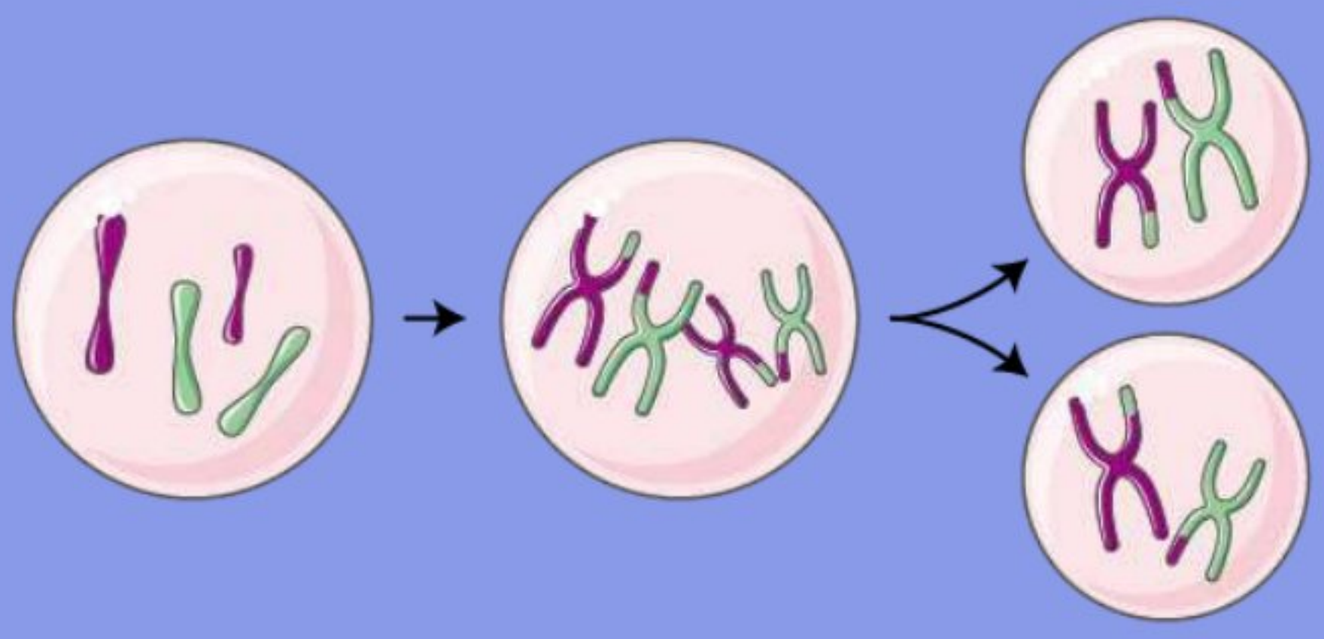
- **DO NOT** call chromosomes daughters/sisters after crossing over
- **ALWAYS** identify the phase of meiosis with 1 or 2.
- **BE ABLE** to draw the phases.
- **KNOW** how meiosis introduces variation via: crossing over, random arrangement.

How:

MEIOSIS 1

- **Purpose :** to create **2 non-identical** cells that are **haploid** with ONLY one of the homologous pairs present.
- **How to identify:** cells in meiosis 1 will have:

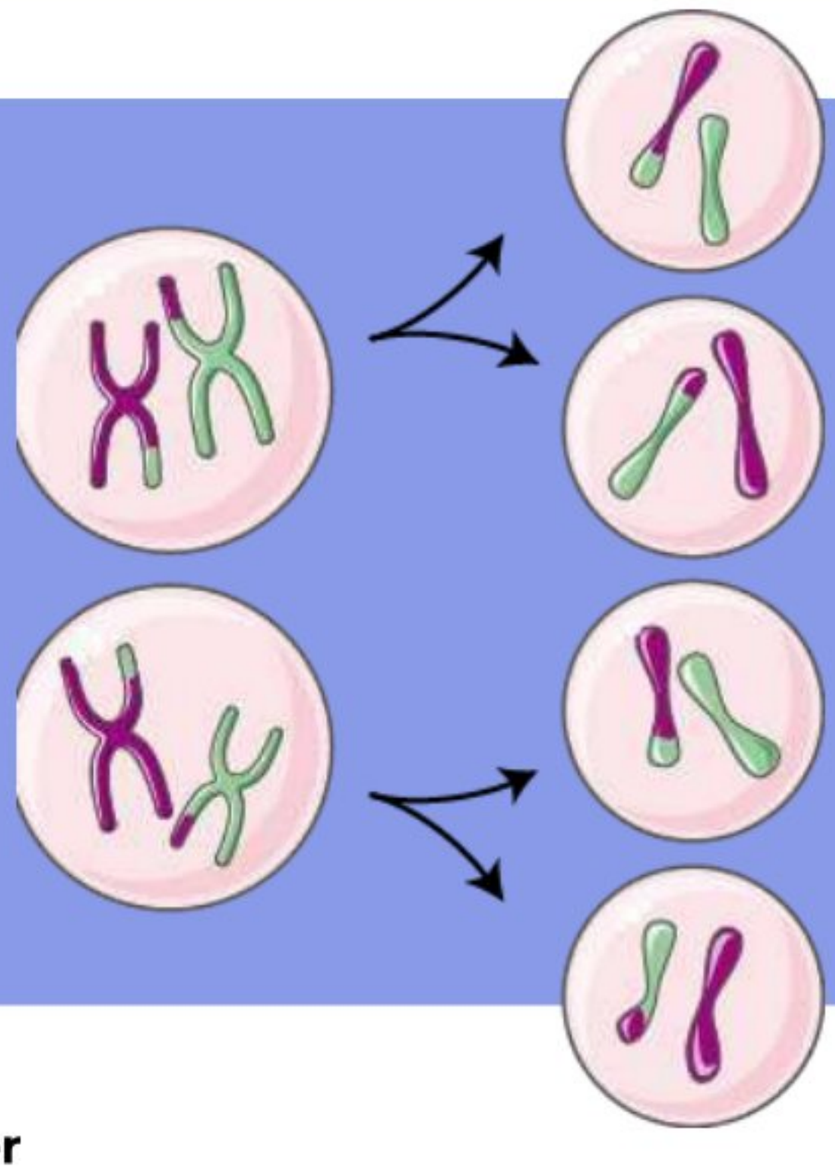
- double-stranded chromosomes
- homologous pairs crossing over
- non-identical/recombinant chromosomes



MEIOSIS 2

- **Purpose :** to create **4** non-identical cells, with single stranded chromosomes.
- **How to identify:** cells in meiosis 2 will have:

- no crossing over taking places
- no homologous pair present
- single-stranded chromosomes that may be recombinant



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PHASES OF MEIOSIS

Interphase

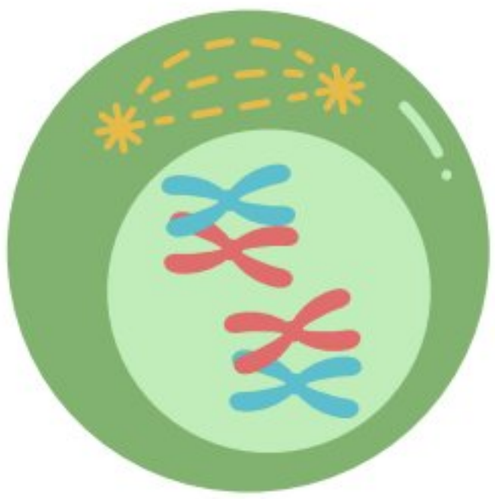


How to identify:
- single stranded chromosomes **OR**
- double stranded homologous chromosomes <u>not</u> paired yet
- chromatin network visible
- nuclear membrane visible

Purpose:
- DNA replication takes place here
- ensures correct chromosomal number

MEIOSIS 1

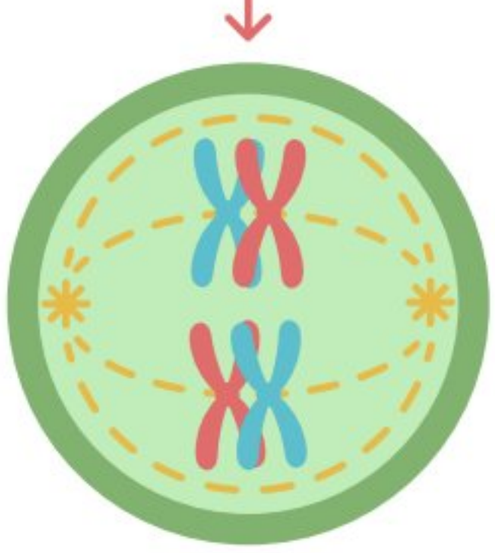
Prophase 1



How to identify:
- nuclear membrane breaking down
- formation of spindle fibers
- centrioles moving to poles

Purpose:
- crossing over (genetic variation)
- synapsis of homologous pairs forming bivalents

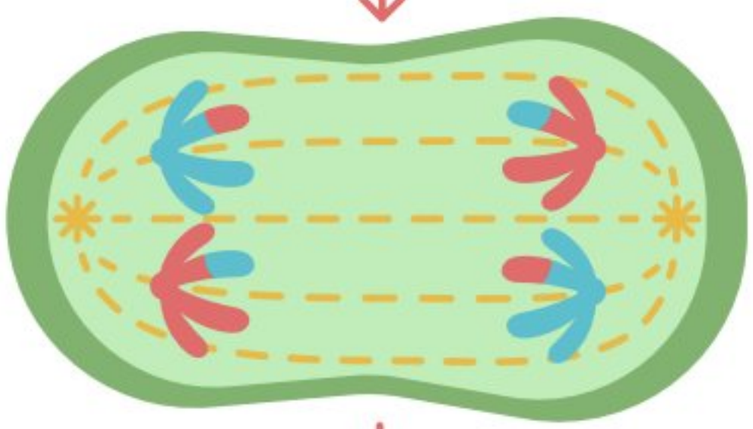
Metaphase 1



How to identify:
- chromosomes align on equator
- centrioles are at opposite poles
- spindle fibers attached to centromere
- pairs of double stranded chromosomes still present

Purpose:
- random arrangement of paternal and maternal chromosomes

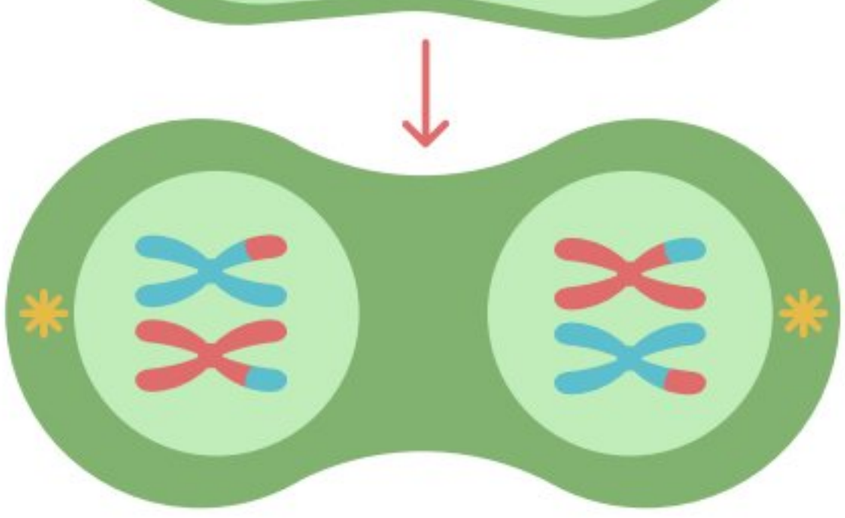
Anaphase 1



How to identify:
- double stranded chromosomes pulled to opposite poles
- recombinant chromosomes visible

Purpose:
- separate homologous pairs
- halving chromosome number

Telophase 1



How to identify:
- cell cleavage
- nuclear membrane formation
- separate cell membrane reforms
- spindle fibers disappear

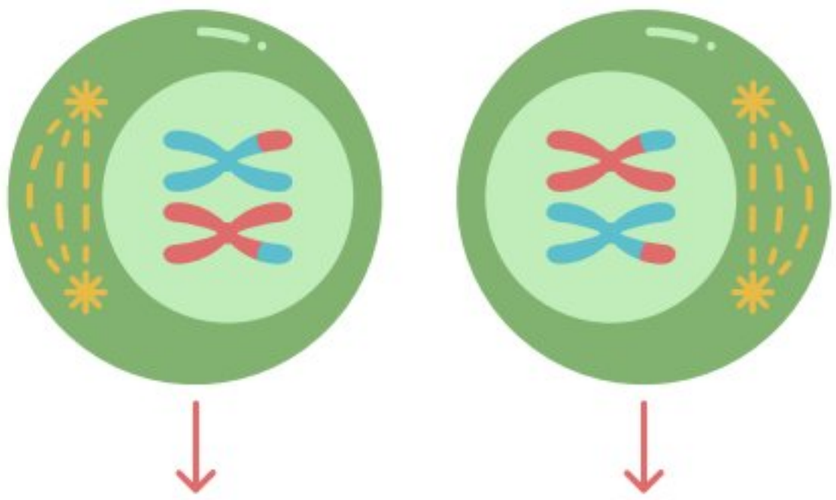
Purpose:
- separate cytoplasm (cytokinesis)
- form two individual cells

Miss Angler

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MEIOSIS 2

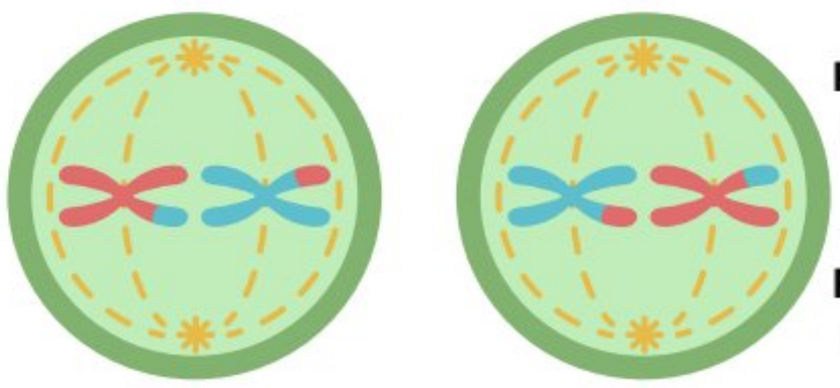
Prophase 2



How to identify:
- no crossing over
- recombinant chromosomes visible
- spindle fibers are forming

Purpose:
- spindle fiber formation
- centrioles moving to opposite poles

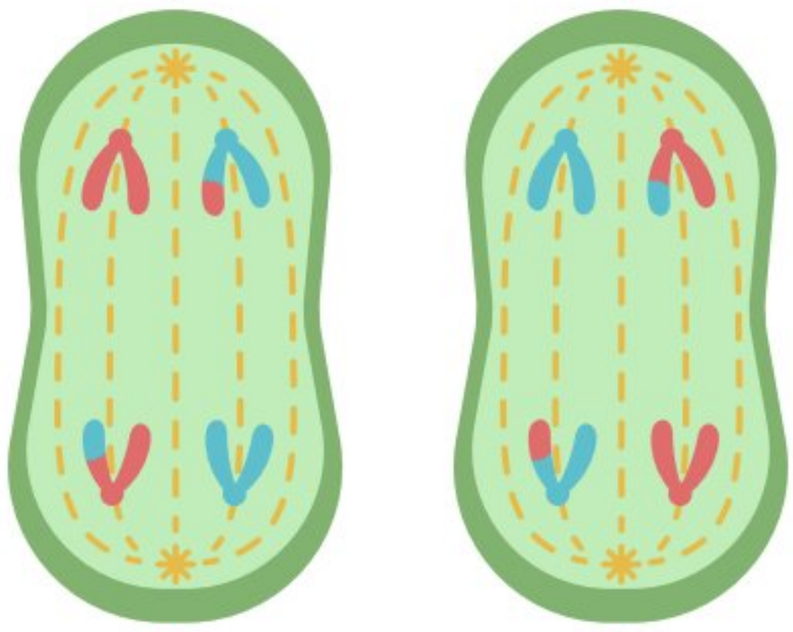
Metaphase 2



How to identify:
- double stranded (recombinant) chromosomes align at equator
- spindle fibers attached to centromere

Purpose:
- random arrangement of double stranded (recombinant) chromosomes

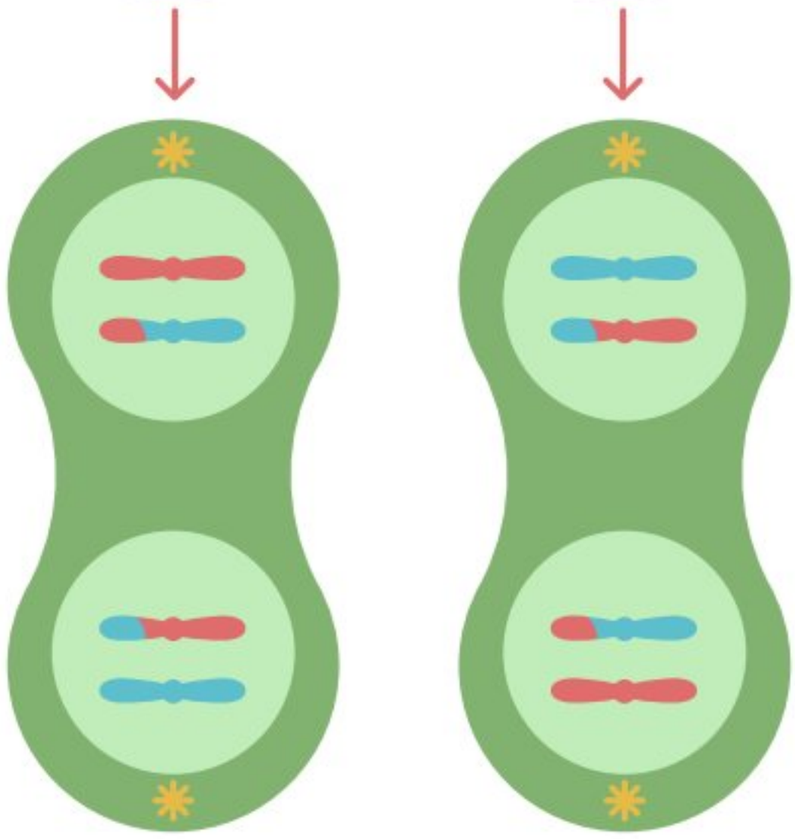
Anaphase 2



How to identify:
- centromeres have been pulled apart
- double stranded chromosomes becomes single stranded

Purpose:
- separating recombinant chromosomes
- forming single stranded chromosomes

Telophase 2



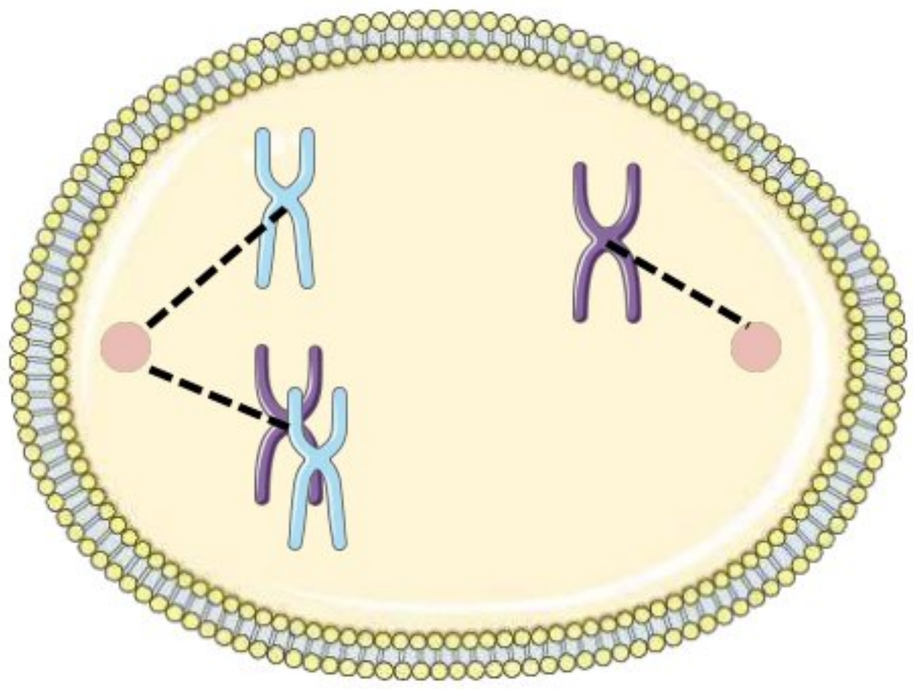
How to identify:
- four cells present (non-identical)
- single stranded chromosomes present
- nuclear membrane reforms

Purpose:
- cytokinesis

Miss Angler 23

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ABNORMAL MEIOSIS



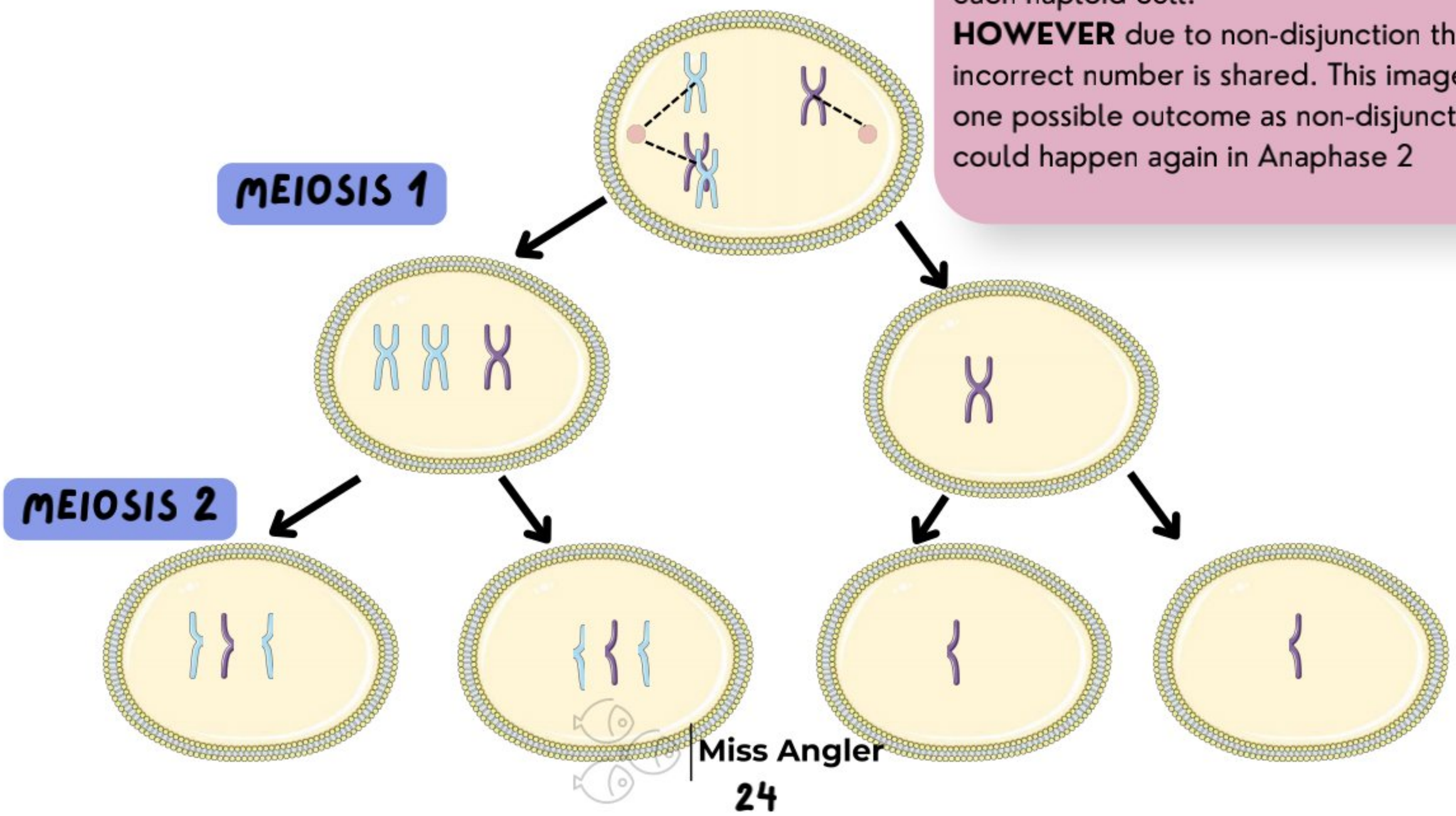
When chromosomes fail to separate we call this **Non-disjunction.** This occurs during **Anaphase 1** or **2** in humans. (as seen above)

HOW TO IDENTIFY AND EXPLAIN ABNORMAL MEIOSIS

- **Identify** - when homologous chromosomes fail to separate and go towards the same pole.
- **Result**- Non-disjunction of chromosomes at position 21 during Anaphase in humans to form abnormal gametes with an extra copy of chromosome 21
- The fusion between an abnormal gamete (24 chromosomes) and a normal gamete (23 chromosomes) may lead to Down syndrome.

ABNORMAL MEIOSIS RESULTS

Diploid cell began with 4 chromosomes and should end with 2 chromosomes in each haploid cell.
HOWEVER due to non-disjunction the incorrect number is shared. This image is one possible outcome as non-disjunction could happen again in Anaphase 2



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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Describe how meiosis creates variation**.

1. A question with "describe" requires lots of details, so in your answer you must say:

- **Where** it happens (chiasmata/metaphase 1 and 2).
-**When** it happens (synapsis and prophase 1).
- **How** it happens (crossing over, random arrangement).
- **Why** it happens (variation + increases offspring's chances of survival).

- **Explain the purpose of crossing over.**

2. This is a shorter answer where you make a statement and then provide a reason:

- **What** is crossing over.
-**Why** it must happen (creates variation).

- **Draw/label chromosomes**

3. Depending on the question you may need to draw a chromosome from the picture OR what it may look like at the end of meiosis.

SHORT QUESTIONS

1. I**dentify the phases of meiosis (without seeing the phases in correct order).**

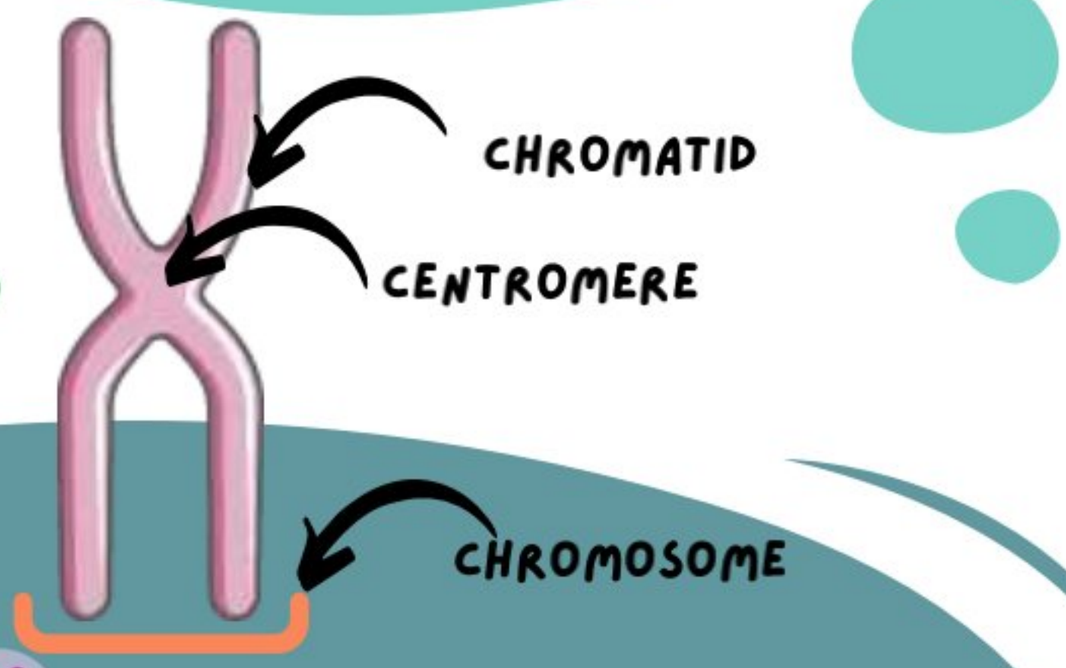
- you will be asked to draw or name the phase of meiosis you may see in the diagram given.

OR

- you may need to provide the name of the phase before (preceding) or after (following) the one they have given you in the picture.

2.**Give the number of chromosomes of this cell (X).**

- you must count the full number of chromosomes and NOT just the chromatids. NEVER assume it is always a human cell either.



TRICKY QUESTIONS

- **Describe how non-disjunction occurs and leads to Down syndrome.**

- **WHAT** is non-disjunction: failure of chromosomes to separate during meiosis during Anaphase 1 or 2.
-**WHERE**: occurs in the ovaries during gametogenesis.
- **HOW**: spindle fibers shorten towards the opposite poles and fail to separate the chromosomes.
- This results in a gamete with one extra chromosome (2n+1) or aneuploidy.
- **PRODUCT:** When a normal sperm cell (n) fuses with an egg that is (2n+1) this will result in 47 chromosomes in the offspring.

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REPRODUCTIVE STRATEGIES

TERM	DEFINITION	ADVANTAGE	DISADVANTAGE
EXTERNAL FERTILISATION	• Takes place in water • mostly aquatic vertebrates	• large number of gametes to avoid predation • courtship rituals bring gametes closer	• wasteful number of eggs • fertilisation not certain
INTERNAL FERTILISATION	• terrestrial vertebrates • no water to transport sperm	• fertilisation is more certain • fewer gametes needed • protective shell/yolk	• finding a mate • fewer reproduction opportunities • longer gestation
OVIPARY	• eggs develop outside • fertilised external or internal	• Aquatic: many eggs with small amounts of yolk (less energy) • Land: very few eggs 1. more yolk 2. more protection 3. parental care	• aquatic: often very little parental care • Land: susceptible to predators
OVOVIVIPARY	• eggs are fertilised internally • eggs are kept inside then hatch internally	• large amount of yolk • protection from predators • young born fully developed	• na
VIVIPARY	• internal fertilisation • eggs do not have shell • born live	• reduced egg numbers • nourishment & protection • provide parental care	• na

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HOW WILL THEY ASK THIS?

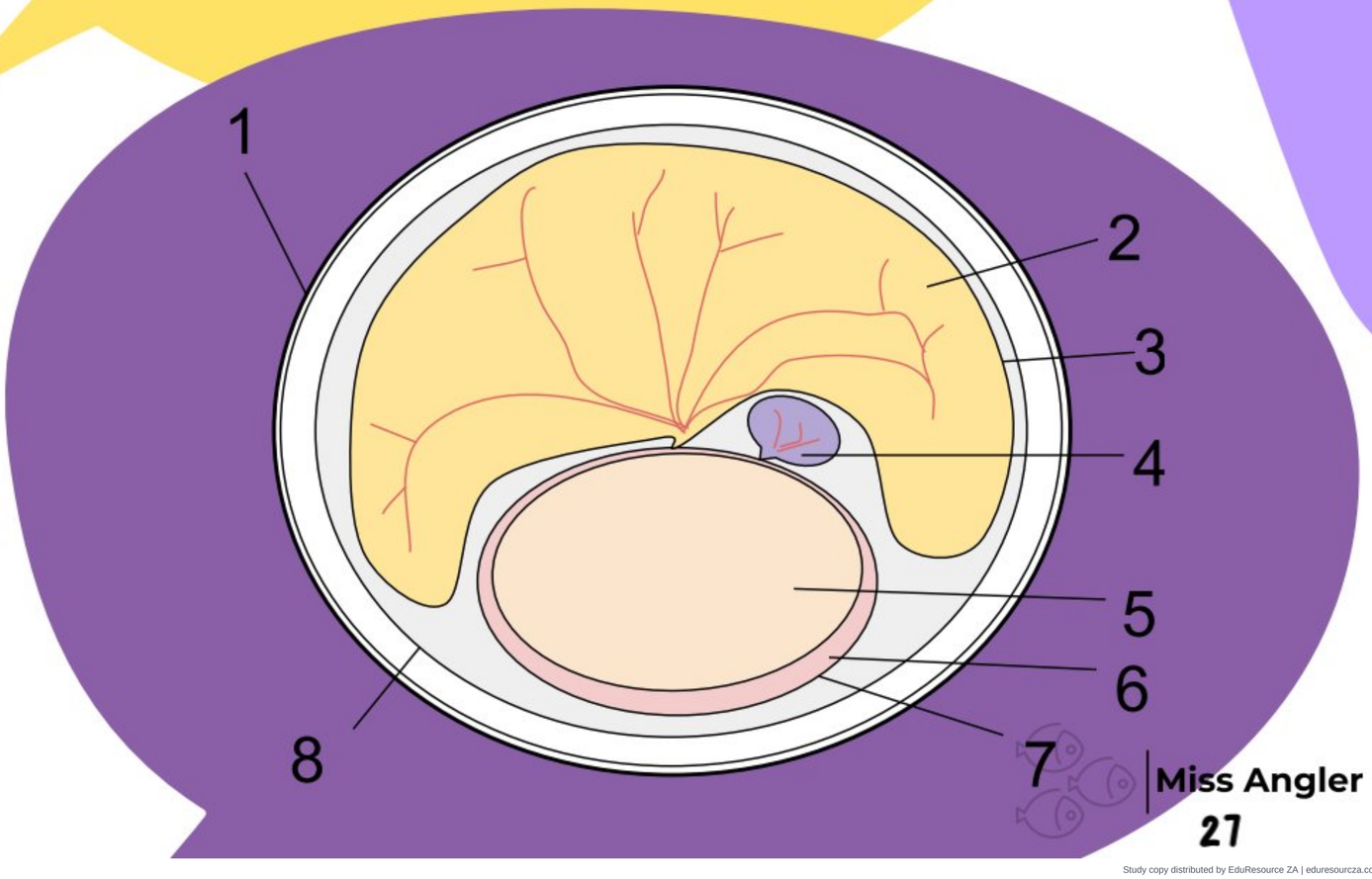
SHORT QUESTIONS

1. **Draw and label an amniotic egg.**
- provide at least 3 labels.

2. **State the function of the structures.**
- be able to state the functions of each of the layers.

3. **Provide the advantages/disadvantages of each reproductive strategy.**
- refer to the table above

4. **By looking at the picture given state what kind of reproductive strategy this animal uses.**
- Here you will need to know a few examples of each animal that uses this strategy just by looking at the animal.



STRUCTURES AND FUNCTIONS

1. **Shell**
- provides protection/ prevents dehydration

2. **Yolk sac**
- nutrition for embryo

3. **Albumin**

4. **Allantois**
- reservoir for nitrogenous wastes

5. **Embryo**

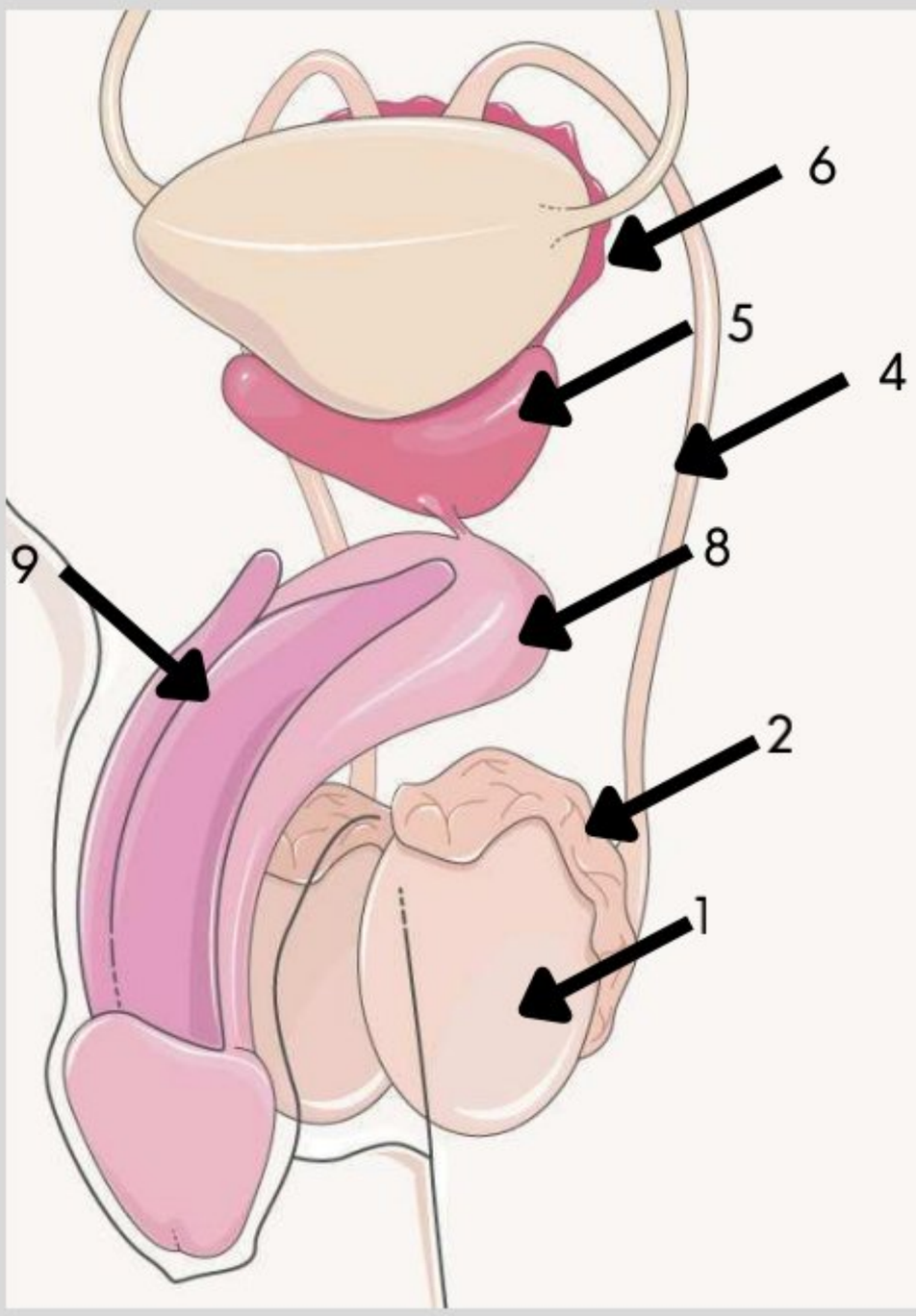
6. **Amniotic fluid**
- prevents dehydration & mechanical injury

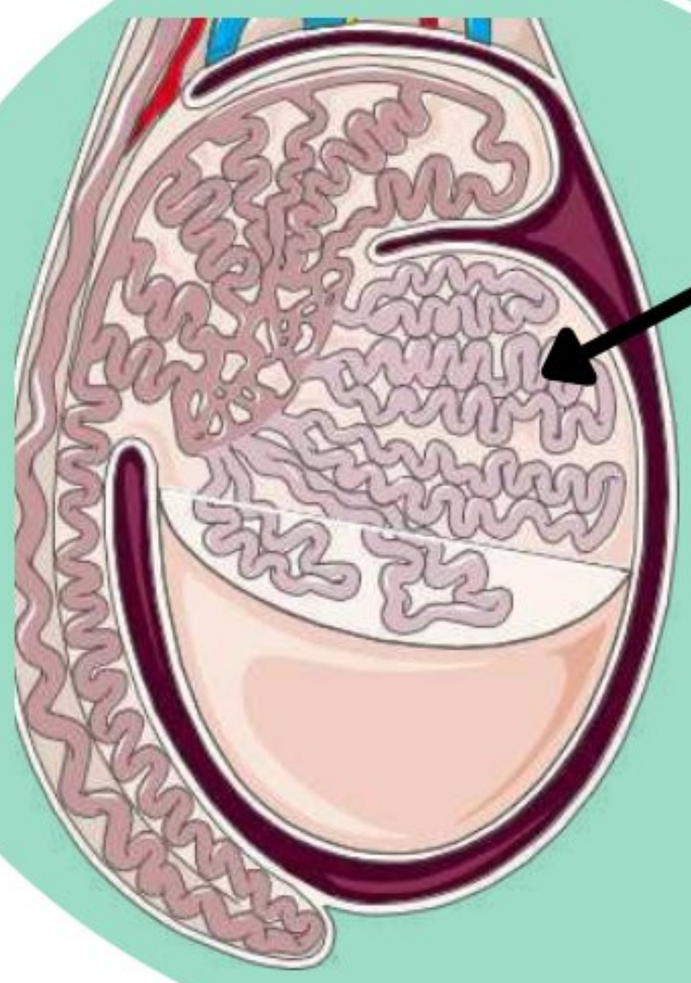
7. **Amnion**

8. **Chorion**
- allows gaseous exchange forms placenta in mammals

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MALE REPRODUCTIVE SYSTEM





1. **TESTES**
- produces sperm cells
- secretes testosterone

2. **EPIDIDYMIS**
- site of sperm maturation
- sperm storage

3. **SEMINIFEROUS TUBULE**
- site of sperm cell production

4. **VAS DEFERENS**
- transports sperm

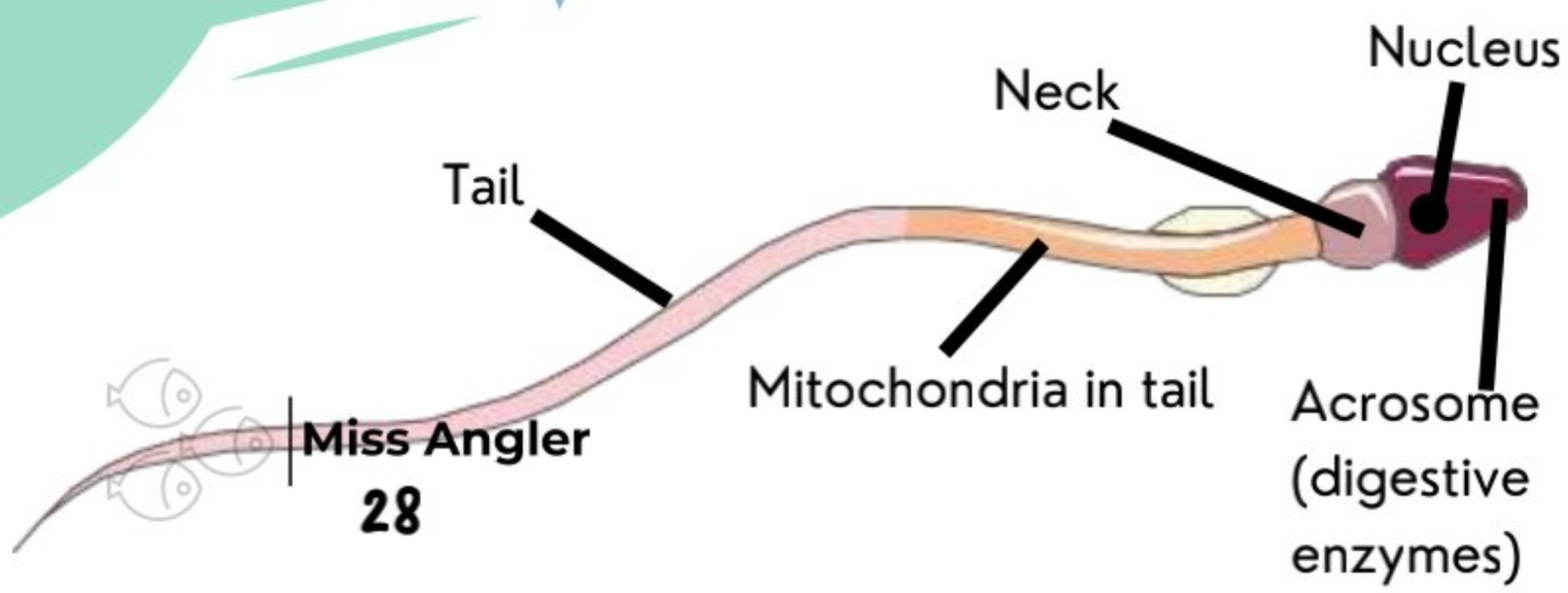
5. **PROSTATE GLAND**
- produces secretions that contribute to semen
- provides nutrients to sperm

6. **SEMINAL VESICLE**
- produces secretion that contributes to semen
- neutralises acid pH of vagina

7. **COWPERS GLAND** (not seen in this diagram)
- secretes fluid used in semen
- fluid assists with movement of the sperm cells

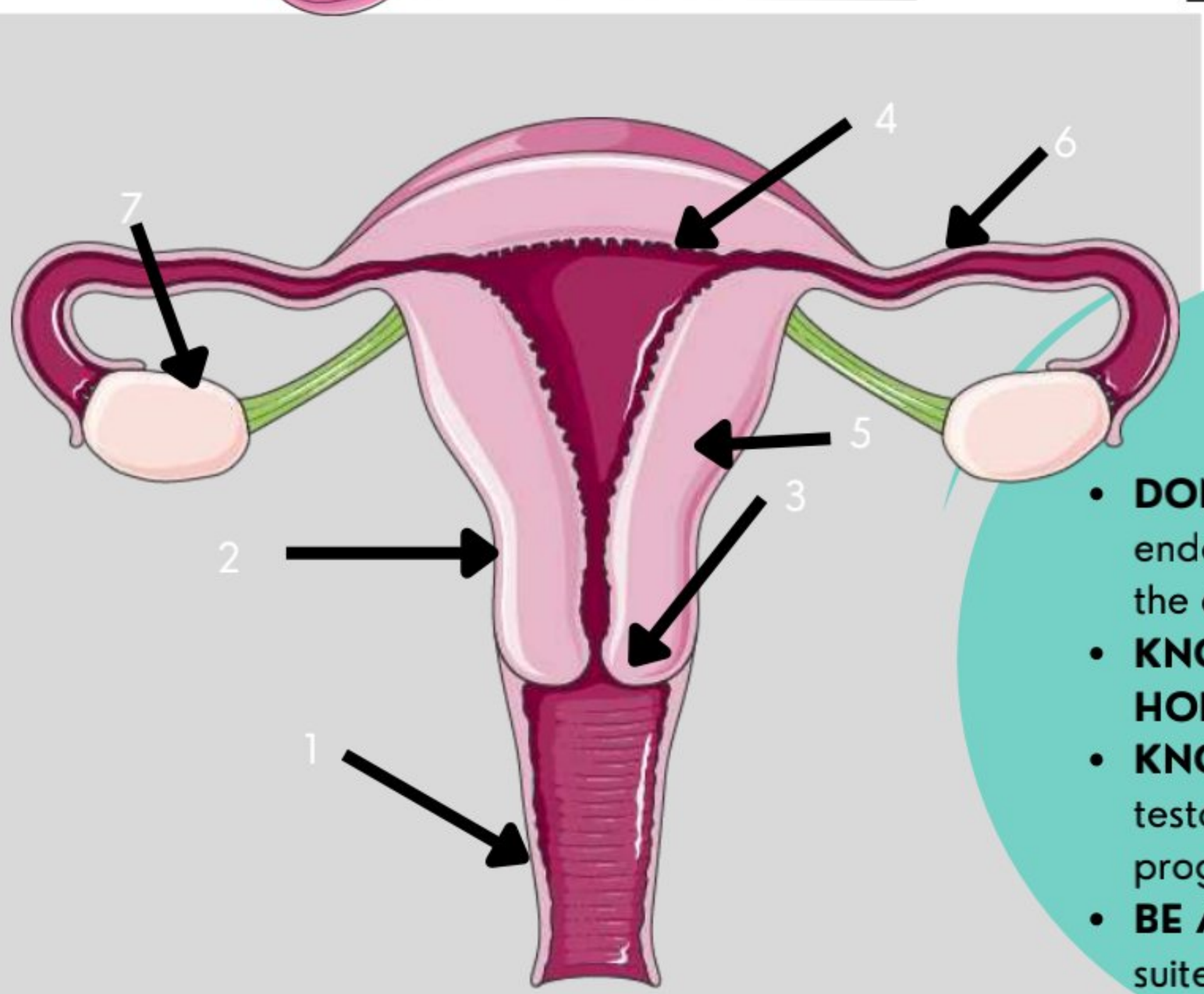
8. **PENIS**
- organ used to deliver sperm to vagina

9. **URETHRA**
- tube that semen passes through during ejaculation



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FEMALE REPRODUCTIVE SYSTEM



PRO-TIPS

- **DON'T** confuse the wall of the uterus with the endometrium. The wall is the muscle, the lining is the endometrium.
- **KNOW** all the functions of the structures and **HORMONES.**
- **KNOW** the **STIMULATING** hormones that cause testosterone to be made (ICSH) and oestrogen/ progesterone (LH and FSH).
- **BE ABLE** to explain how the sperm cell is well-suited for its function.

1. **VAGINA**
- passage which receives semen and penis
- birth canal

2. **UTERUS**
- muscular organ
- location of pregnancy

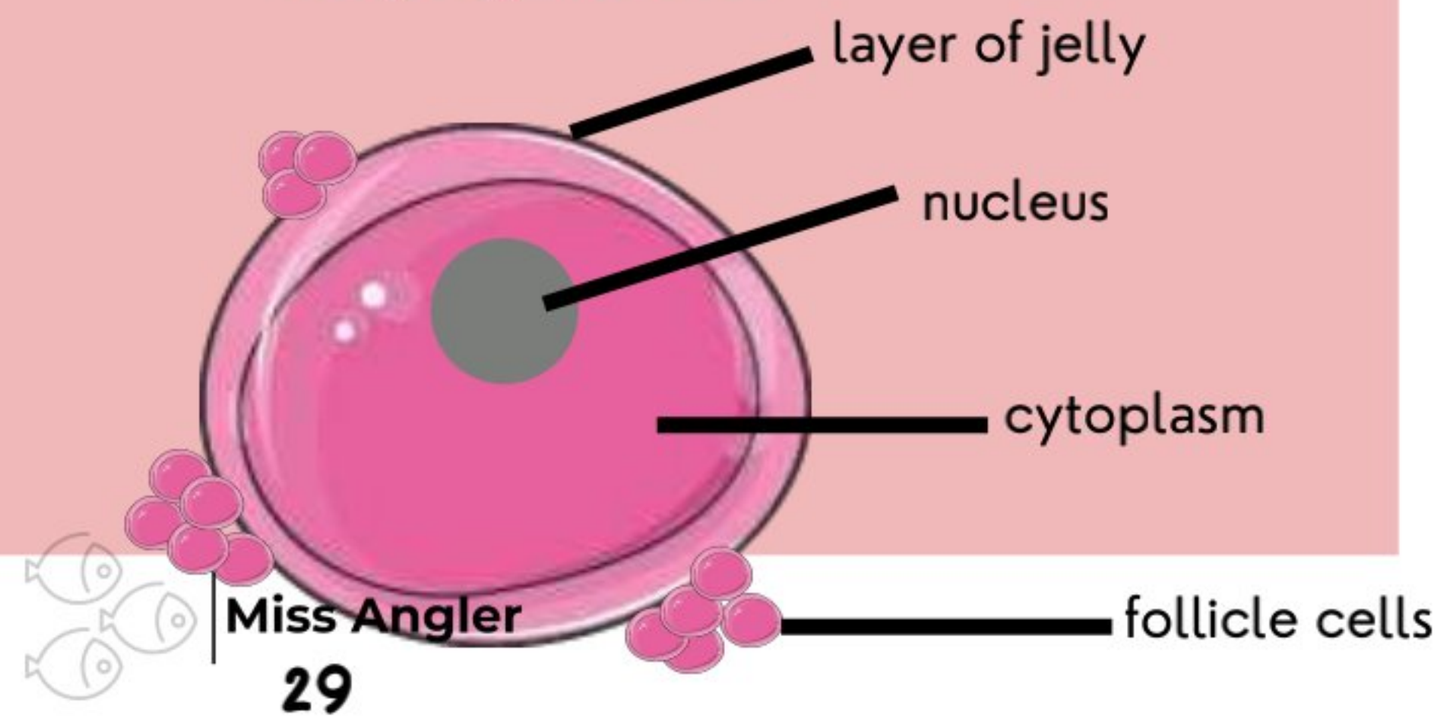
3.CERVIX
- opening of uterus
- protects uterus

4.**ENDOMETRIUM**
- lining of uterus where embryo attaches
- falls away every 28 days

5.**MYOMETRIUM**
- muscular layer of the uterus

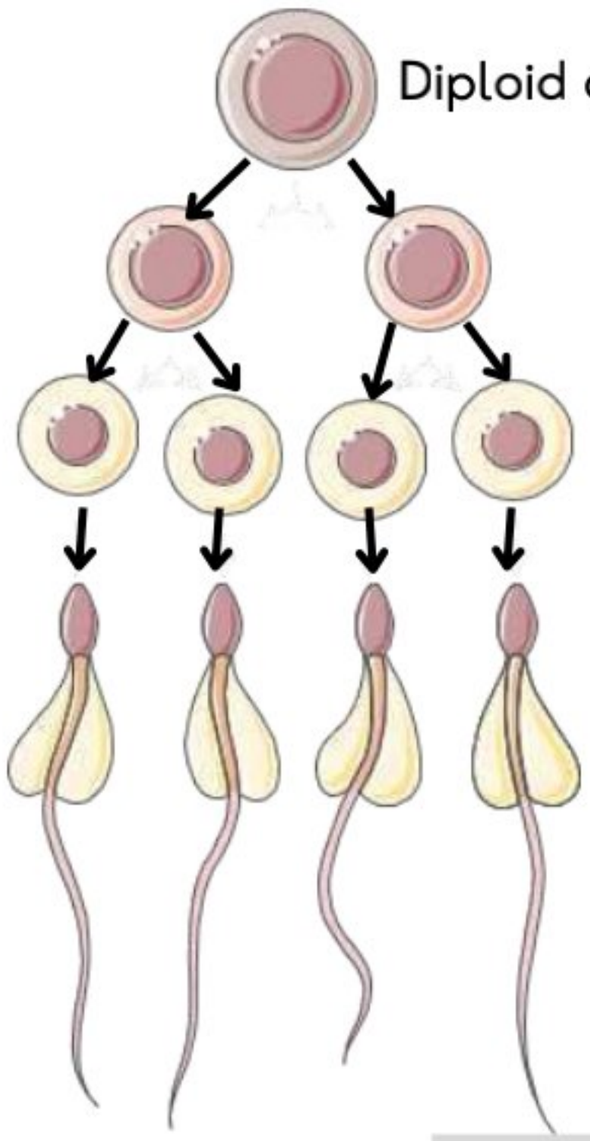
6.**FALLOPIAN TUBE**
- site of fertilisation
- lined with cilia to move ovum along

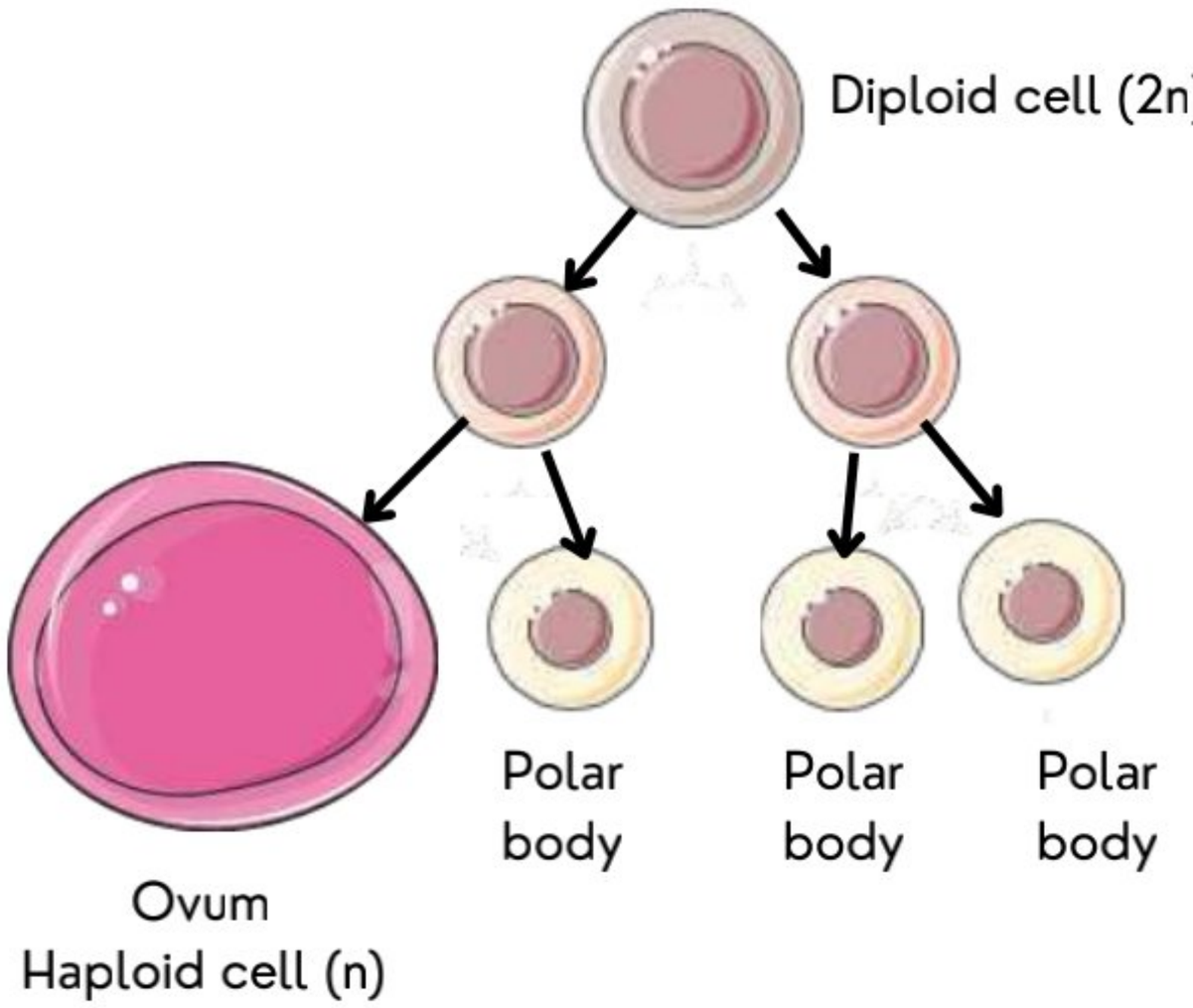
7.**OVARY**
- site of oogenesis
- secretes the hormones oestrogen and progesterone.



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GAMETOGENESIS





SPERMATOGENESIS

- under the influence of **TESTOSTERONE**
- **DIPLOID** cells in the seminiferous tubules of the testes
- undergo **MEIOSIS**
- to form **HAPLOID** sperm cells

OOGENESIS

- **DIPLOID** cells in the **OVARY** undergo **MITOSIS**
- to form numerous **FOLLICLES**
- at the beginning of **PUBERTY**
- under the influence of **FSH**,
- **ONE** cell inside a follicle enlarges and undergoes the rest of meiosis
- **FOUR** cells are produced, only **ONE** survives and matures to become the ovum
- this occurs in a monthly cycle

PROTIPS

- **KNOW** the difference between puberty and adolescence
- **PUBERTY**: is the **PROCESS** of physical and physiological changes
- **ADOLESCENCE**: the **PERIOD** of time when these physical, physiological and psychological changes occur

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Describe the process of fertilisation.**

1. This "describe" question requires a lot of detail, so in your answer you must say:
- **Where** it happens: fallopian tubes
-**When** it happens: around day 14
- **How** it happens: sperm nuclei fuses with ovum nuclei
- **Why** it happens: to combine nuclei in order to have the correct chromosome number and to increase variation

- **Explain the process of fertilisation.**

2. This is a shorter answer where you make a statement and then provide a reason:
- **What** is fertilisation: the fusing of sperm and ovum nuclei.
-**Why** it happens: to create embryo with the correct chromosome number.

- **Describe how the sperm cell is suited for its function.**

- **State** the various structures in the sperm:
nucleus
acrosome
mitochondria
tail/flagellum
- **Explain** the function of each of these structures.

SHORT QUESTIONS

1. N**ame/ label the diagram.**
- provide the correct labels

2.**State the hormones created at X.**
- know where your hormones are made and what they do

3.**State the site of fertilisation.**
- fallopian tube (this is asked OFTEN)

TRICKY QUESTIONS

- **Describe oogenesis/spermatogenesis.**

- this question is tricky because it requires you to use your knowledge both from meiosis and from gametogenesis.
- you will need to mention the roll the various hormones play in each sex as well.
- only if it asks for male/female then talk about them specifically. If it just says "describe gametogenesis" then describe it in general terms:

1. one diploid cell under goes mitosis
2. forms numerous follicles
3. under the influence of FSH
4. produces one cell that undergoes meiosis
5. in males = 4 sperm cell , females= 1 ovum and 3 polar bodies.

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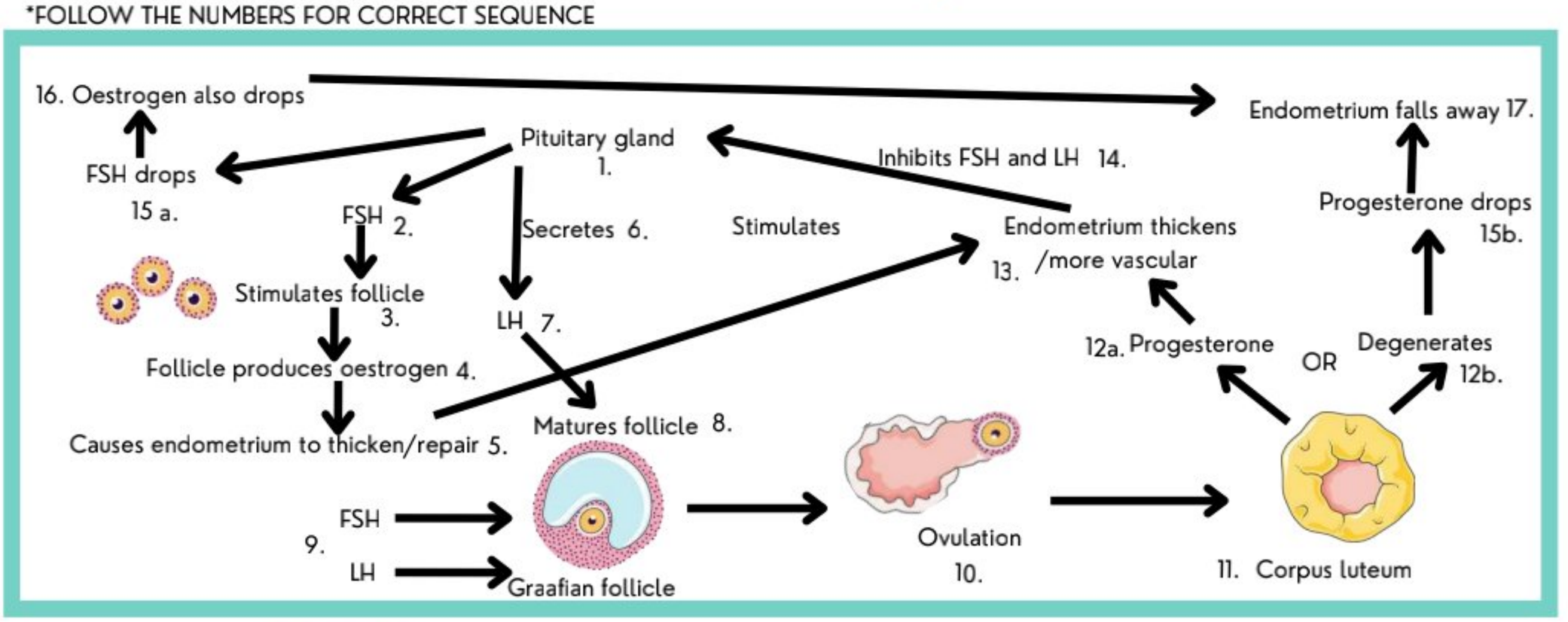
MENSTRUAL CYCLE

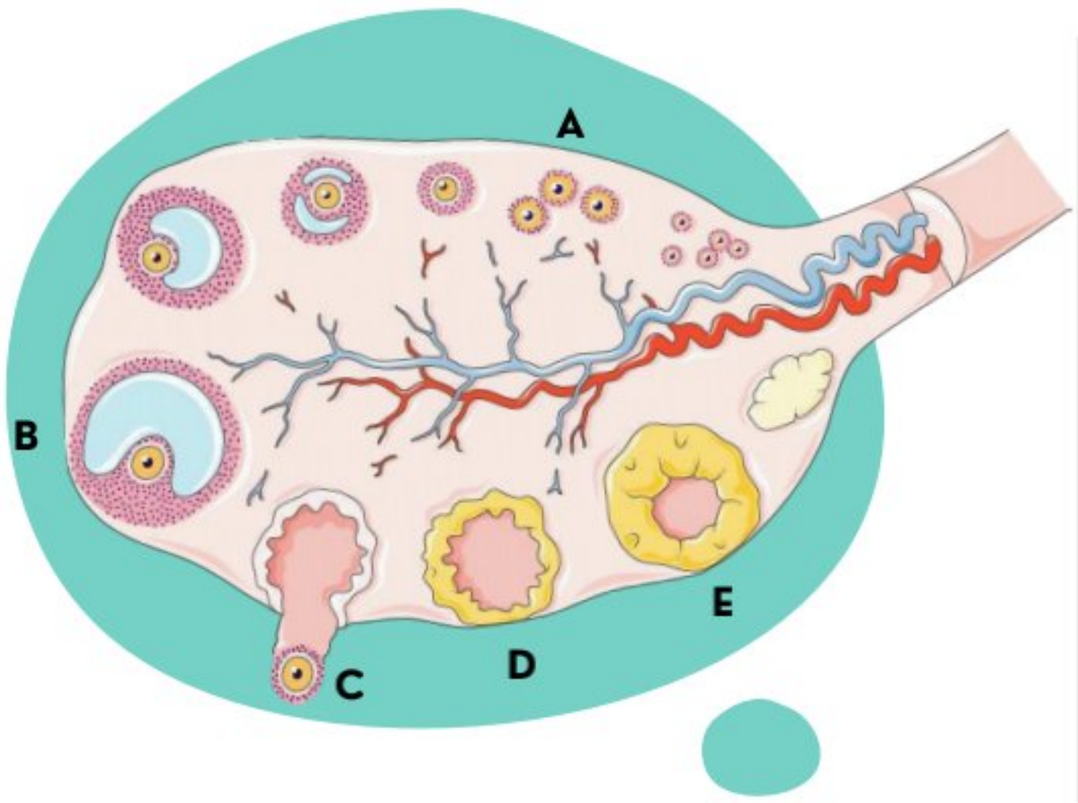
When: 28-day cycle
Where: Ovaries and uterus
Why: To produce a mature ovum and prepare the uterus for possible implantation.

PRO-TIPS

- **DO NOT** call the endometrium the wall of the uterus when talking about the lining falling away during menstruation.
- **KNOW** the functions of ALL 4 hormones and where they are made.
- **BE ABLE** to identify the follicle structures.
- **BE ABLE TO** describe the negative feedback affect of FSH and LH has on oestrogen and progesterone (vice versa).

*FOLLOW THE NUMBERS FOR CORRECT SEQUENCE





WHAT HAPPENS THE IN OVARY

A - FSH stimulates the production of a follicle.
B- Follicle develops into the Graafian follicle, secreting oestrogen.
C- LH causes the follicle to ovulate
D- LH causes the Graafian follicle to develop into the corpus luteum
E- corpus luteum secretes progesterone

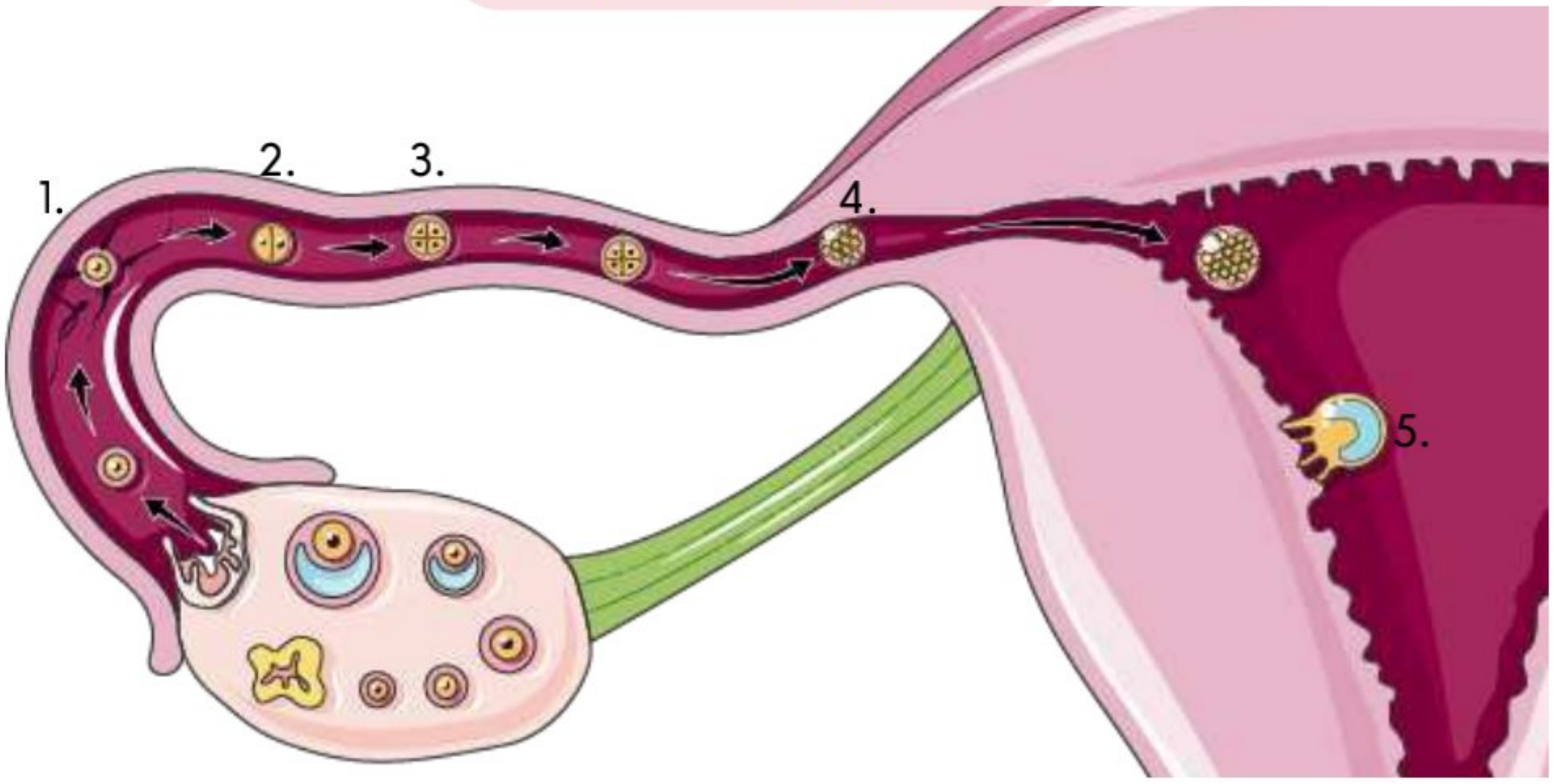
WHAT HAPPENS IN THE UTERUS

B - oestrogen produced by the follicle is sent to the endometrium where it begins to regrow and once regrown, and is maintained.

E - the progesterone secreted by the corpus luteum makes the endometrium more glandular and vascular, preparing for pregnancy.
NOTE: progesterone is secreted by the placenta once it has formed which replaces the corpus luteum.

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IMPLANTATION AND EMBRYONIC DEVELOPMENT



STEPS OF FERTILISATION TO IMPLANTATION

1. **fertilisation**
- Fusing of the nucleus of the ovum with the nucleus of the sperm cell

2. **zygote**
- diploid zygote forms

3. **morula**
- zygote undergoes mitosis to form solid ball of cells called morula

4. **blastocyst**
- morula undergoes mitosis to form hollow ball of cells called blastocyst

5. **implantation**
- blastocyst sinks into endometrium forming chorionic villi

EMBRYONIC LAYERS

1. **chorion**
- outermost membrane
- develops outgrowths that penetrates the endometrium
- increases attachment surface area
- contains capillary network so that mother's blood and embryo's blood never mix

2. **placenta**
- temporary organ
- secretes progestrone and oestrogen in order to maintain pregnancy
- allows for diffusion of oxygen and nutrients
- foetal waste is removed via placenta to mother's blood
- barrier to prevent diseases

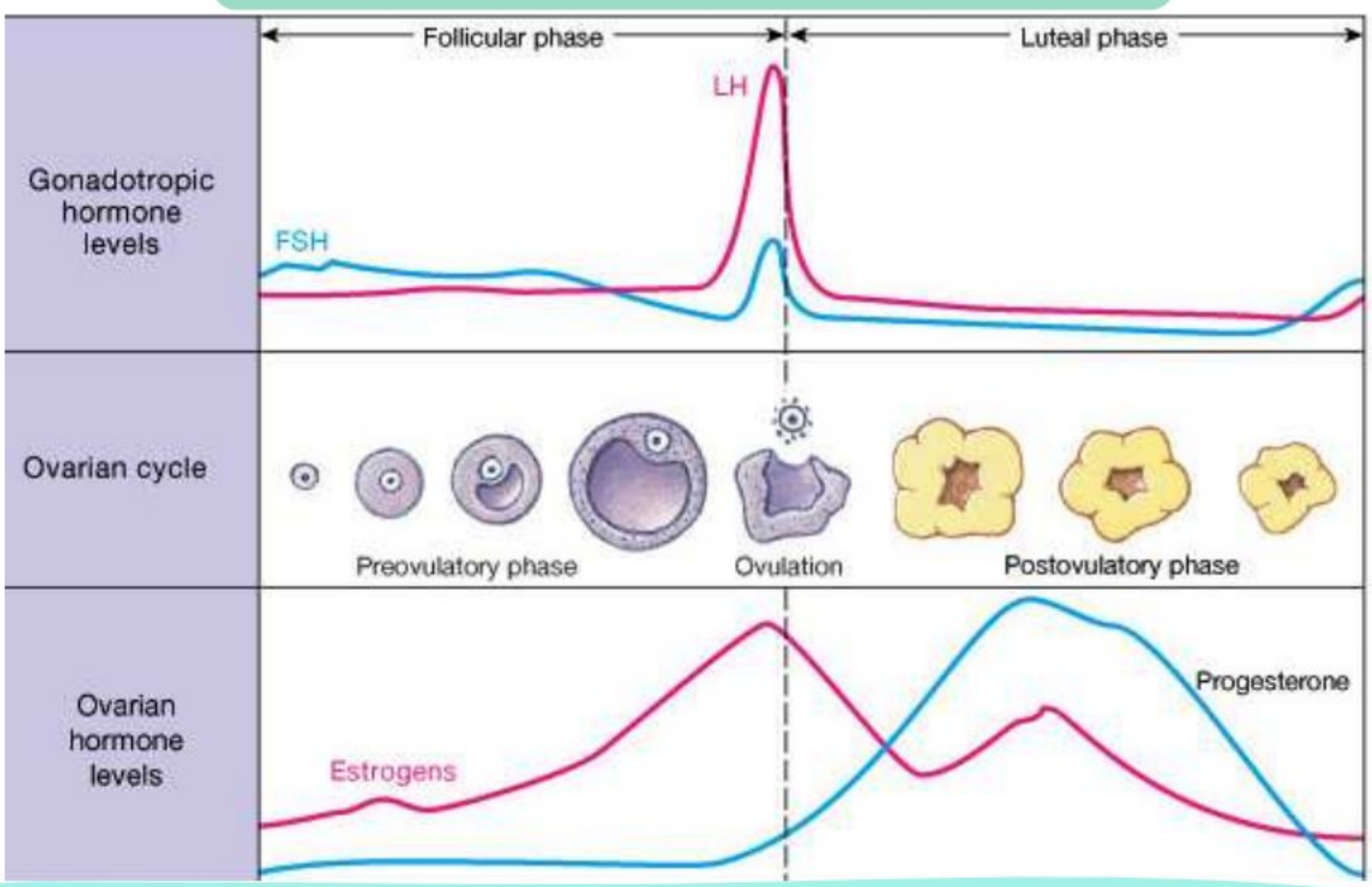


PROTIPS

- the process that follows fertilisation is **MITOSIS**
- you **MUST** know the **FUNCTIONS** of the various layers around an embryo
- the **VEIN** and **ARTERY** in the umbilical cord have the **OPPOSITE** function compared to other blood vessels
- **VEIN** carries oxygenated blood with nutrients
- **ARTERY** carries deoxygenated blood with wastes

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HOW TO IDENTIFY THE HORMONES ON A GRAPH



1. **FSH**

- **What to look for**: two peaks on the graph.
- FIRST hormone to rise from the beginning
- Second peak is at ovulation
- **Why**: FSH must peak during follicle development to grow follicle into Graafian follicle.
- The second peak is to simulate ovulation.

2. **LH**

- **What to look for:** one peak **ONLY** at ovulation (day 14)
- **Why:** LH needs to peak in order to cause ovulation BUT ALSO to form the corpus luteum

3. **Oestrogen**

- **What to look fo**r: two peaks, one just **BEFORE** ovulation (don't confuse with FSH, FSH will always peak first)
- Will peak **AFTER** ovulation
- **WHY**: oestrogen peaks once as the follicle develops and gets bigger, therefore makes more oestrogen.
- It peaks again after ovulation so that the endometrium is maintained for pregnancy and to trigger negative feedback.
- Peaks **TWICE** - once just **BEFORE** ovulation and once **AFTER**

4. **Progesterone**

- **What to look for**: **ONLY** peaks **AFTER** ovulation
- **Why:** progesterone is the hormone responsible for making the endometrium more vascular and glandular for pregnancy.
- **HOW TO SPOT PREGNANCY IN GRAPH**: the progesterone hormone level will stay constant and not dip down.

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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

1. **Draw and label an ovum.**
- provide at least 3 labels.
2. **Identify the hormones on the graph.**
- be able to tell the difference and provide a reason how you know.
3. **Where is FSH and LH made?**
- pituitary gland and then sent to ovary.
4. **State where fertilisation takes place.**
- fallopian tubes.
5. **State the function of progesterone.**
- maintains endometrium and makes it more vascular and glandular.

LONG QUESTIONS: HORMONES

Describe the function of oestrogen in the uterine cycle.
- **when**: during day 7 to 14 peak
- **where**: made by the Graafian follicle
- **why**: prepares endometrium for pregnancy
- **how**: Graafian follicle secretes oestrogen, as FSH decreased due to the increased oestrogen levels.

Explain the negative feedback that occurs during the menstrual cycle.
- here you will need to mention the relationship between FSH and LH with oestrogen and progesterone, in how they inhibit each other when too high, causes the opposite pair to increase while the other pair of hormones decrease.

Based off the evidence in the graph/diagram, has pregnancy occurred?
- based of the graph or diagram you will need to look for either the hormone progesterone staying constant after ovulation instead of decreasing, or, if it's a diagram, look for the corpus luteum not degenerating and staying the same size after ovulation.

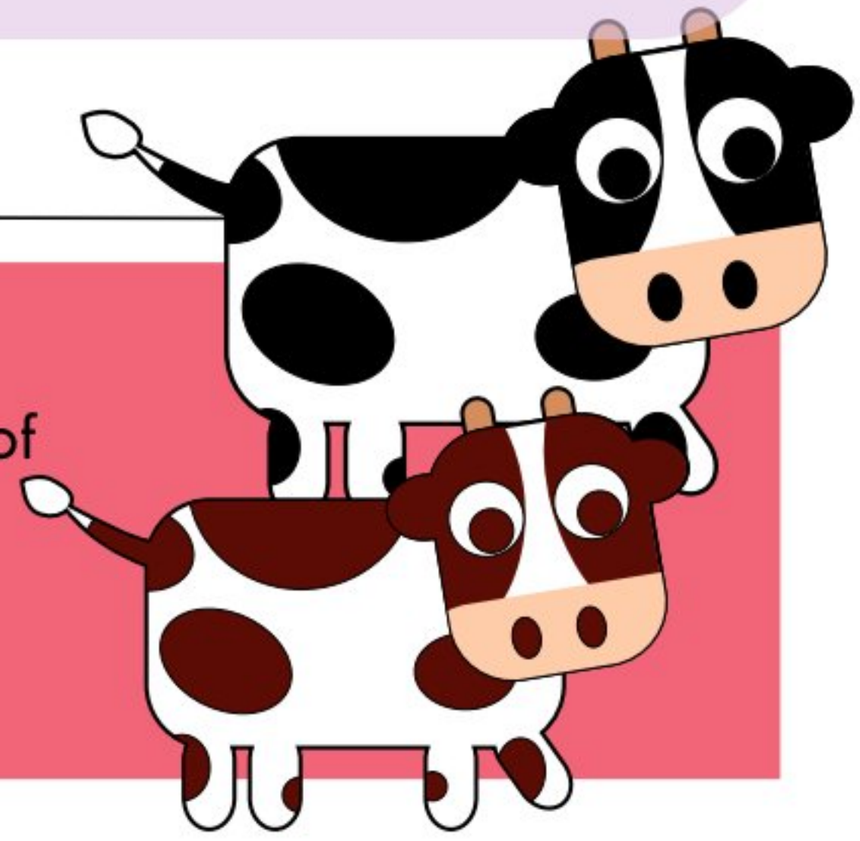
CONTRACEPTIVE QUESTIONS

Describe the effect tablets containing progesterone will have on the ability to fall pregnant.
-here you will need to speak about the negative feedback that occurs between progesterone and FSH.
-if progesterone levels are high, then FSH level are low preventing the release of an ovum
-therefore no fertilisation can take place, preventing pregnancy.

Explain the effect cutting the fallopian tubes/vas deferens will have on the person's ability to fall pregnant.
-this refers to the fact that gametes can still be made **BUT** cannot leave their sites of production therefore ovum/sperm cannot fuse

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MONOHYBRID CROSS



WHEN: Working with only ONE set of alleles.
WHY: We use these crosses to show the type of dominance.
WHAT: This cross can be used for all types of dominance.

How to layout a monohybrid for full marks:

P1: BLACK FUR x WHITE FUR ✓

BB bb ✓

MEIOSIS

✓

GAMETES B B ✓ b b ✓

FERTILISATION

F1:

	B	**B**
b	Bb	Bb
b	Bb	Bb

✓

Note:
1 mark for P1 and F1
1 mark for meiosis and fertilisation

PHENOTYPE: 100 % BLACK ✓

GENOTYPE: 100% Bb

PRO-TIPS

- used to prove which trait is dominant over the other.
- when crossing two **purebred** individuals the **dominant** colour will always produce 1**00%** offspring in the F1 generation
- in the F2 generation it will change to **75% dominant ,25% recessive**

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COMPLETE DOMINANCE

Definition: one allele is dominant and the other is recessive, such that the effect of the recessive allele is masked by the dominant allele in the heterozygous condition.

EXAMPLE:

In hamsters the colour of their fur is controlled by two alleles Brown (B) and White (b). A hamster with the brown fur has offspring with a hamster with white fur. Some of the offspring have brown fur and others have white. Use a genetic cross to show how this is possible.

HOW TO SOLVE THIS GENETIC PROBLEM

Step 1 : Identify which is the dominant and which is the recessive trait.

- In this example the clue is in the size of the letters (B) for dominant and (b) for recessive.
- It could also be seen via the offspring outcome but this is more advanced as you will need to understand the genetic ratios for different crosses first.

Step 2: Decide on what letters to use if none are given. Use the letter they provide if they do.

- Write out the parent's phenotype and genotype as stated in the question.
- This is tricky as the Brown parent may be BB or Bb, the clue is in the offspring. As there is a white baby, the Brown parent must be Bb.
- This is the case because white is recessive (bb) so in order to inherit one (b) from each parent the brown parent must be Bb.

Step 3 : Write out your genetic cross as seen earlier in this study guide.

- Ensure to include the gametes
- The punnett square must be clear

Step 4: Write the final phenotype and genotype total for all the offspring.

- Remember to include all offspring with the same phenotype together even if the genotype is different. In this example both BB and Bb will be Brown hamsters so group them together.

Step 5: Provide the total percentage or ratio.

- This depends on the question asked.
- Each complete dominance cross has a different ratio outcome.

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CO- DOMINANCE

Definition: both alleles of a gene are equally dominant whereby both alleles express themselves in the phenotype in the heterozygous condition.

EXAMPLE:

In cats the colour of fur is controlled by two alleles for Black (B) and White (W). When crossing a male black cat with a female white cat, the offspring they produce will have white fur with black spots. Use a genetic cross to show how this is possible.

HOW TO SOLVE THIS GENETIC PROBLEM

Step 1: Identify the type of dominance.

- In co-dominance there is no trait dominant over another, therefore they are equally dominant.
- Therefore both the two DIFFERENT letters must be used to express the alleles.

Step 2: Decide on a letter to use if not given. Use the letters they provide.

- Often you are given the letters you must use but if not then use the first letter of each trait.
- If you create your own letters then you MUST provide a key.
- For this type of dominance you have two options when writing your letters :

EITHER - BB x WW or C^BC^B x C^WC^W

- The first is similar to a complete dominance cross so be careful not to forget it will make a combo phenotype of BW = Black with white / White with black.
- The second option is also useful so that you don't confuse it with the other types of dominance C^BC^W = Black and white or Black-white

Step 3:Write out your genetic cross as seen earlier in this study guide.

- Make sure to use the letter you have decided upon.
- The Punnett square is key to not make a mistake.

Step 4: Write out the phenotype and genotype.

- Remember that this cross will create either pure colours or combo colours.
- BB = black, WW= White and BW = Black and white or Black with white.

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INCOMPLETE DOMINANCE

Definition: neither one of the two alleles of a gene is dominant over the other, resulting in an intermediate phenotype in the heterozygous condition.

EXAMPLE:

Parrots have three possible feather lengths: long, medium and short. Two parrots with medium length feathers interbreed and produce offspring. Use a genetic cross to show all the possible outcomes. Show the phenotypic ratio of this cross.

HOW TO SOLVE THIS GENETIC PROBLEM

Step 1 : Identify the type of dominance.

- The clue is in the three different alleles that show an intermediate.
- It's important not to confuse this with co-dominance as it also has three possible alleles. The difference is that this produces a phenotype that is somewhere in the middle or a mix of both **NOT** a combination where each trait is equally expressed like in co-dominance.

Step 2: Decide on what letters to use if not given. Use the letters they provide if they do.

- Generally we will use the first letter of each trait again like (L) and (S) for long and short.
- This time however when both (L) and (S) are together they make a new intermediate phenotype (LS) = medium.
- You can see how this can become tricky when always using capital or lowercase letters. This is why we suggest using the superscript technique as seen in the co-dominance explanation so that you can keep them separate in your mind.

Step 3: Write out your genetic cross as seen earlier in this study guide.

- For this example two parrots with medium length feathers (LS) interbreed
- This means there will be multiple possible outcomes.

Step 4: Write out the phenotype and genotype.

- Remember that this cross will create either pure feather lengths or intermediate lengths.
- LL = long, SS= short and LS = medium
- This question also asked for the ratio which is: 1:2:1 (1 long : 2 medium : 1 short)

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BLOOD GROUPS

HOW TO WORK WITH BLOOD GROUP ALLELES

- blood groups are an example of **CO-DOMINANCE** and **COMPLETE** dominance.
- A and B blood groups are co-dominant.
- **BUT** A and B blood groups are dominant over O blood.
- blood groups can be used to determine if a child is adopted.
- it can also **EXCLUDE** a father in a **PATERNITY** test but it **CANNOT** confirm a father as many men may have the **SAME** blood group as the child.

Blood Type Alleles:

I^A (co-dominant)
I^B (co-dominant)
i (recessive)

	I^A	I^B	i
I^A	$I^A I^A$ A	$I^A I^B$ AB	I^A i A
I^B	$I^B I^A$ AB	$I^B I^B$ B	I^B i B
i	i I^A A	i I^B B	i i O

HOW TO DETERMINE IF A CHILD IS ADOPTED VIA BLOOD GROUPS

EXAMPLE: mother with blood group AB and a father with blood group A have a child with blood group O. Is this child their own or adopted?

STEP 1: write down the alleles of both parents.

STEP 2: write down the child's alleles.

STEP 3: looking at the child's alleles was it possible that they received one allele from each parent to form their blood group?

STEP 4: if it is possible then the child is theirs/ if not then the child is adopted. (in this example the child is adopted, as only the father could have possibly given an O blood allele.)

phenotype (blood type)	genotype
Type A	$I^A I^A$ I^A i
Type B	$I^B I^B$ I^B i
Type AB	$I^B I^A$
Type O	i i

PROTIPS

- you may **ONLY** use the letter I or i for blood groups
- for blood group **A** and **B** you super script the letter above the (**I**)
- in order to have blood group **O** you **MUST** have the alleles (**ii**)

Miss Angler

40

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

- **Complete a genetic cross**

- here you will need to use the **format** shown above to prove the outcome of your cross.

- **Explain the inheritance pattern.**

- you will need to state what type of dominance it is
- then explain the following:
1. what is the **parents** genotype
2. what is the **offspring** genotype
3. how did the offspring inherit **one allele** from each parent.

- **Give a reason for your identification of the type of dominance.**

- Provide the different **ratios** that are seen in different crosses eg:
  1. Pure breed = 100% (no ratio)
  2. Heterozygous = 75%:25% (3:1)
  3. Heterozygous x homozygous recessive = 50%:50% (1:1)

SHORT QUESTIONS

- **Define the type of dominance.**

- here you will need to use your exam guideline to define the 3 main types of dominance.

- **Identify the dominant/recessive trait.**

- this can be done by looking at the frequency of the trait occurring:
- more frequent = dominant
- less frequent = recessive

TRICKY QUESTIONS

- **Using a genetic cross, show the type of dominance (this genetic cross is an example of an unseen question where you are unfamiliar with the organism and its traits, however, it uses the same principles of an example you have done before).**

- EG: blood groups are co-dominant and complete dominance (A, B, AB and O).
- now apply this with another trait like colour of snail shells (black, white, black-white and yellow.
- the principle of inheritance is the same as blood groups. All that has changed is the phenotype.
- if you know enough about blood groups you would be able to complete the question with ease.



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SEX LINKED DISORDERS

WHEN: Working with disorders found on the **X chromosome.**
WHY: We use these crosses to show us the inheritance of sex-linked disorders as well as showing **how common they are in each sex.**
WHAT: The genotype of **females XX** allows them to carry the disorder but feel no symptoms. **Males XY** only have one X so if its affected they will experience symptoms.

How:

Haemophilia

EG: an unaffected man has a child with a woman that is a carrier for Haemophilia. Show all the possible offspring in a genetic cross.

P1: unaffected male x unaffected female (carrier)

X^HY x X^HX^h

meiosis

gametes X^H Y X^H X^h

fertilisation

F1:

	X^H	X^h
X^H	X^HX^H	X^HX^h
Y	X^HY	X^hY

Phenotype: 50% unaffected female
25% unaffected male
25% haemophiliac male

Recessive and sex-linked

Key:
X^H- dominant, not haemophiliac
X^h- recessive, haemophiliac

PRO-TIPS

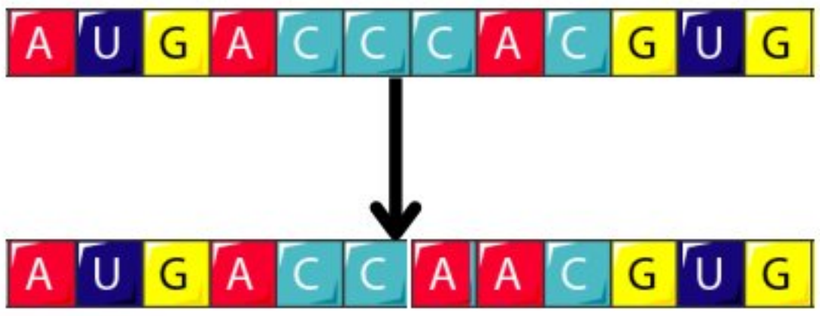
- a **CARRIER** is not a phenotype so **DO NOT** include it in the phenotype of the female, keep it in brackets so you don't forget.
- group **ALL** the normal and carrier females together when writing your F1 phenotype as they do belong together even though their genotypes are different.
- **ALWAYS** write that it's a male or female in all your answers and in crosses.

Miss Angler 42

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MUTATIONS

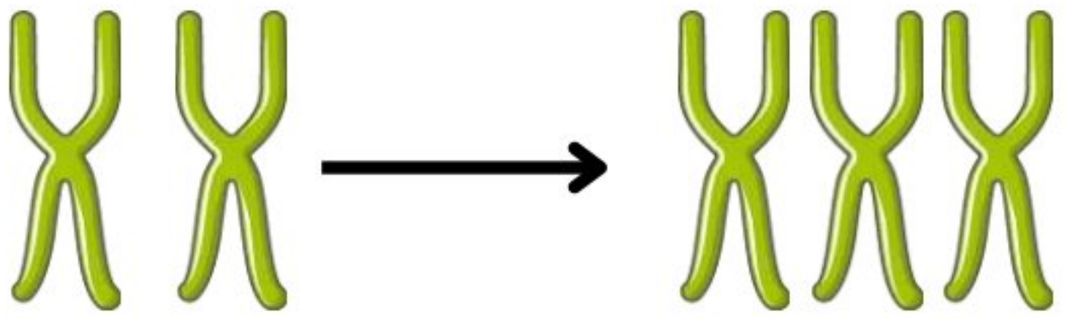
GENE MUTATION



- When one or more nucleotides change and is deleted, substituted with another nitrogenous base or repeated.
- this leads to a change in the mRNA
- therefore different mRNA strands will attract different tRNA molecules with different amino acids
- creating a different protein

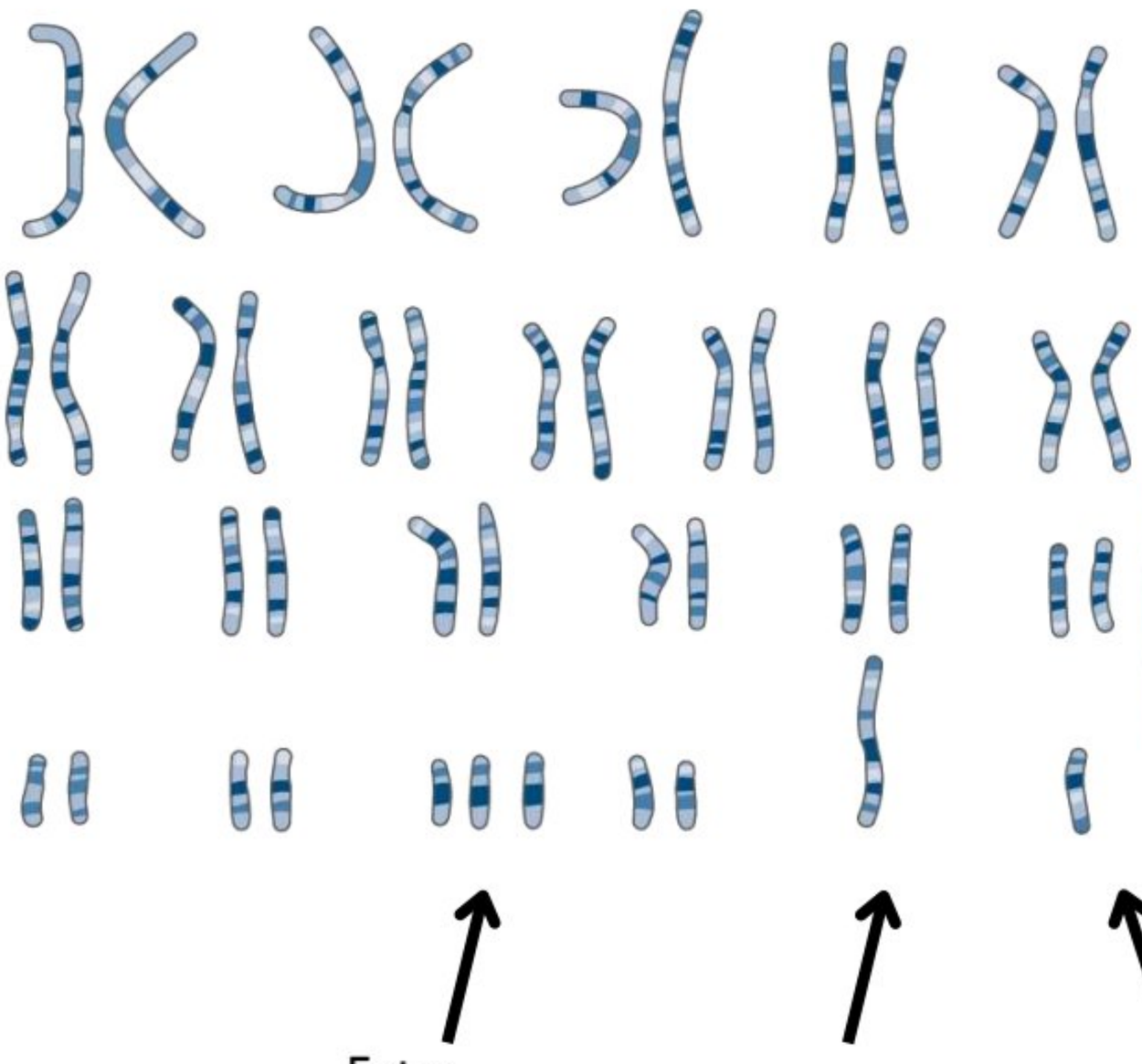
NOTE: **ALWAYS** check that a different amino acid is actually coded for, check via the amino acid table they will give you. It may turn out that the codon is different but still codes for the **SAME** amino acid.

CHROMOSOMAL MUTATION



- When a whole chromosome is added or deleted
- occurs during meiosis
- must occur in the gametes in order for it to be inherited

NOTE: you can have extra **AUTOSOMES** like in **Down syndrome** with an extra 21 chromosome. You **WILL** need to be able to **EXPLAIN** how this occurs during anaphase, where chromosome fail to separate leading to one gamete having 24 chromosomes and the other having 23 resulting in **47** chromosomes.



KARYOTYPES

- **WHAT**: arrangement of chromosomes that have the same shape, size and genes
- **WHEN**: helps to identify chromosomal mutations
- **HOW**: use these diagrams to identify the sex and the chromosomal mutation.

NOTE: in exams these are often given for Down syndrome so you must be able to **IDENTIFY** if this is the case or identify any syndrome.

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PEDIGREE DIAGRAMS

HOW TO SOLVE PEDIGREE DIAGRAMS

Step 1. Identify whether it is an **AUTOSOME** or **SEX-LINKED** disorder.
- **Autosomal** disorder will use letter alleles like **B** and **b.**
- **Sex-linked** disorders will use **X** with a superscript letter like **H** or **R** (could be any letter)**.**

Step 2. Identify if it is a **RECESSIVE** or **DOMINANT** disorder.
- this will be indicated via the size of the letter allele given eg: (**H**) will be dominant (**h**) will be recessive.

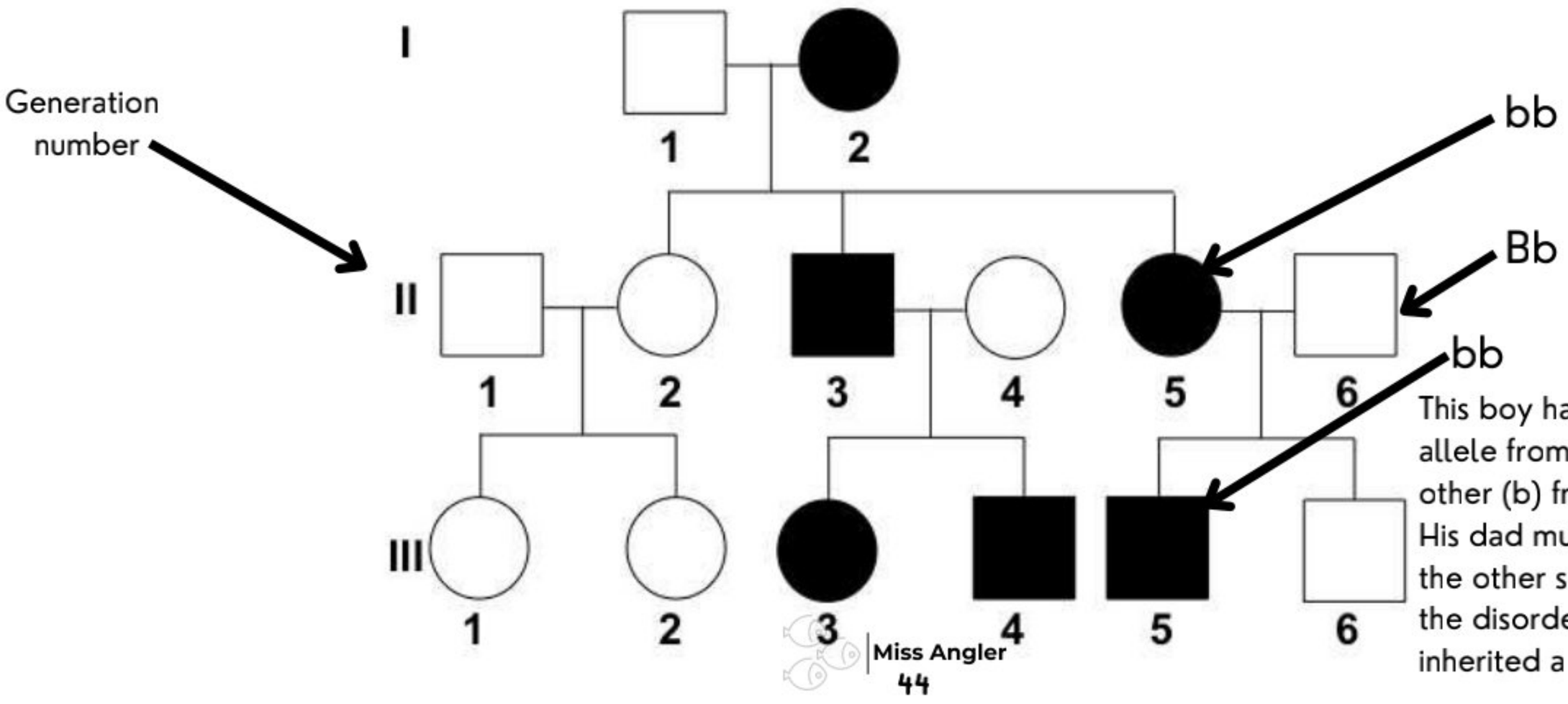
Step 3. If sex-linked fill in each individuals X and Y chromosomes respectively. **(go to step 6)**
OR
(go to step 4) If autosomal go straight into giving all the autosomal alleles.

Step 4. Start by filling in all the individuals you know for certain.
EG: in an autosomal recessive disorder all individuals who have it will be (bb)
All other individuals without will either be (BB) or (Bb).

Step 5. To determine whether an individual is (**BB**) or (**Bb**) you must look at the **OFFSPRING** of that couple.
EG: if the couple has one child that has the disorders (bb) then both parents must have at least **ONE** (**b**) each. Their other allele might be (**B)** if they don't have the disorder or (**b**) if they do.

Step 6. Fill in all the recessive alleles on the **X chromosomes** of the individuals who have the disorder.
Starting with the males as they only have **ONE** X chromosome.
Females have two X chromosomes, if they have the disorder then **BOTH** X chromosomes will have the recessive allele (**h**) on it.
A female can also be a **CARRIER**, which means one X has a dominant allele (**H**) and the other X has a recessive allele.
To determine if she is a carrier you will need to look at her children, especially her boy children as they inherit **ONLY** their **X** chromosome from their mother and **ONLY** their **Y** chromosome from their **father**.

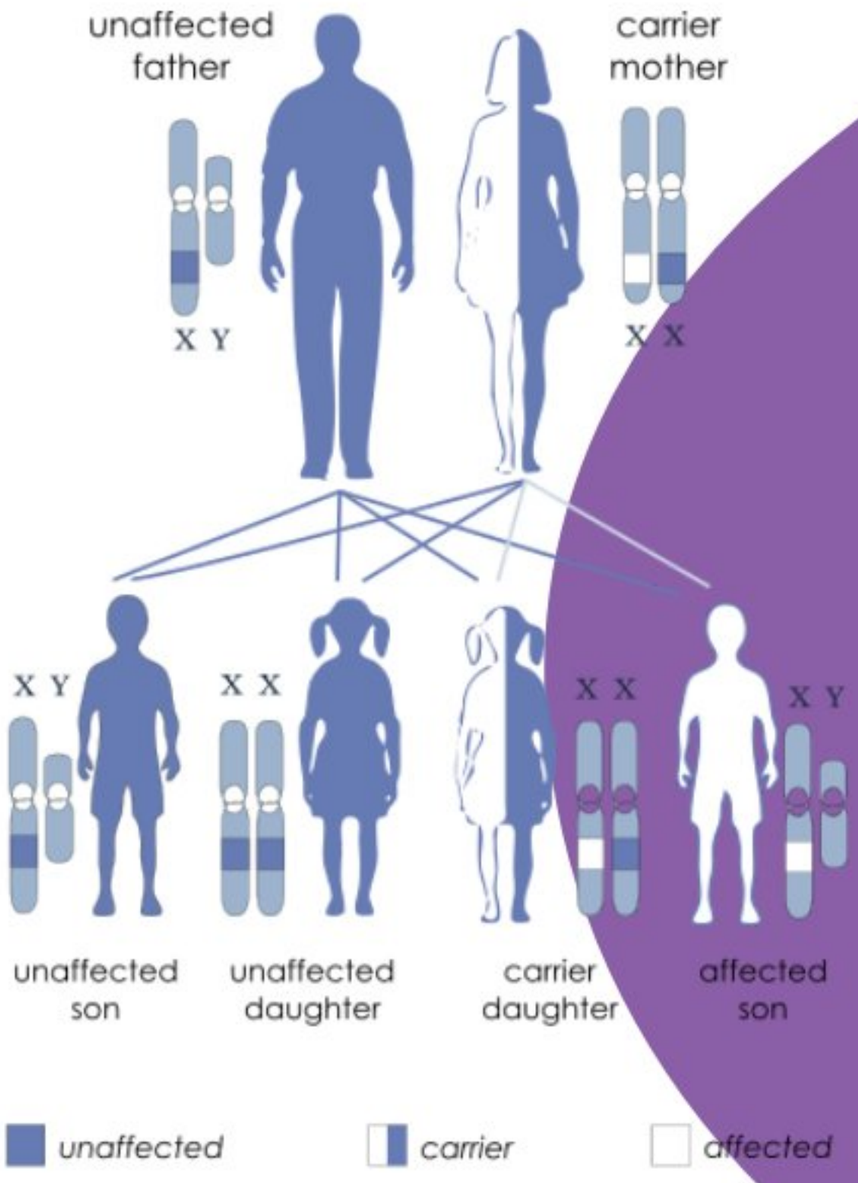
AUTOSOMAL RECESSIVE DISORDER EXAMPLE

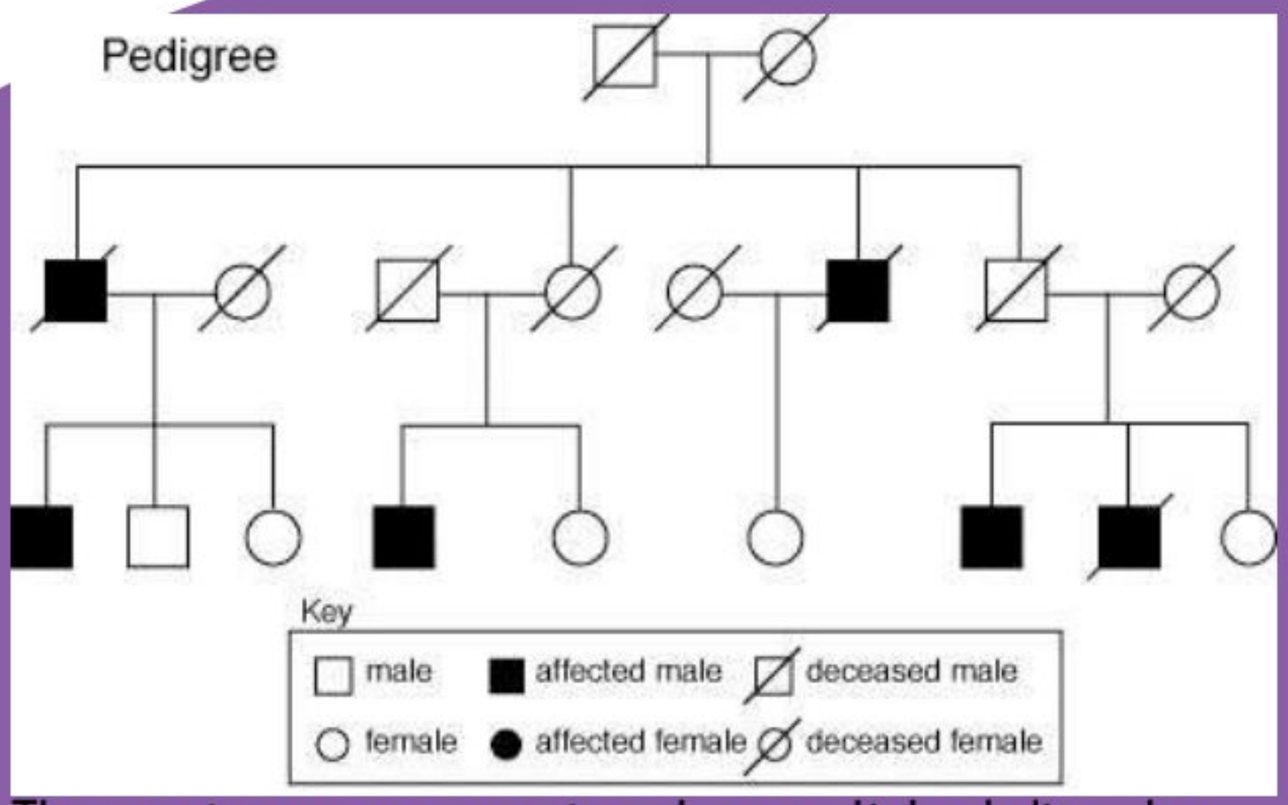


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HOW WILL THEY ASK THIS?

X-linked recessive inheritance





- The most common way to ask a sex-linked disorder question is to use a pedigree diagram.
- Always remember to give everyone an X or Y.
- Remember that the word "carrier" is not accepted as a phenotype, those females are still called "unaffected females".
- If you want to use the word "carrier" so you remember they are heterozygous, then write it in brackets.

LONG QUESTIONS

- **Explain why males are more susceptible (more common) to sex-linked disorders.**

- here you will need to mention that males are XY and females are XX.
- because the X chromosome carries the recessive disorder.
- males only need **ONE** recessive allele to have the disorder.
- they don't have another X chromosome to **MASK** it.

- **State the percentage of the MALES vs how many of the OFFSPRING have the disorder.**

- this is a **VERY TRICKY QUESTION!!!!!**
- the first question wants to know the percentage of just the **MALES,** so if there are 4 males in a family and 2 have the disorder then 50% have the disorder.
- **HOWEVER,** if they ask the percentage of the **OFFSPRING,** they are talking about ALL the children and therefore you must include girls too.
- so if the family has 8 children, 4 boys and 4 girls, with 2 of the males having the disorder, then only 25% have the disorder.

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DIHYBRID CROSS

WHEN: Working with only **TWO sets** of alleles (**4** in total, 2 from each parent).
WHY: We use these crosses to show the **outcome** of two alleles being expressed in the **phenotype.**
WHAT: This cross can be used for more than 2 characteristics (height and colour OR texture and size).

How:

TEST CROSS

Seed colour : Green (G) Yellow (g)

Seed texture: Rough (R) Smooth (r)

P1: Green rough seed x Yellow smooth seed ✓

GGRR ggrr ✓

MEIOSIS

GAMETES GR GR GR GR gr gr gr gr ✓

FERTILISATION

F1:

	GR	**GR**	**GR**	**GR**
gr	GgRr	GgRr	GgRr	GgRr
gr	GgRr	GgRr	GgRr	GgRr
gr	GgRr	GgRr	GgRr	GgRr
gr	GgRr	GgRr	GgRr	GgRr

GENOTYPE: 100% GgRr ✓

PHENOTYPE:
100 % Green and rough seeds ✓

Note:
1 mark for P1 and F1 ✓
1 mark for meiosis and fertilisation ✓

PRO-TIPS

- These types of crosses still use the same laws of dominance that we see in a monohybrid.
  Eg: T = tall t= short therefore Tt = tall
- An allele can only be used **TWICE** when creating the gametes.
- You will **NEVER** be asked to complete a whole dihybrid, just fill in the missing pieces.

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CROSSING TWO OFFSPRING FROM THE F1 GENERATION

P2: Green rough seed GgRr x Green rough seed GgRr

MEIOSIS

GAMETES: GR Gr gR gr x GR Gr gR gr

FERTILISATION

F2:

	GR	**Gr**	**gR**	**gr**
GR	GGRR	GGRr	GgRR	GgRr
Gr	GGRr	GGrr	GgRr	Ggrr
gR	GgRR	GgRr	ggRR	ggRr
gr	GgRr	Ggrr	ggRr	ggrr

Phenotype:

9 green and rough seeds
3 green and smooth seeds
3 yellow and rough seeds
1 yellow and smooth seed

Ratio - 9:3:3:1

PRO-TIPS

- The ratio of **9:3:3:1** is very important when completing a cross with two **heterozygous parents** as seen above.
- **ALWAYS** group together the same phenotypes even though the genotypes are different, as they produce the same physical outcome due to the law of dominance.

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HOW TO SOLVE A DIHYBRID CROSS

REMEMBER: You will never have to complete a full dihybrid cross!

EXAMPLE 1: In a family the genetic disorder for albinism (a) is present where the skin lacks melanin(pigment) . Associated with this disorder is night blindness (N). An albino mother who is heterozygous for night blindness has children with a man who is normal, homozygous dominant for melanin and has normal sight.

How to determine the parent's genotypes:

- In this example they tell us albinism is recessive by giving us the letter (a) which means you need (aa) to have the disorder.
- Night blindness is a dominant disorder by telling us it's (N), this means either (NN) or (Nn) will have the disorder.
- Mother = aaNn
- Father = AAnn

Example 2	aN	an	aN	an
An	AaNn	Aann	AaNn	Aann
X	AaNN	AaN n	AaN N	AaNn

How to fill in the blanks in a dihybrid Punnett square:

Determine the missing gametes:

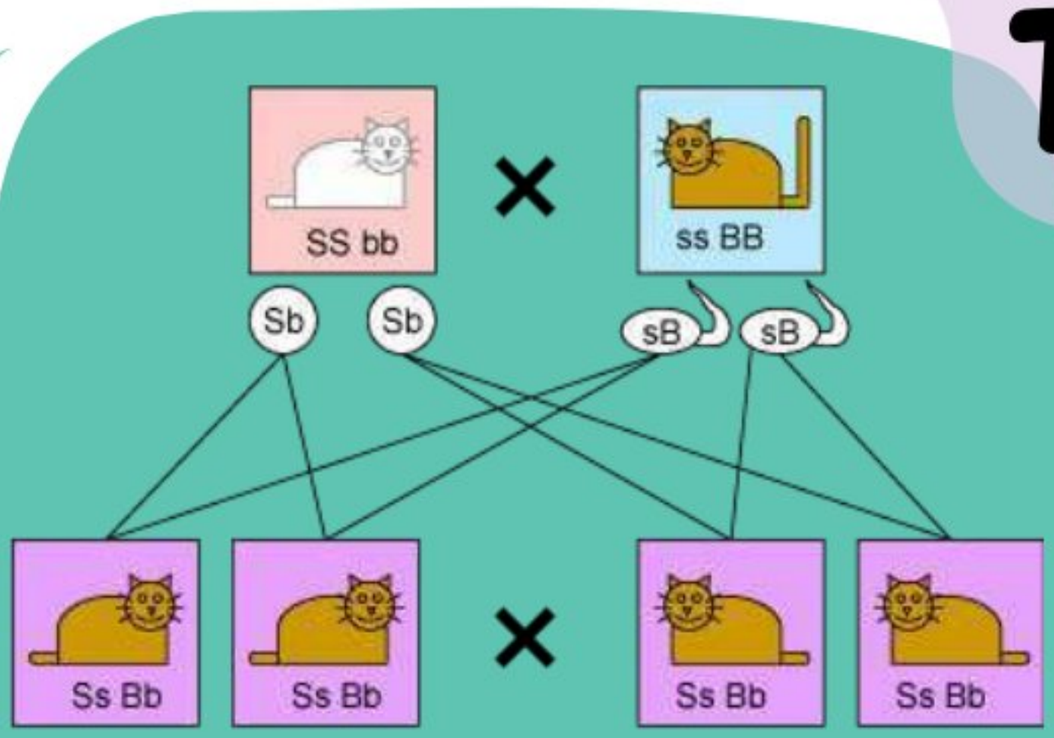
- Look at the offspring produced
- Subtract the letters you have in one column, the left over letters are what is missing at "X"
- Answer: AN

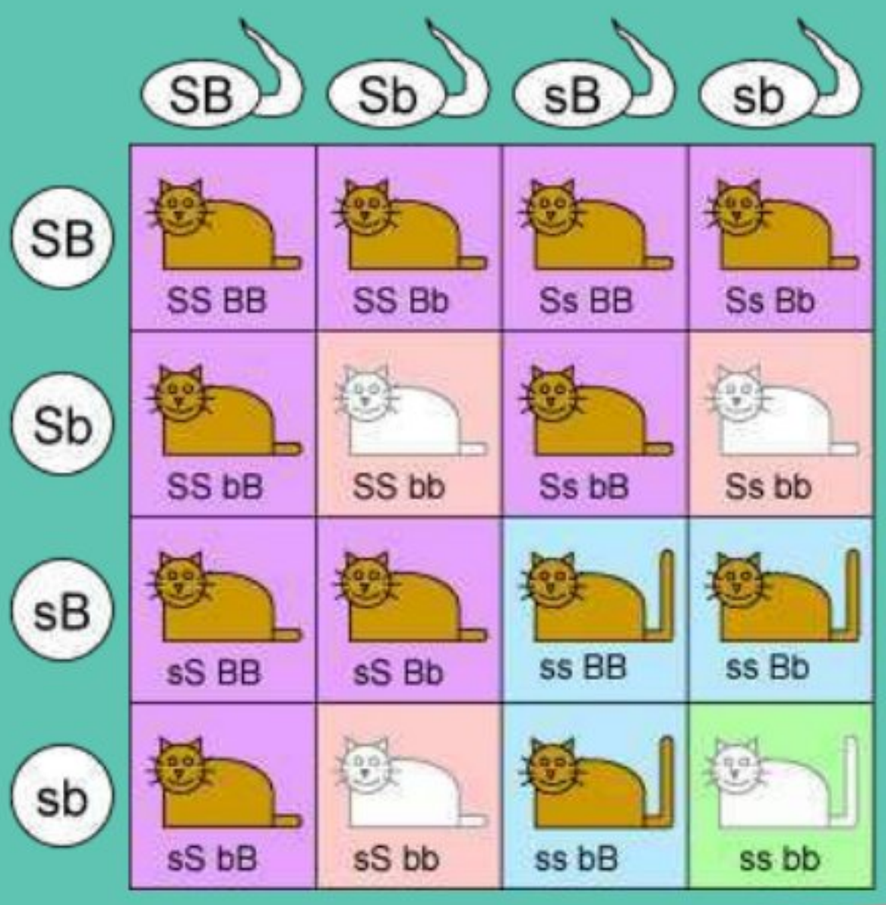
How to determine the offspring that will NOT be the same as the parent's phenotypes:

- We know the genotypes of both parents from example 1.
- Write out the phenotype that is NOT represented by the parents: albino with normal vision. (aann)

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HOW WILL THEY ASK THIS?





SHORT QUESTIONS

1. **State why the above example represents a dihybrid.**
- it contains 4 alleles with 2 genes (height and colour).

2. **Write down the phenotype/genotype.**
- simply provide the missing info from the punnett square.

3. **Give the gametes produced by parent A.**
- here you show all the possible gamete formations

LONG QUESTIONS

- **A man and a woman can only produce a certain type of offspring. State their only possible genotypes.**

- in this question they will provide you with one parent's genotype and the offspring's and you will have to work backwards to calculate the missing parent.
- to do this you will remove one allele set from the parent provided and the remaining alleles will be the missing parent.

- **Identify the dominant trait for each of the two genes pictured above.**

- looking at the cat dihybrid cross above we see two traits: fur colour and tail length.
- the first cross shows us that brown and short tail length is dominant as this is the only visible trait in the phenotype when crossing two pure-bred parents.

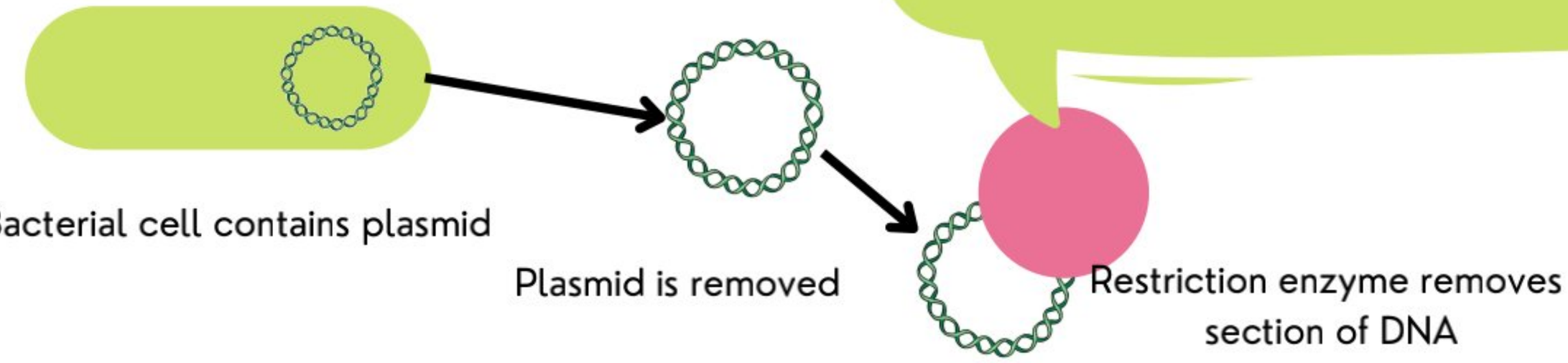
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GENETIC MODIFICATION

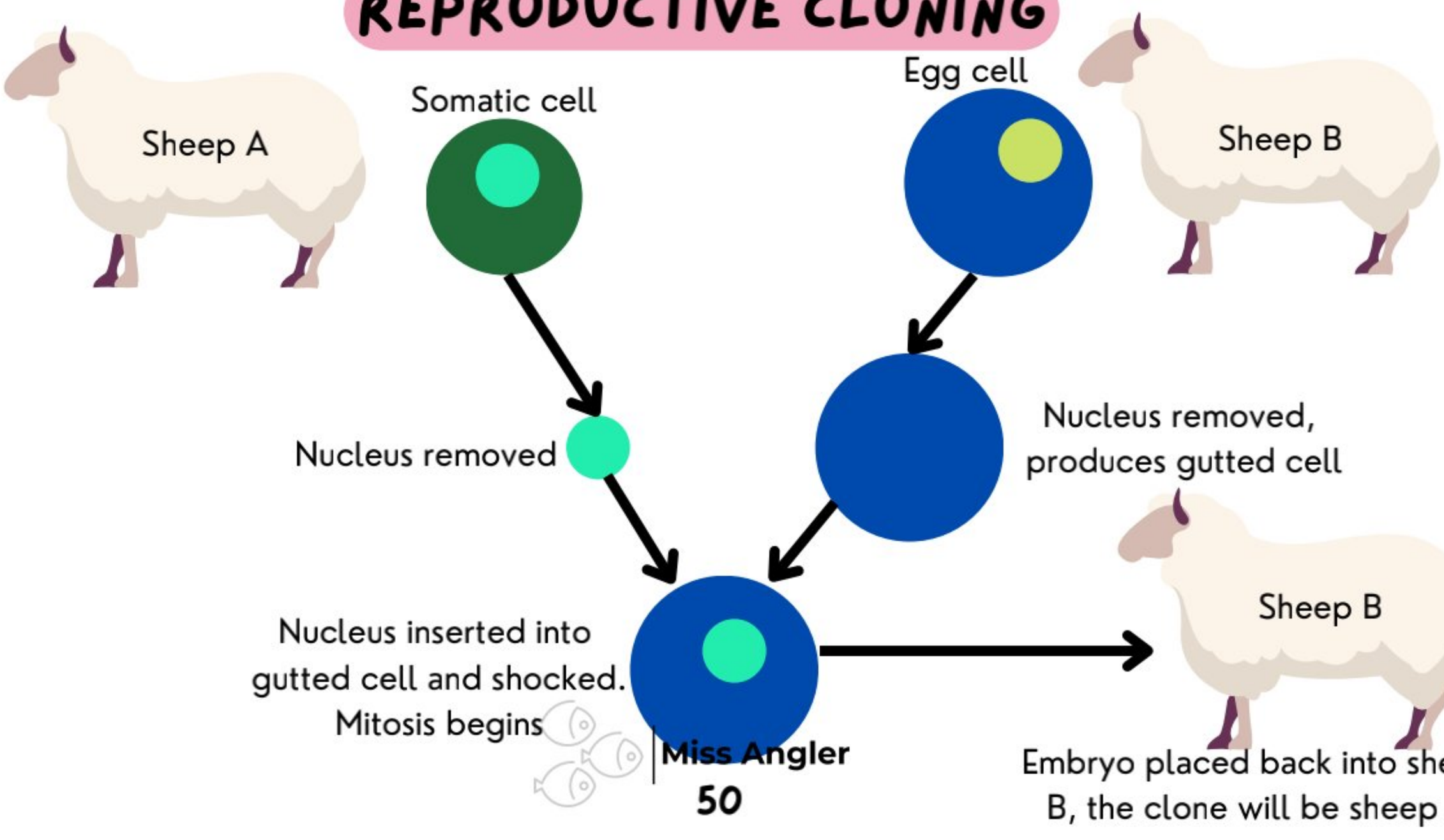
PRO-TIPS

- You **MUST** know the difference between **BIOTECHNOLOGY** and **GENETIC ENGINEERING.**
- You **DO NOT** need to know the full name of enzymes - just call them restriction enzymes.
- The **PLASMID** is an extra-nuclear ring of **DNA.**
- Why we use **BACTERIA** in these experiments is because they reproduce rapidly and have a plasmid.

MOLECULAR CLONING



REPRODUCTIVE CLONING



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HOW WILL THEY ASK THIS?

LONG QUESTIONS

1.**Describe the process of reproductive cloning.**
- **REMEMBER** to use the basics of describing: how, when, why and where.
- you can use the template answer as seen above **BUT** always make sure to use the animal they have provided in your answer.

2. **Explain which organism will be cloned: the nuclear (somatic) donor or the egg donor.**
- **REMEMBER** to make a statement then give a reason.
- **STATEMENT**: the nuclear donor will be the clone.
- **REASON**: the somatic cells contain the full genetic code/all the chromosomes needed.

3. **Name TWO benefits of cloning/GMOs.**
- many answers to choose from: grow faster, larger yield, more nutrients, cheaper (in the long term) and lower use of pesticides.

SHORT QUESTIONS

1.**Name a source of stem cells.**
- embryonic stem cells
- umbilical cords

2. **State TWO reasons why cloning animals can have a negative affect.**
-reduced genetic variation
-increases organisms susceptibility to diseases
-genetics can cross over into non-GMO organisms

INVESTIGATION QUESTIONS

1. **Bacteria is often used to produce insulin for diabetics. Different amounts of insulin were used in a group of 10 people and their blood glucose levels were recorded every hour for 10 hours.**
- These types of questions are building scientific method and theory into one.
- They will ask - independent variable
  - dependent variable

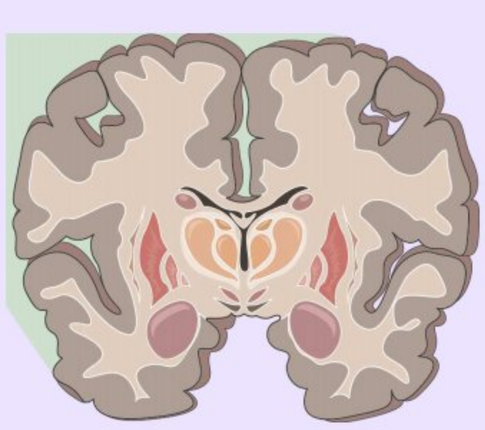
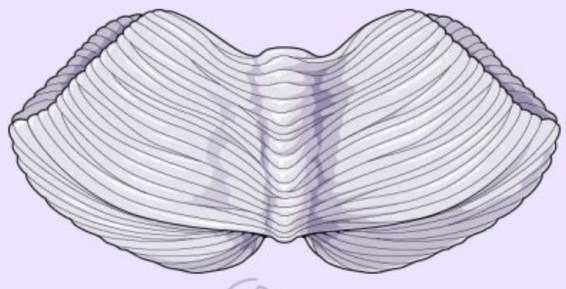
Answer: - amount of insulin
- blood glucose level

- **O**ther questions like "how did /how should validity and reliability be maintained?"

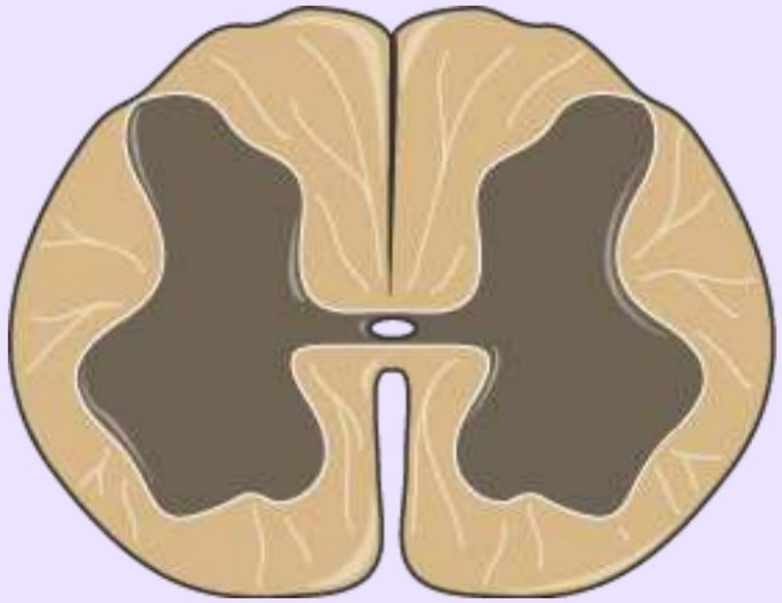
- **<u>NOTE</u>**: This is a crossover question where they can ask about homeostasis and genetic engineering.
- They may also ask you to explain how the pancreas normally regulates blood glucose.

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NERVOUS SYSTEM STRUCTURES

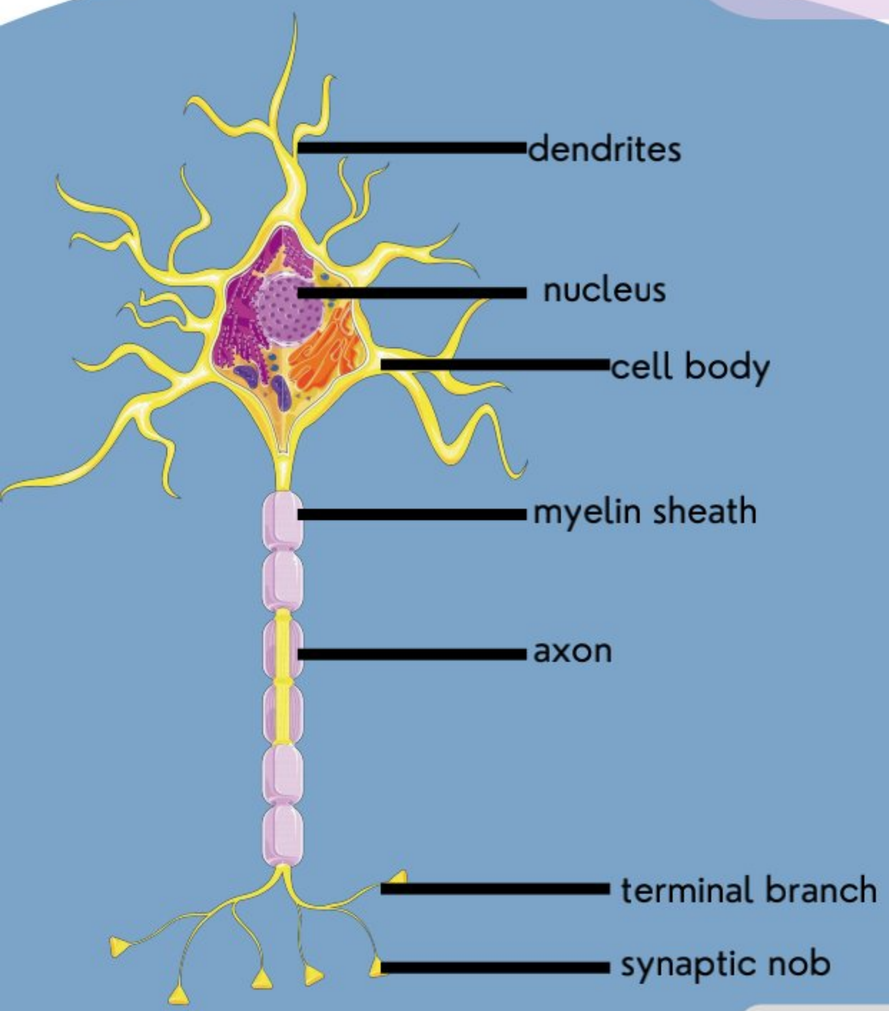
REGION	STRUCTURE	FUNCTION
MENINGES	• Pia mater- outer • Arachnoid- middle • Dura mater - outer	• protection
CEREBRUM	• Corpus callosum • Ventricle • Gyri and sulci  **lobes:** frontal parietal temporal occipital	• connection between hemispheres • filled with cerebral-spinal fluid • increases surface area 1. white matter 2. grey matter memory, intelligence skin sensations, temperature, hearing ,taste, smell sight
CEREBELLUM		• co-ordinates voluntary movement • muscle tone • posture and balance

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REGION	STRUCTURE	FUNCTION
BRAINSTEM	• medulla oblangata • (lower section before exiting the foramen magnum)	• pathway to and from brain • breathing, heartbeat • less important reflexes like sneezing or coughing
	• Spinal cord • NOTE: the white and grey matter swap locations when compared to the cerebrum/cerebellum 	• pathway for impulses • intergrative reflexes • primitive reflexes

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HOW WILL THEY ASK THIS?



LONG QUESTIONS

1.**Describe the pathway taken by a reflex arc when a sharp object is touched by the finger.**
- **REMEMBER** this answer requires detail so you will need to mention:
How- receptors in skin
When- pain stimulus/safety
Where- name all the structures the impulse moves through from sensory to inter to motor neuron and finally effector

You may also be expected to mention the specific structures of the spinal cord itself in this answer (use mark allocation as a guide for detail).

2. **Describe how the medulla oblongata and the endocrine system respond during a stressful situation**.
- Here you will need knowledge of both systems in order to answer
Provide the function of the medulla oblongata.
Provide the endocrine system (**adrenal**) that would assist.
Mention hormones involved with increasing heartrate and how these two systems work together.
Mention which part of the **PNS** is involved with flight or fright (**sympathetic**).

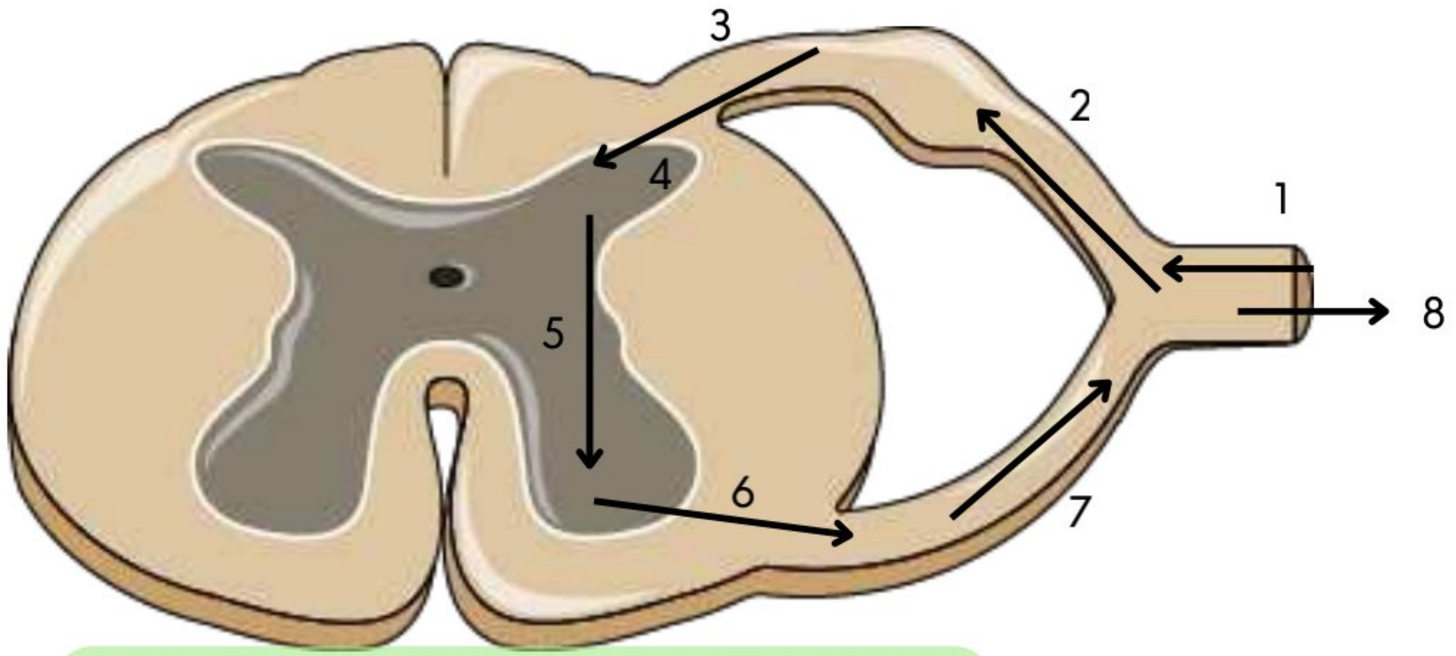
SHORT QUESTIONS

1. **Provide labels for structures.**
- Here you need to be able to identify all the structures in the diagram.
2. **State the function of the structures.**
- This is a common question for any structure in the brain or CNS.
3. **Tracing a reflex through which neurons.**
- You will need to mention the correct order in which the impulse moves.
4. **State the outcome if region X is damaged.**
- **T**his question is also a function-based question because if you know the function then you will know what won't work if it's damaged .

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54

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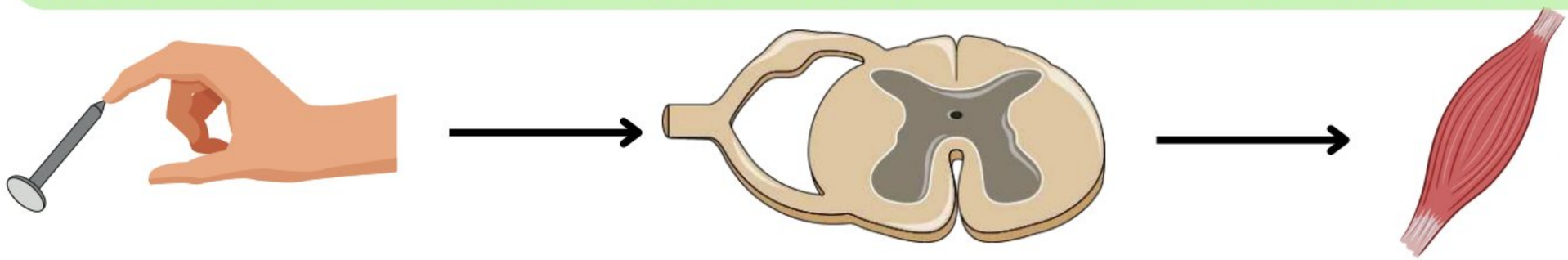
PATHWAY OF REFLEX



GENERAL ROUTE OF REFLEX ARC

1 stimulus --> 2 sensory neuron --> 3 dorsal root --> 4. grey matter --> 5 interneuron --> 6 ventral root --> 7 motor neuron --> 8 effector

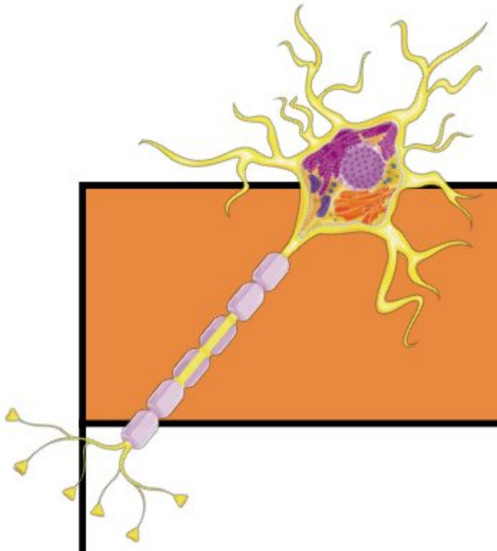
EXAMPLE ROUTE OF REFLEX ARC WHEN TOUCHING SOMETHING SHARP



1. pain receptors in finger --> 2. send impulse along sensory neuron --> 3. impulse enters dorsal root --> 4. grey matter --> 5. interneuron interprets stimulus and creates a response --> 6. impulse travels along ventral root --> 7. motor neuron transfers response --> 8.the muscle in the finger responds, contracting moving away from the stimulus

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55

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	ALZHEIMER'S	MULTIPLE SCLEROSIS
Cause	• **Autoimmune** disease • Genetically inherited • Build up of **amyloid plaque** around neurons • prevents correct transfer of electrical impulse • affects 50+ year olds	• **Autoimmune** disease • genetically inherited • environmental linked • loss of **myelin** sheath surrounding neurons • can't conduct electtical impulse from neuron to neuron • affect 20 - 40 year olds
Symptoms	• decline in memory • dementia • loss of motor functions (late stage)	• fatigue • vision problems • muscle spams
Treatments	• Currently none • Immunotherapy can slow down progression • Terminal disease	• currently none • physical therapy • muscle relaxants

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HOW WILL THEY ASK THIS?

SUMMARY OF NERVOUS SYSTEM BREAKDOWN

Nervous system

Central nervous system
Brain
Spinal cord

Peripheral nervous system
Cranial nerves
Spinal nerves

Somatic nervous system
Voluntary movement
Skeletal muscles

Autonomic nervous system
Maintaining homeostasis
Involuntary movement

Parasympathetic nervous system
Rest and digest

Sympathetic nervous system
Fight and flight

Miss Angler 57

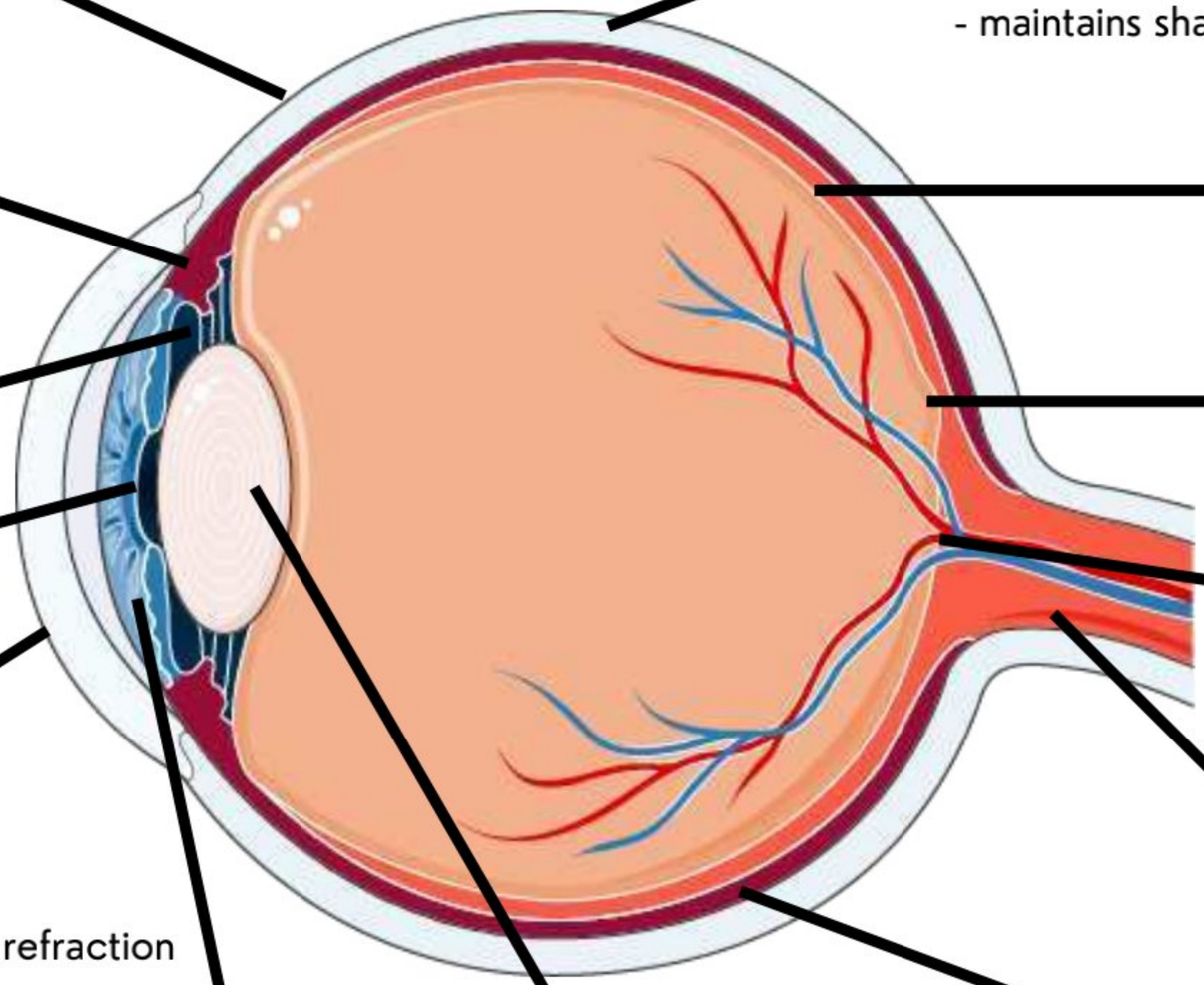
LONG QUESTIONS

1.**Describe the pathway taken by a reflex arc when a sharp object is touch by the finger.**
- **REMEMBER** this answer requires detail so you will need to mention:
How- receptors in skin.
When- pain stimulus/safety.
Where- name all the structures the impulse moves through from sensory to inter to motor neuron and finally effector.
You may also be expected to mention the specific structures of the spinal cord itself in this answer (use mark allocation as a guide for detail).

2. **Explain/describe the response undertaken by the eye when a bright object is thrown at your face.**
- **NOTE:** this is referencing the pupillary mechanism so you will need your eye content for this answer, **HOWEVER** they can also include the reflex from the eye that occur when blinking because something is suddenly thrown at you.
- here you will need to explain the normal reflex pathway as you will be contracting the muscles of the body to pull away from the dangerous stimulus.

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STRUCTURE OF THE EYE



Conjunctiva
-protects
- clear membrane

Sclera
-protects
- maintains shape of eye

Ciliary body
- contains ciliary muscles
- responsible for changing shape of lens

Retina
- contains rods and cones
- converts light into impulse

Suspensory ligaments
- attached to lens
- controls thickness of lens

Fovea (yellow spot)
- highest point of visual acuity

Pupil
- hole that allows light to enter eye
- changes size

Blind spot
- no rods or cone
- area where optic nerve leaves eye

Cornea
- transparent
- causes converging of refraction (light bending)
- contains pain receptors

Optic Nerve
- transfers impulse to cerebrum

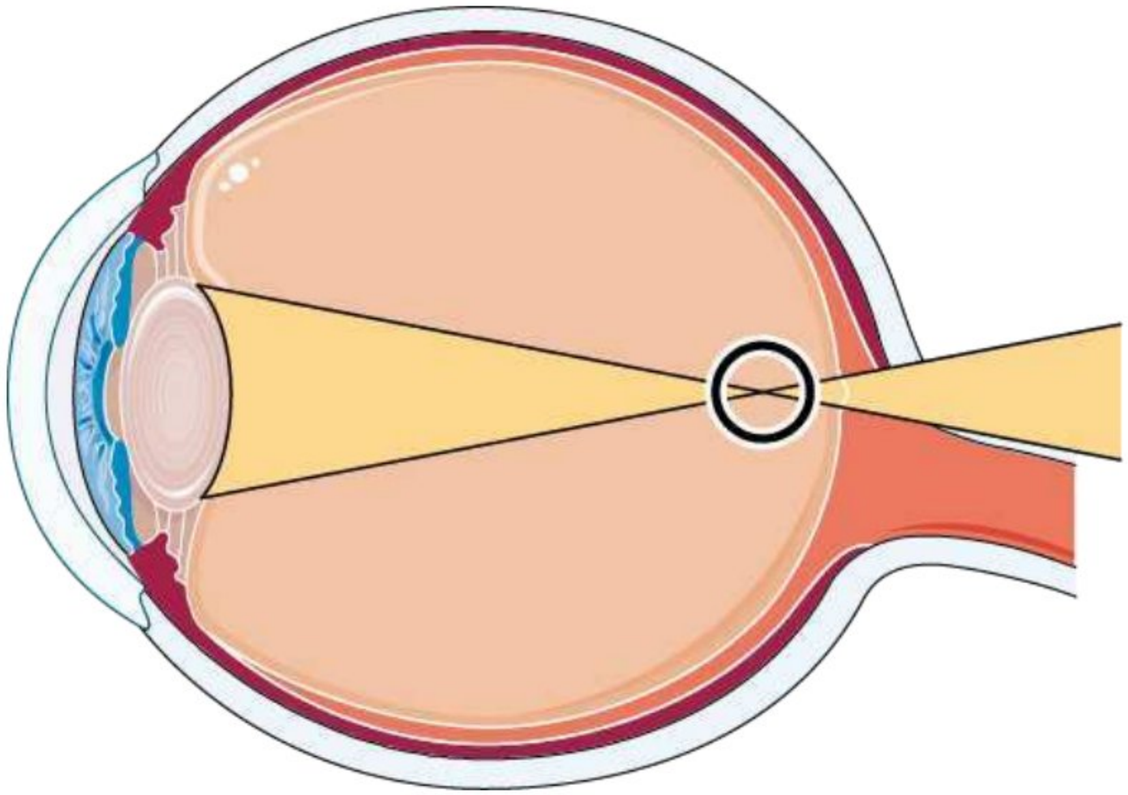
Iris
- contract and relaxes to form pupil
- responsible for how much light enters eye
-contains radial and circular muscles

Lens
- flexible structure
- transparent
- refracts (bends) light
- focuses light onto retina

Choroid
- filled with blood vessels
-provides nutrient to eye
- absorbs excessive light

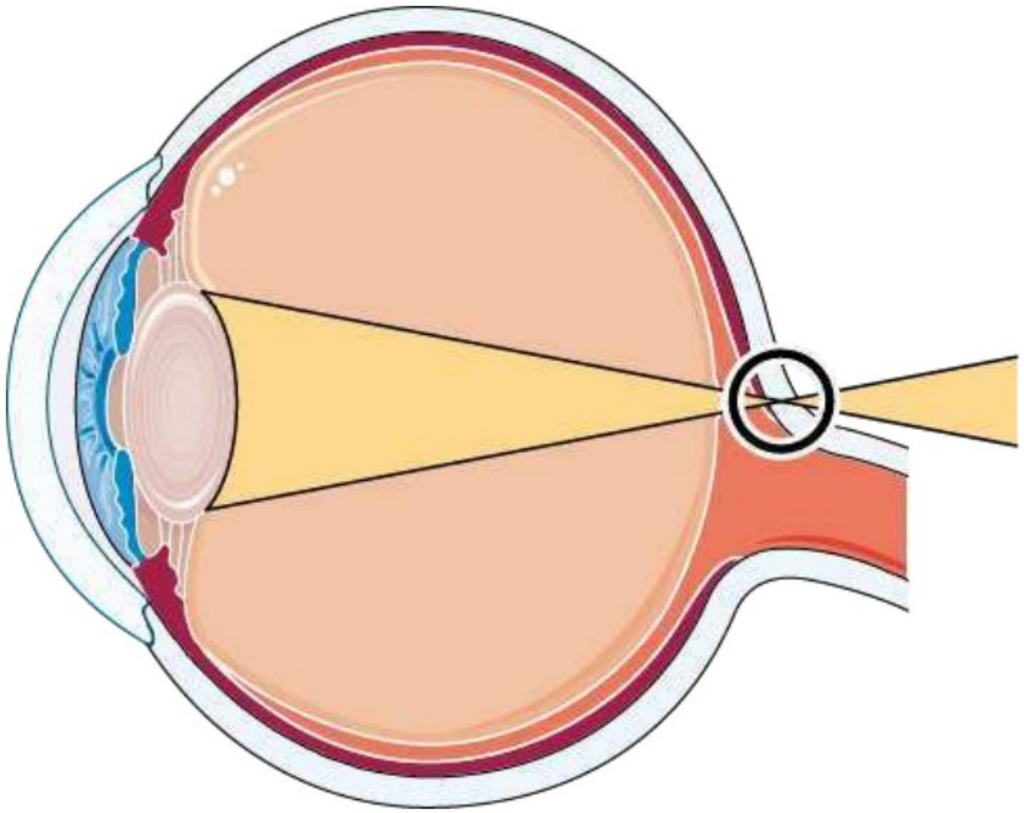
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VISUAL DEFECTS OF EYE



MYOPIA (SHORT SIGHTEDNESS)

- when you can see close up **BUT** not far
- eyeball is too **LONG**
- cornea or lens is too **CONVEX**
- light rays meet in front of retina
- **SOLUTION**: wear **CONCAVE** lenses



HYPERMETROPIA (LONG SIGHTEDNESS)

- when you can see far away **BUT** not close up
- eye is too **SHORT**
- the cornea of lens is too **FLAT**
- light rays meet behind the retina
- **SOULTION**: wear convex lenses

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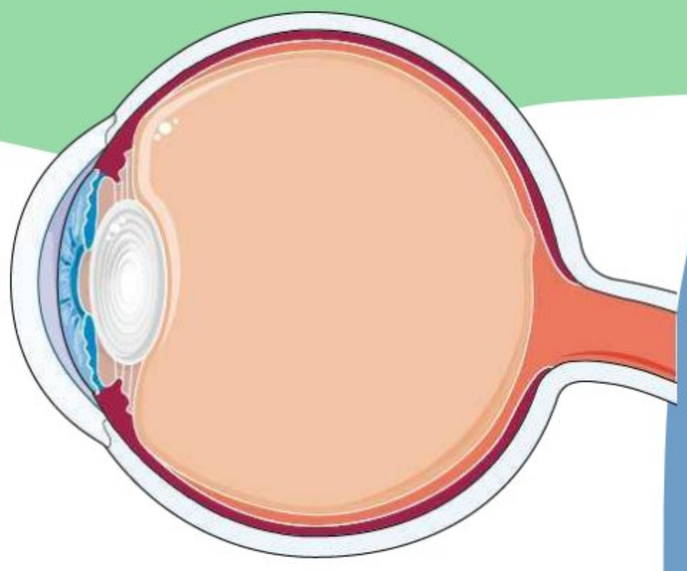
HOW WILL THEY ASK THIS?

ASTIGMATISM

Causes: hereditary but can be caused by injury
irregularly shapes lens or cornea
Treatment: corrective lenses

CATARACTS

Cause: old age where proteins in the eye clump together
results in clouding of the lens where less light enters the eye
Treatment: surgery to remove hardened cloudy layer above lens



SHORT QUESTIONS

1.**Identify part (X).**
- simply provide the name of the structure.
- you may also need to follow up with the correct function.

2. Name the visual defect observable in the diagram.
- you need to look for the **POINT** of **FOCUS** in the diagram this is the clue to identify the correct visual defect. (see above diagrams)

3. Where is light stimulus converted to an impulse?
- here you will need to know the functions of the various structures in the eye.
- the retina is the site of conversion.

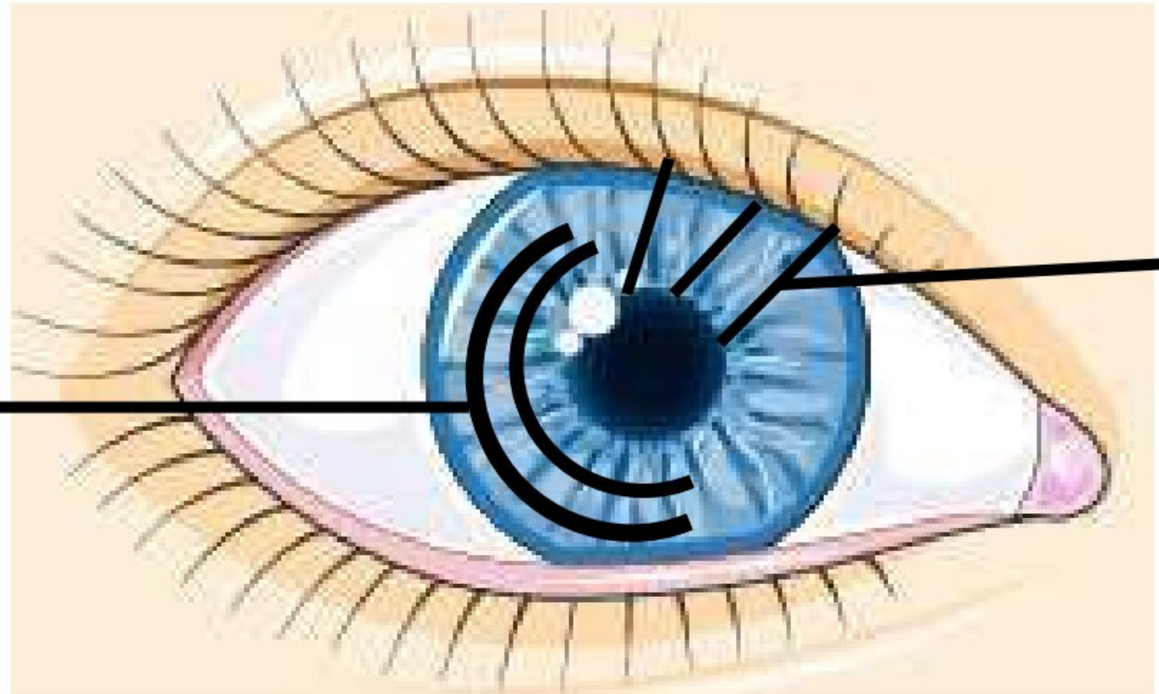
LONG QUESTIONS

1.**Describe the consequences of the visual defect observed in the diagram.**
- here again you **MUST** know what various defects look like in cross sections.
- **DESCRIBE** questions require you to provide many details like:
  - what effect this defect has on their vision
  - how one aspect of the defect influences the next **EG**. - how myopia does not allow you to see far away images therefore the the image is blurred.

2**. Explain the consequences if light rays landed on the blind spot.**
- **REMEMBER** this is a statement and then a reason (sometimes more than one).
- there are **NO RECEPTORS** in the blind spot
- **THEREFORE** there will be no **IMPULSE** and no **IMAGE** formed.

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PUPILLARY MECHANISM



DIM LIGHT

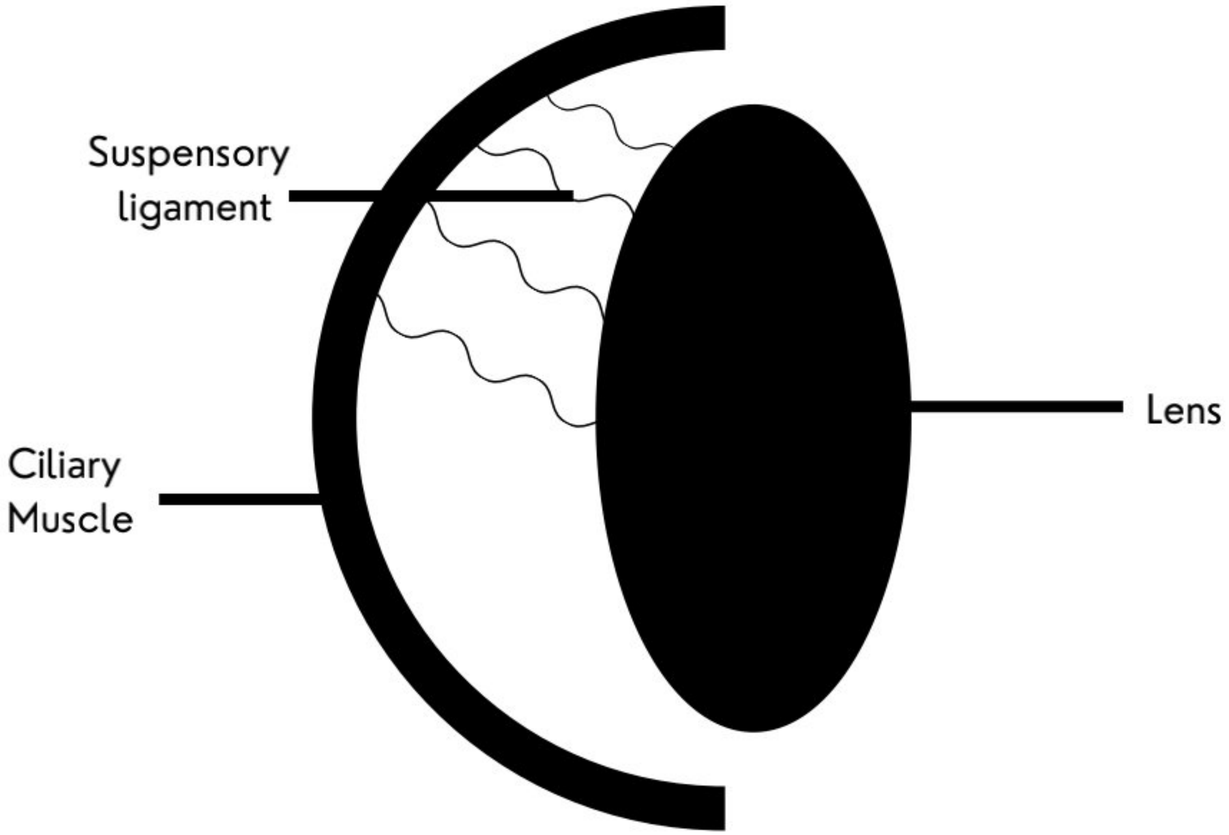
- Radial muscles contract
- Circular muscles relax
- Pupils dilate
- More light let into the eye

BRIGHT LIGHT

- Radial muscles relax
- Circular muscles contract
- Pupils reduces
- Less light let into the eye

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ACCOMMODATION OF THE EYE



Cross section of eye
(able to see the muscles and ligaments that control the lens shape)

Near vision <6m

- ciliary muscle contracts
- suspensory ligaments slacken
- lens becomes more convex (bulges)
- refraction increases
- clear image formed on retina

Distance vision >+6m

- ciliary muscle relaxes
- suspensory ligaments pull taught
- lens becomes flatter
- refraction decreases
- clear image formed on retina

PRO-TIPS

- **LEARN** just the one form of accommodation and the other is the opposite.
- **ALWAYS** finish your eye process explanations with the fact that the image is formed on the retina.
- **ALWAYS** mention the **SHAPE** of the lens changing when speaking about accommodation.

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62

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

1.**Describe the pathway taken by light when forming an image on the retina.**
- **REMEMBER** this answer requires detail so you will need to mention:
How- speak about light moving through all the structures the light passes through.
When- view an object in light.
Where- image forms on the retina and an electrical impulse is created and sent via the optic nerve to the occipital lobe in the cerebrum.

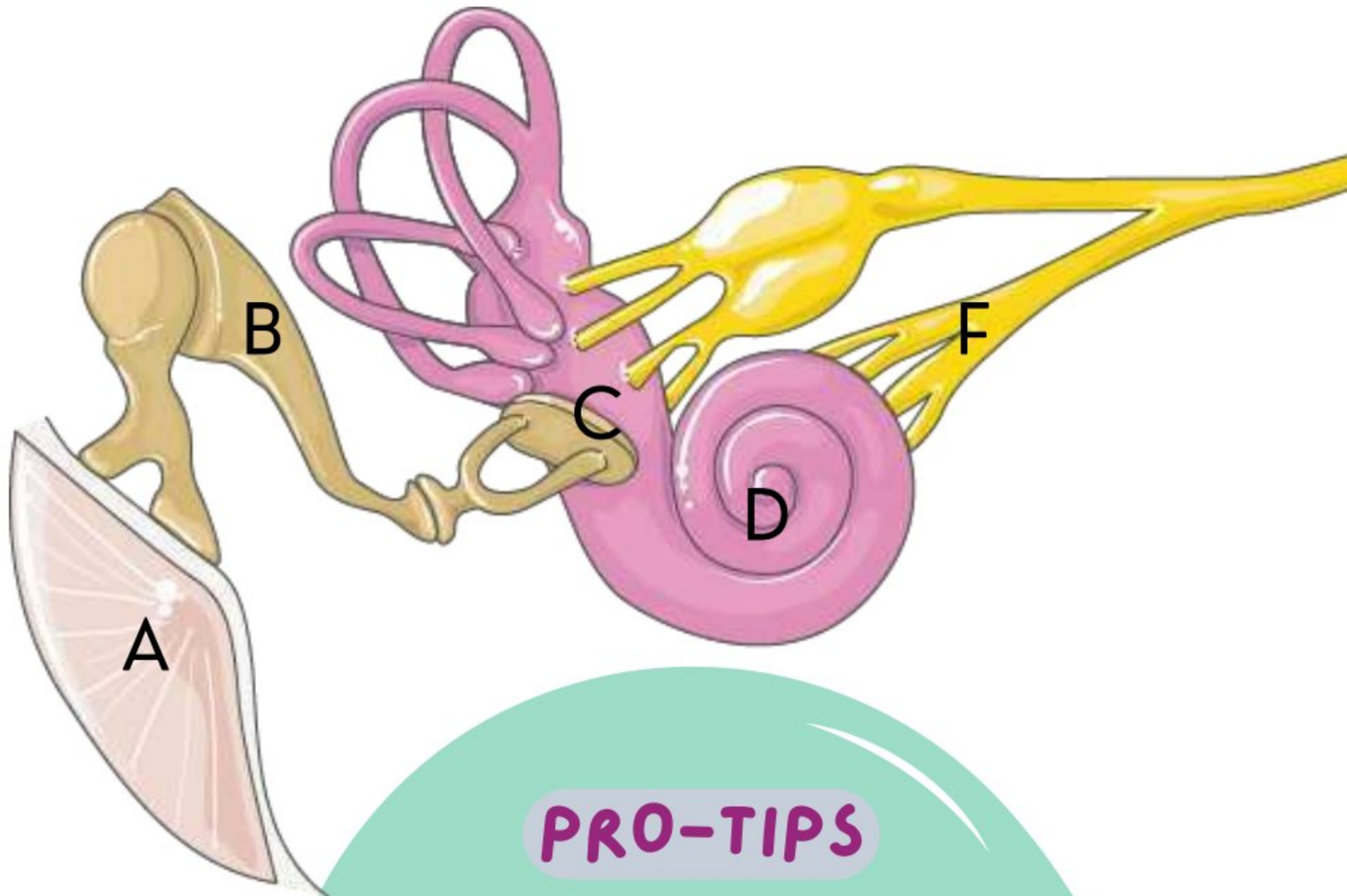
2. **Explain/describe the response undertaken by the eye when a bright object is thrown at your face.**
- **NOTE:** this is referencing the pupillary mechanism so you will need your eye content for this answer, **HOWEVER** they can also include the reflex from the eye from blinking when something is suddenly thrown at you.
- here you will need to explain the normal reflex pathway as you will be contracting the muscles of the body to pull away from the dangerous stimulus.

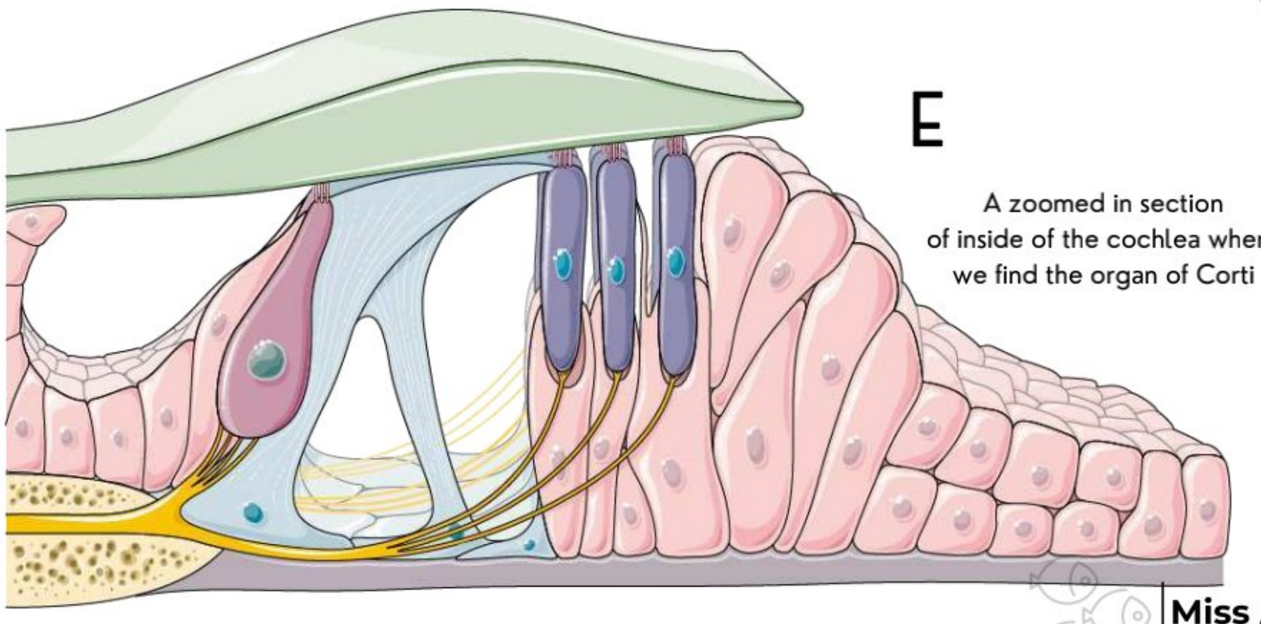
3. **Describe the changes that occur in the eye when looking at the board in class and then looking back down at your school book.**
- here you will need to describe accommodation of the eye looking close-up or less than 6m away.
- mention ALL the points above regarding changes to the structures and the final product.

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HOW TO EXPLAIN HEARING

- pinna traps sound waves
- into the ear canal
- this causes the tympanic membrane (A) to vibrate
- the vibration is transmitted to the ossicles (B)
- the ossicles amplify the vibration
- and transmit it to the oval window (C)
- the oval window vibrates, creating waves
- in the endolymph/fluid of the cochlea (D)
- which stimulates the organ of Corti (E)
- to convert the wave into an impulse
- the impulse travels along the auditory nerve (F)
- to the cerebrum, where it is interpreted as sound





E

A zoomed in section of inside of the cochlea where we find the organ of Corti

PRO-TIPS

- **ALWAYS** mention the receptors' name (Organ of Corti).
- You **DO NOT** need to know any detail about the organ of Corti or its surrounding membranes.
- **ALWAYS** end your hearing answer with **where** in the brain you hear.

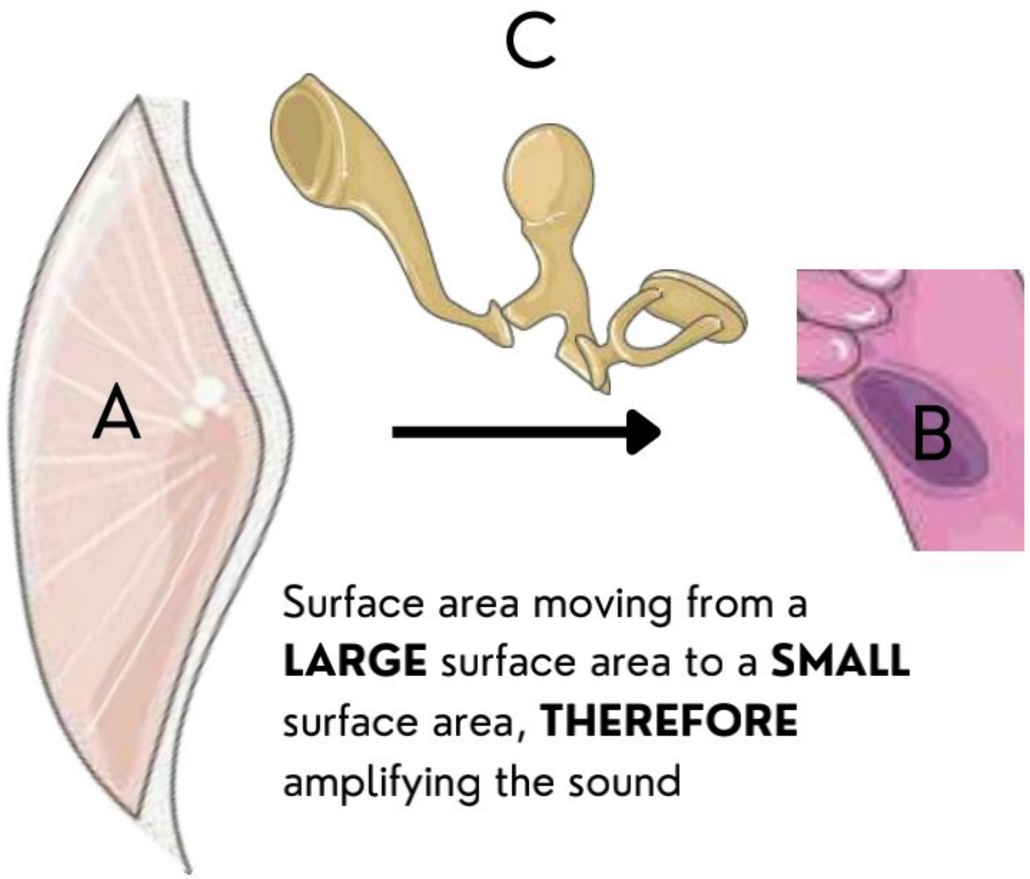
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64

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HOW TO EXPLAIN AMPLIFICATION

- the sound vibrations are transmitted from the large tympanic membrane (A)
- to the smaller oval window (B)
- through the ossicles (C)
- which are arranged from largest to smallest
- this concentrates the vibrations, amplifying them



Surface area moving from a **LARGE** surface area to a **SMALL** surface area, **THEREFORE** amplifying the sound

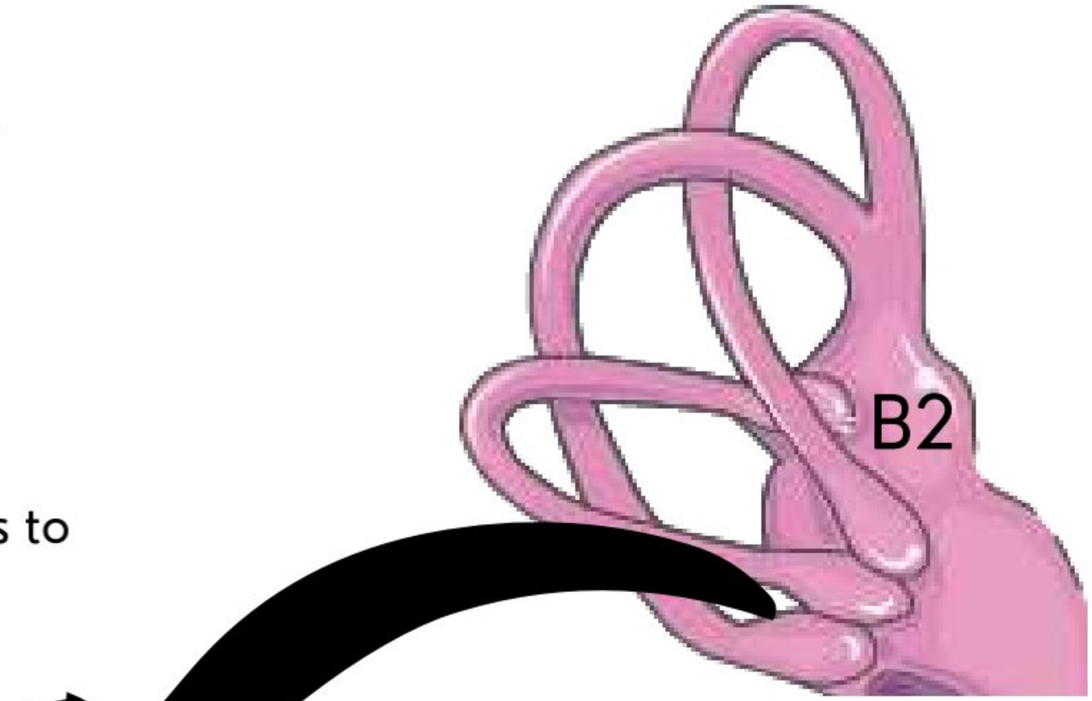
PRO-TIPS

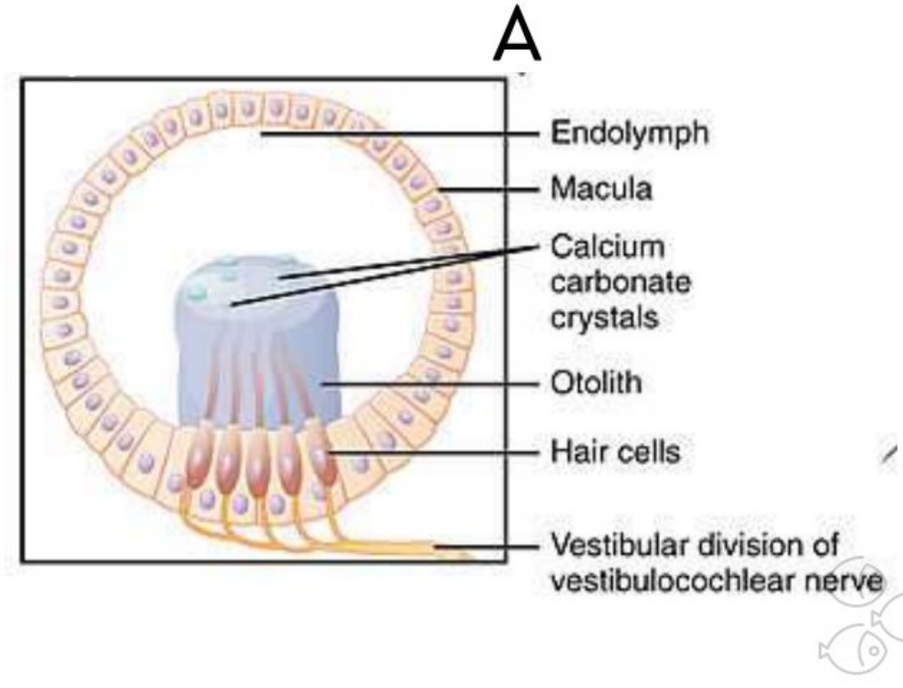
- **KNOW** the function of the ossicles (amplification).
- **KNOW** that moving from a large to a small surface area **CONCENTRATES** the sound.

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HOW TO EXPLAIN POSTURE

- a change in the position of the head in space
- stimulates the maculae (A)
- in the utriculus (B1) and sacculus (B2)
- the stimulus is converted into an impulse
- the impulse is transmitted to the cerebellum
- via the auditory nerve
- the cerebellum sends impulse to the muscles to restore posture





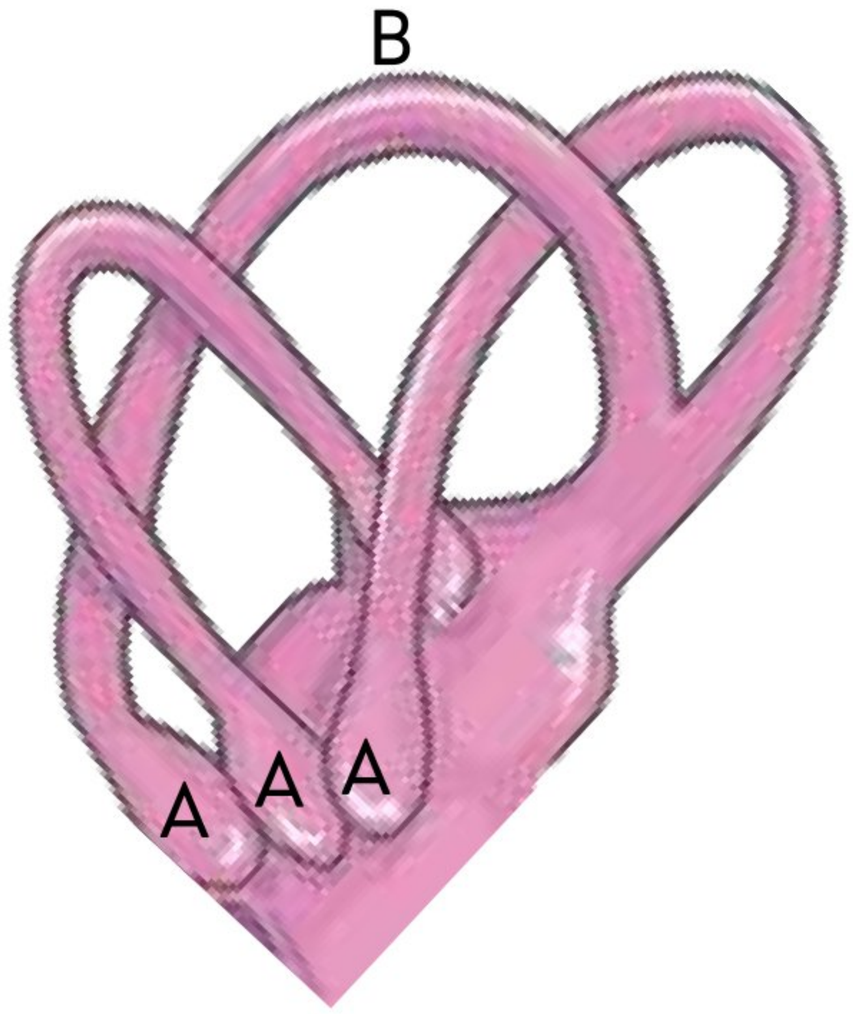
PRO-TIPS

- you **DO NOT** need to know the details about the **STRUCTURE** of the maculae.
- **KNOW** the structures and receptor names.
- **ALWAYS** end your answer with how the muscles restored posture.
- **REMEMBER** posture and balance are **NOT** the same thing.

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HOW TO EXPLAIN BALANCE

- a change in speed/direction of movement
- stimulates the cristae (A)
- in the semi-circular canals (B)
- the stimulus is converted to an impulse
- the impulse is transmitted to the cerebellum
- via the auditory nerve
- the cerebellum sends an impulse to the muscles to restore balance



PRO-TIPS

- you **DO NOT** need to know the details about the **STRUCTURE** of the cristae.
- **KNOW** the structures and receptor names.
- **ALWAYS** end your answer with how the muscles restored balance.
- **REMEMBER** posture and balance are **NOT** the same thing.

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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

1. **Label parts of the ear.**
- simply be able to identify from a diagram.

2. **Give functions of ear structures.**
- these are short answers that are all recall.

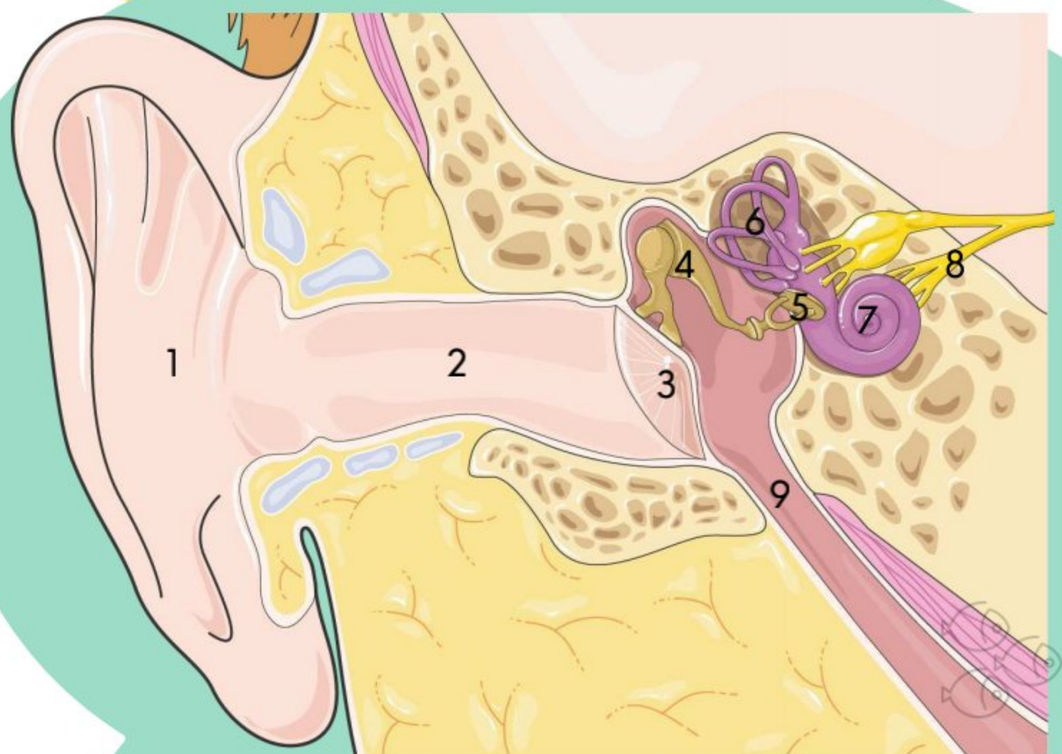
3. **Name the sources/types of hearing issues and how to fix them.**
- here you will need to mention things like hearing aids or grommets, depending on what the issue is.

LONG QUESTIONS

1. **Explain/describe how the ear maintains balance.**
- often these questions require application as they build a **story** around it - for example, if you are playing a game of soccer, describe how the ear maintains your balance.

2. **Describe what happens when certain parts of the ear are damaged.**
- here you will need to first know what that part of the ear does **BEFORE** you can say what would happen if it doesn't work.

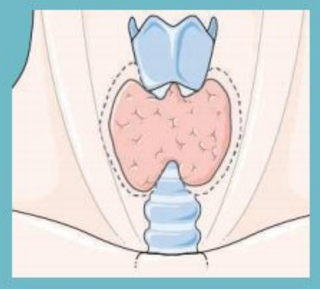
3. **Explain how the ear equalises pressure.**
- this is a common question they like to ask, where you need to have knowledge about the Eustachian tube and how it **maintains** pressure by **equalising** it on the middle ear to that of the external environments.



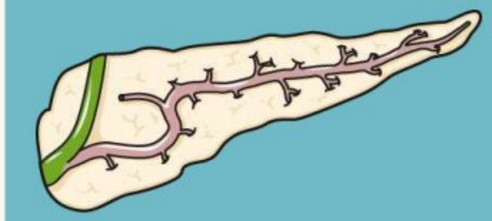
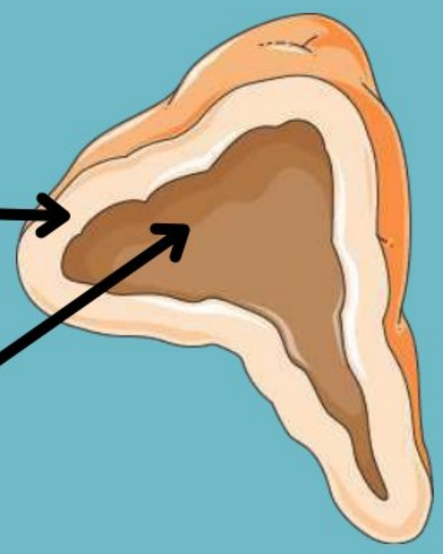
1. pinna
2. ear canal
3. tympanic membrane (ear drum)
4. ossicles
5. oval window
6. semi-circular canal
7. cochlea
8. auditory nerve
9. Eustachian tube

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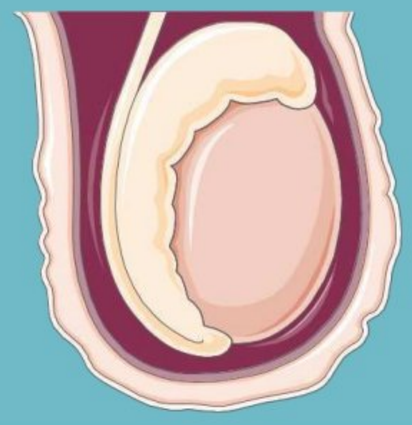
ENDOCRINE SYSTEM STRUCTURES

GLAND	LOCATION	FUNCTION	DISORDER
HYPOTHALAMUS	• Part of brain • Located above pituitary	• Secretes **ADH** • Osmoreceptors detect low water levels • Responds and releases ADH	NA
PITUITARY GLAND (HYPOPHYSIS)	• Attached to hypothalamus 	**Chemical coordinator** • **TSH**—> thyroid gland —> thyroxin • **FSH** —> ovary —> ovum • Testes—> sperm • **LH** —> ovary —> ovulation • Prolactin —> mammary gland—> breast milk • **ACTH** —> adrenal gland —> cortisone & aldosterone • **ICSH**—> testes —> testosterone • **GH** —> skeleton & muscles —> growth	**Hyper secretions** • In children = over development of skeleton (**giantism**) • In adults = **acromegaly** • **Hypo-secretion** • underdevelopment of skeleton • **pituitary dwarfism**
THYROID	• Butterfly-shaped gland on trachea, below larynx 	• Secretes **thyroxin** • Increases basal metabolic rate • Normal functioning of heart • Normal functioning of neutrons, increases awareness	• **Hypothyroidism** • Adults = myxedema • Children = cretinism • **Hyperthyroidism** • High metabolic rate

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REGION	STRUCTURE	FUNCTION	
PANCREAS	• Attached to small intestine 	• Both endocrine and exocrine gland • **endocrine** = islets if Langerhans • **exocrine** = pancreatic duct Islets of Langerhans • **alpha cell** = glucagon (glucose increase) • **beta cell** = insulin (glucose decrease) • negative feedback affect on each other	**Diabetes 1** • starts in childhood • insulin dependent • autoimmune disease • doesn't make enough insulin **Diabetes 2** • starts in • non-insulin dependent • produces less/not able to use insulin (no response to hormone)
ADRENAL: CORTEX MEDULLA	• Pyramid-shaped gland 	**Aldosterone** • Causes reabsorption of sodium ions • Vital for osmoregulation • Cortisol increases boys' resistance to stress, also anti-inflammatory **Adrenaline** • Fight or flight • Prepares body to deal with emergency	NA

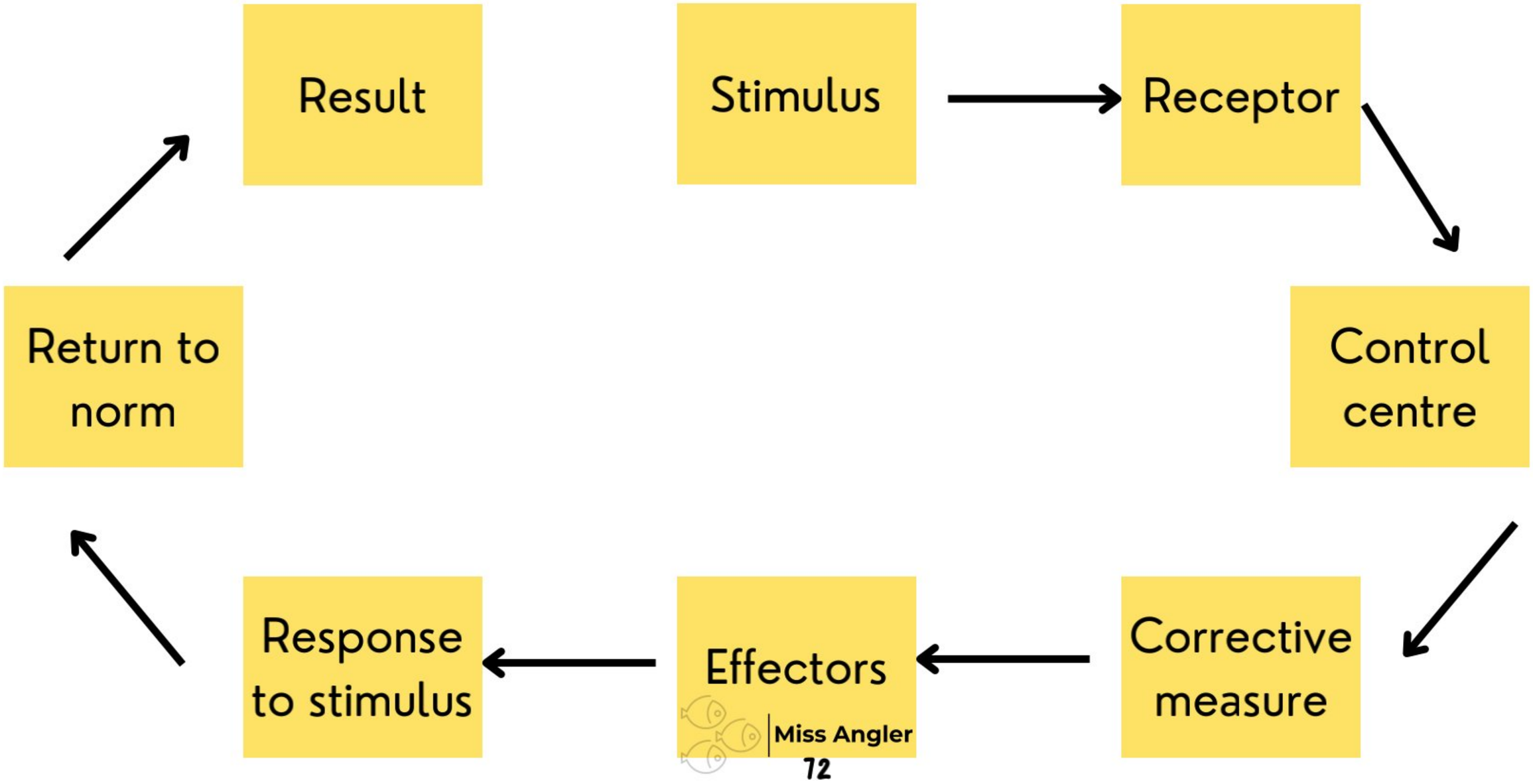
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REGION	STRUCTURE	FUNCTION	
OVARIES	• Lower abdomen • Attached to uterus 	**Oestrogen** • Rapid physical growth • Secondary sex characteristics • Maturation of sex organs **Progesterone** • Promotes cyclic changes in endometrium • During pregnancy maintains endometrium • Kekeps smooth muscle of uterus relaxed during pregnancy	NA
TESTES	• Lower abdomen • Inside scrotum 	**Testosterone** • Rapid physical growth • Secondary sex characteristics • Maturation of reproductive organs • Sex drive	NA

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11

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TEMPLATE ANSWER FOR ALL ENDOCRINE/HOMEOSTASIS PROCESSES



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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

1. **Provide labels for structures/glands.**
- identify the glands from their location.

2. **State the function of the hormones.**
- this is a common question where they want to know the effect each hormone has on the body.

3. **Identifying hormones effect from a graph.**
- you will need to decide/ briefly explain the relationship between hormones and their effect on substances or structures.

4. **State the difference between an exocrine and endocrine gland.**
- here you will need to know that glands either use ducts or are ductless and secrete hormones straight into the blood stream.

LONG QUESTIONS

1. **Describe the negative feedback mechanism associated with glucose after eating a meal (this question could also be about other negative feedback loops like FSH and oestrogen, ADH, aldosterone and thyroxin).**
- **REMEMBER** this answer requires detail so you will need to mention:
How- use the **template** answer provided below and substitute in the relevant hormones, structures and effectors.

2. **Explain how the hormone "X" affects the "Y" system/substance etc.**
- here you will need knowledge of the effects hormones have on various body systems.
IMPORTANT: This question often overlaps with the nervous system! You need to show how the two systems work together.

Eg: Explain how the brain coordinates movement while the pancreas regulates sugar during exercise.

INVESTIGATION QUESTIONS

1. **Identify the independent and dependent variable.**
- take this from the aim of the experiment which is present in the introduction paragraph they give you.
- normally it starts with "to determine" or "to investigate".

2. **Explain why you used so many participants.**
- increase reliability
(other ways to increase reliability are: repeat, calculate an average and randomise sample).

3. **Describe the effect of the hormone.**
Again you will provide:
WHERE the hormone is made.
WHAT the effect of that gland/muscle/organ on the body is.
WHEN this hormone is used.
WHY we need this hormone.

TRICKY QUESTION!!
Often they will ask **WHAT** would happen if you increased or decreased the hormone. You need to know its functions, but also the diesels associated with it - if you have too little or too much.

They can also ask **WHY** you did something during the experiment. This is a hard one to answer because you will need to know enough about the gland and its function to know, for **EXAMPLE,** what affect the thyroid gland would have on the body if it were removed.

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HOMEOSTASIS: THERMOREGULATION

PRO-TIPS

- **ALWAYS** mention the receptor, stimulus and result in your answer.
- You must **SHOW** the connection to less sweating.

RESULT

LESS HEAT is lost in:

1. radiation
2. convection
3. conduction

Therefore there is **LESS SWEAT.**

VASOCONSTRICTION (COLD DAY)

Receptors in the skin

Stimulus sent to **hypothalamus**

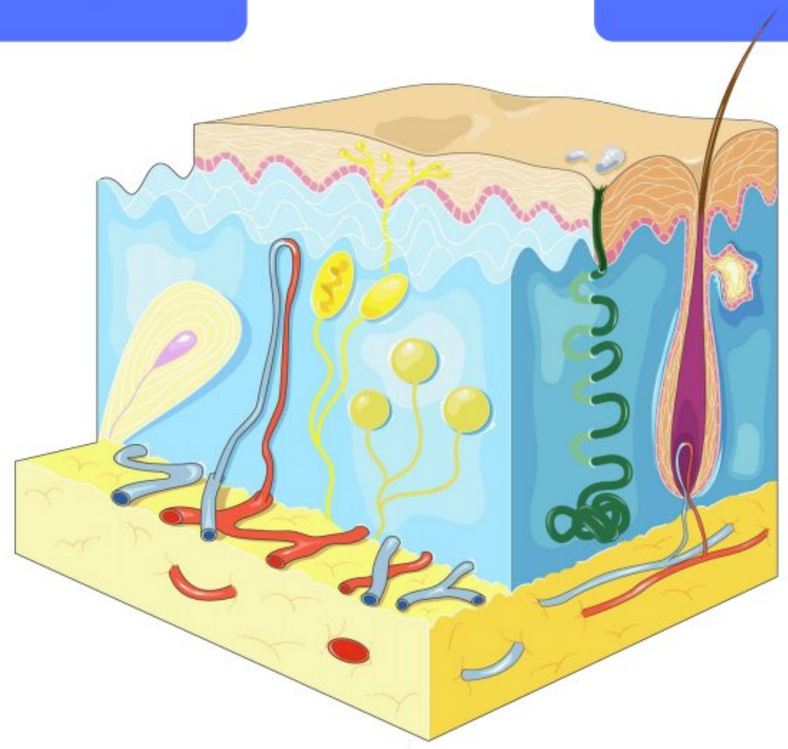
Dermal arterioles

Circular muscles contract

Limits blood flow to surface

Shunt vessels **relax**

More blood is diverted to subcutaneous layer



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HOMEOSTASIS: THERMOREGULATION

PRO-TIPS

- **ALWAYS** mention the receptor, stimulus and result in your answer.
- You must **SHOW** the connection to more sweating.

RESULT

MORE HEAT is lost in:

1. radiation
2. convection
3. conduction

Therefore there is **MORE SWEAT.**

VASODILATION (HOT DAY)

Less blood is diverted to subcutaneous layer

Receptors in the skin



Shunt vessels **contract**

Stimulus sent to **hypothalamus**

More blood flow to surface

Circular muscles **relax**

Dermal arterioles

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75

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HOMEOSTASIS: OSMOREGULATION (ADH)

LOW WATER IN BLOOD (HOT DAY OR SWEATING)

PRO-TIPS

- **ALWAYS** mention the change in osmolarity because salt controls water regulation.
- Ensure to **END** your answers with the amount of urine produced and why.

RESULT

LESS URINE is produced

1. increased sweating
2. More salt is lost via sweat

Hypothalamus

Detects change in **osmolarity, low water in blood** (water & salt ratio)

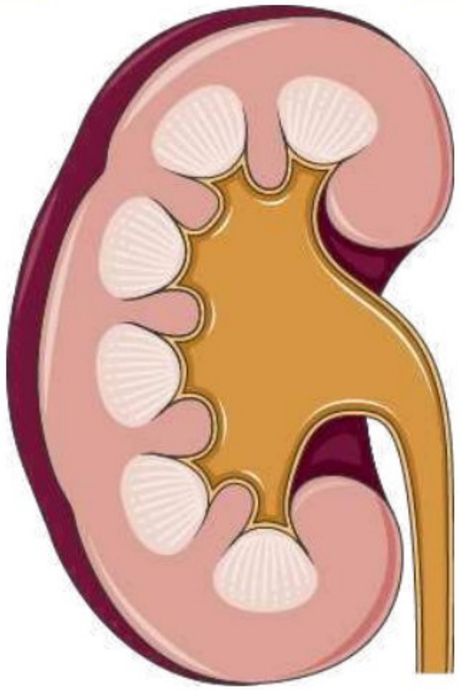
Pituitary gland

Secretes **more ADH**

Sent to distal and collecting duct

Makes tubules **more permeable**

More water reabsorbed returns to the norm and a **small amount of urine** is produced



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HOMEOSTASIS: OSMOREGULATION (ADH)

HIGH WATER IN BLOOD (COLD DAY OR LESS SWEATING)

PRO-TIPS

- **ALWAYS** mention the change in osmolarity because salt controls water regulation.
- Ensure to **END** your answers with the amount of urine produced and why.

RESULT

MORE URINE is produced

1. Decreased sweating
2. More salt is lost in urine

Hypothalamus

Detects change in **osmolarity, high water in blood** (water & salt ratio)

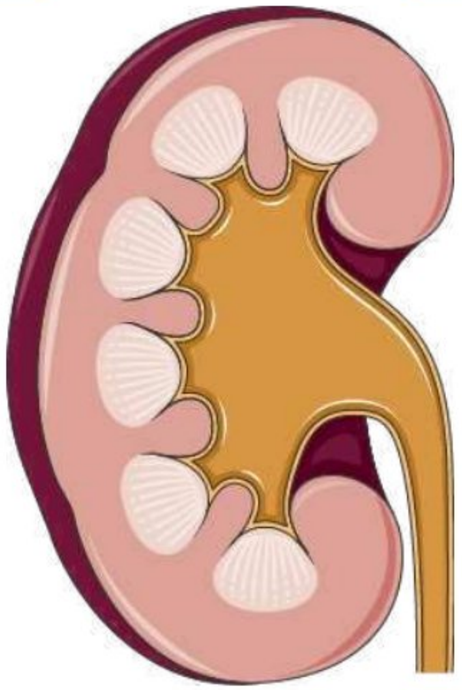
Pituitary gland

Secretes **less ADH**

Sent to distal and collecting duct

Makes tubules **less permeable**

Less water reabsorbed returns to the norm and a **large amount of urine** is produced



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HOMEOSTASIS: SALT (ALDOSTERONE)

PRO-TIPS

- Depending on the question you **MUST** mention how salt regulates water in the blood.
- Sweating is linked to this topic so **SHOW** the link between the two homeostasis process if necessary.

RESULT

More Sodium is reabsorbed = more water will be reabsorbed into blood.

EXCESS potassium will be excreted.

SALT REGULATION (LOW SALT)

Decrease in osmolarity (low salt)

Afferent arterioles (artery entering renal capsule in kidney)

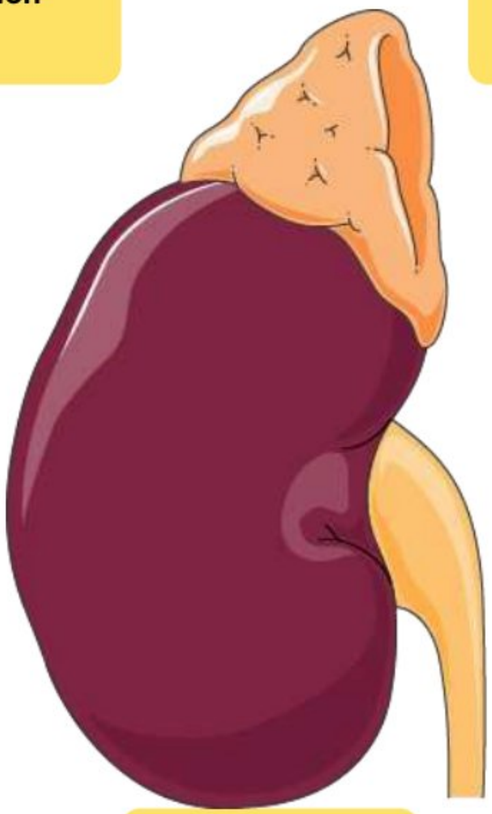
Arterioles secrete **Renin**

Stimulates secretion of **Angiotensin**

Sent to control centre: **adrenal cortex**

Cortex secretes **more Aldosterone**

Sent to distal convoluted tubule to **increase Sodium absorption**



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HOMEOSTASIS: CARBON DIOXIDE (PH)

PRO-TIPS

- The body **ONLY** regulates **CO2.** It **CANNOT** regulate O2.
- The CO2 combines with water to form carbonic acid, therefore the actual stimulus is **PH** of the blood.
- The more acidic the blood, the **faster** and **harder** you breath and your heart beats.

RESULT

- **Heart** beats faster.
- **Breathing** rate increases.

CARBON DIOXIDE (PH DECREASES)

CO2 levels **increase**

Chemoreceptors in wall of aorta & carotid are stimulated by **LOW pH** of blood

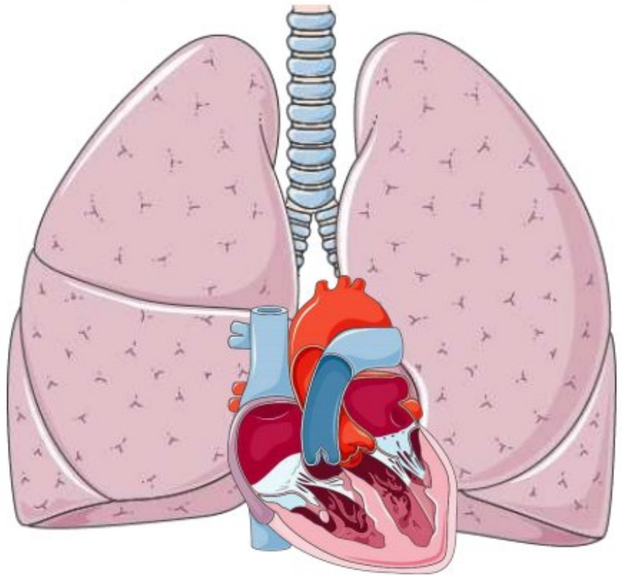
Impulse sent to **medulla oblongata**

Stimulates heart & breathing muscles

Heart beats **faster** & breathing muscles contract more

More CO2 is exhaled

pH of blood **increases** and returns to the norm



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HOMEOSTASIS: GLUCOSE (INSULIN)

PRO-TIPS

- **ALWAYS** mention the affect insulin has on the level of glucose in the blood stream.
- Be **SPECIFIC** when stating where glucose is stored.
- **UNDERSTAND** negative feedback well for this topic .

RESULT

- Glucose levels **decrease.**
- Cellular respiration **increases.**

HIGH GLUCOSE (EATING)

Increased blood **glucose** levels

Blood passes through **pancreas**

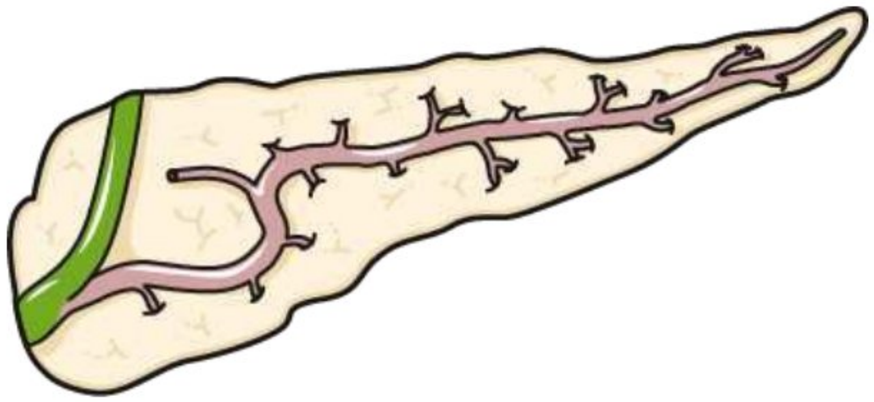
Beta cells detect glucose increase

Secretes **insulin**

Liver and **muscles absorb** more glucose. Liver converts **glucose to glycogen**

blood glucose levels **drop**

Negative feedback causes **insulin** levels to **drop**



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80

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HOMEOSTASIS: GLUCOSE (GLUCAGON)

PRO-TIPS

- **NOTE** when increasing glucose. **ONLY** the liver releases sugar not the muscles.
- these two hormones have **ANTAGONISTIC** (opposite) effects on each other .

RESULT

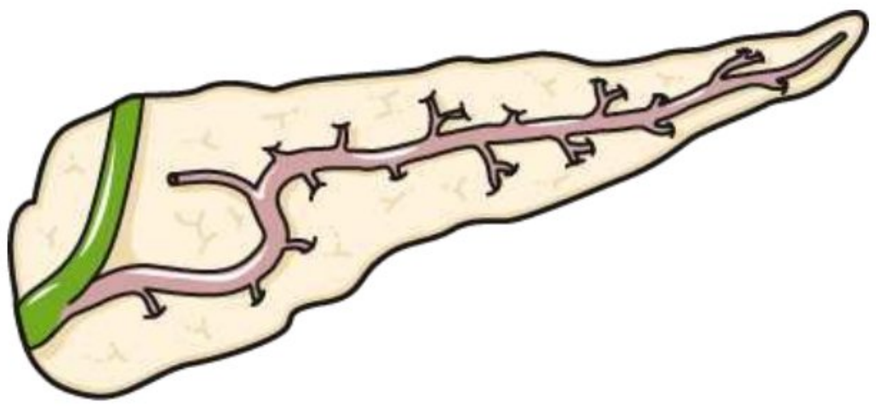
- Glucose levels **increase.**

LOW GLUCOSE (STARVING)

Negative feedback causes **glucagon** levels to **drop**

Decrease blood **glucose** levels

Blood passes through **pancreas**



Alpha cells detect glucose decrease

Secretes **glucagon**

Liver converts **glycogen to glucose**

Blood glucose levels **increase**

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81

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HOMEOSTASIS: THYROID (THYROXIN)

PRO-TIPS

- **NOTE** when Thyroxin levels are high, TSH levels reduce. Therefore they are always **ANTAGONISTIC** hormones.
- **REMEMBER** the pituitary is the receptor and secretes TSH to the effector called the Thyroid.

RESULT

- Tyroxin increases.
- **Metabolism increase** via increased cellular respiration.

LOW THYROXIN (METABOLISM SLOWING)

Thyroxin levels **drop**

Pituitary gland registers drop

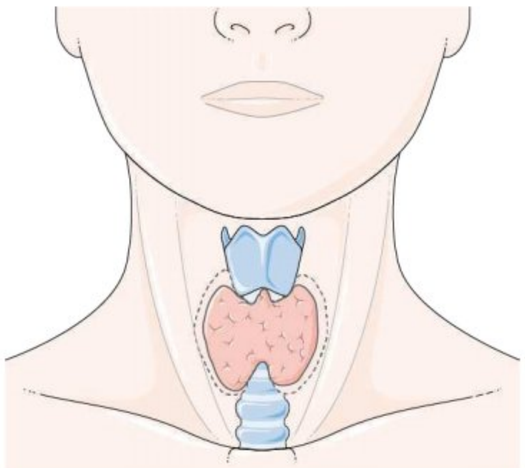
Secretes **TSH**

Sent to the **Thyroid** gland

Thyroid now secretes **thyroxin**

TSH then **reduces**

Cellular respiration increases



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HOW WILL THEY ASK THIS?

LONG/ INVESTIGATION QUESTIONS

1. **Describe the relationship between the stimulus and the effector.**

- here you will need to know your homeostatic cycles as seen in the pages before.
- **HOWEVER** you may only need to mention the stimulus and its effect on the hormone level.
- use the mark allocation to guide you as to how much detail to include.

2. **Describe the negative feedback seen between the hormone and the stimulus.**

- again this one is very similar to the question above however you will need to write the **WHOLE** cycle as seen in the previous pages.

- Explain the medical condition if the hormone is not produced.

- here you will need to mention the hormones **FUNCTION** and then what **DISORDER** is caused without enough hormone.
- you may also be asked to name some symptoms of these diseases.

3. **State the control for this investigation.**

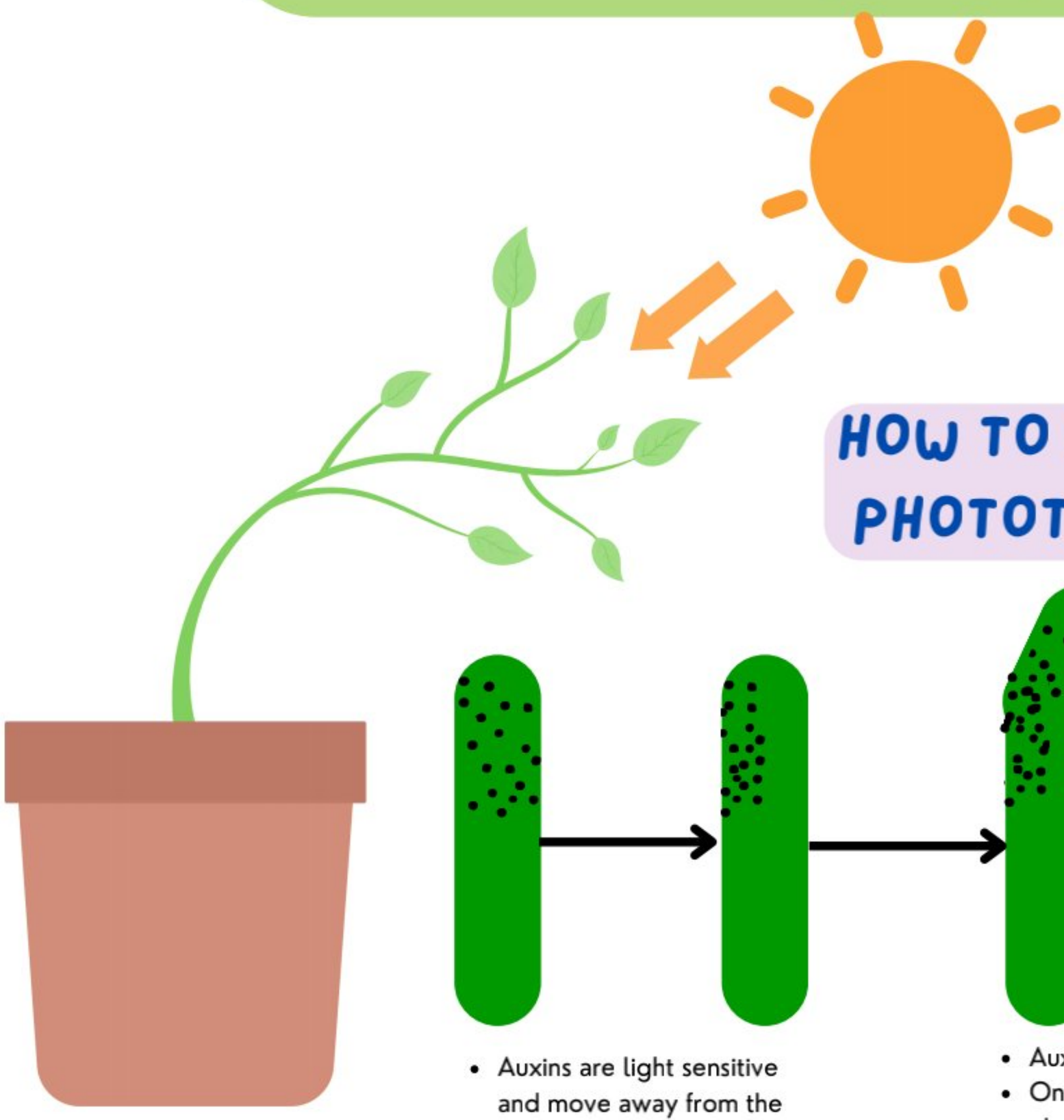
- again you will need to know what the **HORMONE** does in order to know what to remove and what would be the outcome if it **WASN'T** there.

SHORT QUESTIONS

- **For EACH** hormone know:
  1. secreting gland/organ/cell
  2. hormone name
  3. effect on system
  4. product/result of its effect
- **MANY** questions will be asked in the MCQ, focused on the effect the **hormone** has on its **effector.**
- **be ABLE** to identify the hormone from a graph in relation to the substance it controls.
- **VERY OFTEN** hormone functions or names are confused in the A/B, both or none question (glucagon and glycogen)
- often the question will have a **GRAPH** in it that you take answers from it or you may have to **DRAW** a graph from the table provided.
- **CALCULATIONS** are also very common like calculating percentage increase/decrease.

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PHOTOTROPISM



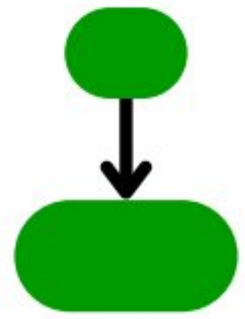
HOW TO EXPLAIN PHOTOTROPISM

- Auxins are light sensitive and move away from the light
- They collect on the dark side of the stem

- Auxins cause cell elongation
- On the dark side cells elongate
- On the light side cells remain small (short)
- Causes the stem to bend towards the light

CELL ELONGATION

lengthening of cell



ROLES of auxins

1. **Promotes growth**
   - stimulates both mitosis and cell elongation.
   - if concentration is too high then cell elongation will be stopped.
2. **Causes apical dominance**
   - high concentration at the top of the plant inhibiting lateral branches from growing.
   - as concentration reduces further down it allows for lateral branches to grow.
3. **Play a part in tropic movements (photo and geo)**
   - external stimuli bring about tropic movements
   - response is so that plant can receive the most sunlight or anchor their roots

PRO-TIPS

- **ALWAYS** describe what the auxins are doing on both sides of stem.
- **REMEMBER** that auxins are made in the tips of stems and roots.
- This bending of the stem **ONLY** happens when the light is **UNILATERAL,** meaning coming from one direction.

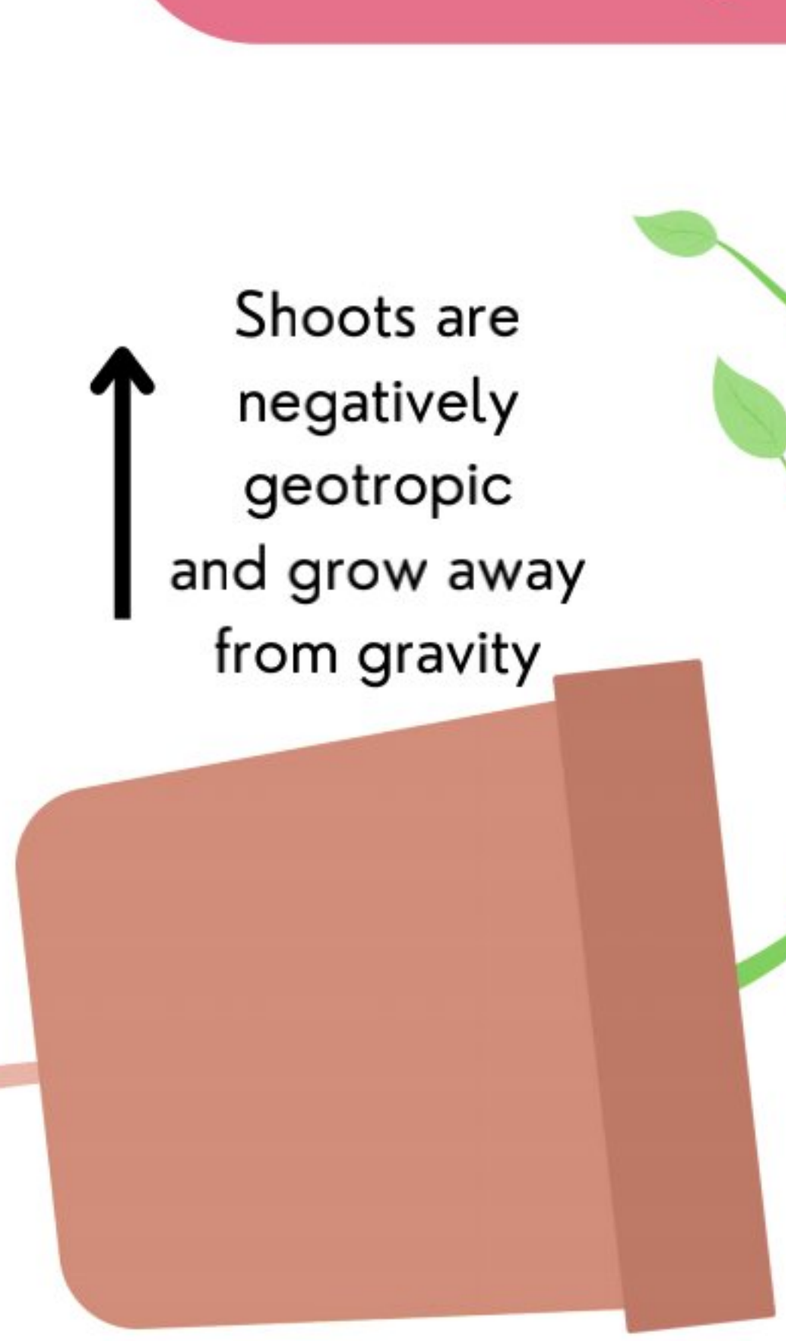


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84

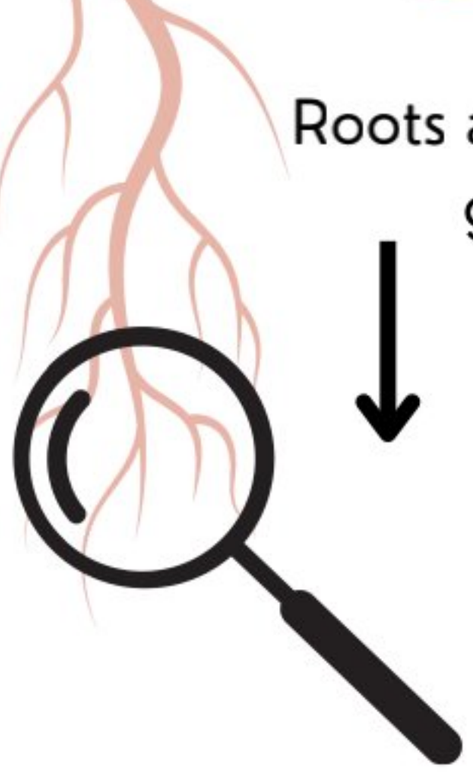
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GEOTROPISM

Shoots are negatively geotropic and grow away from gravity



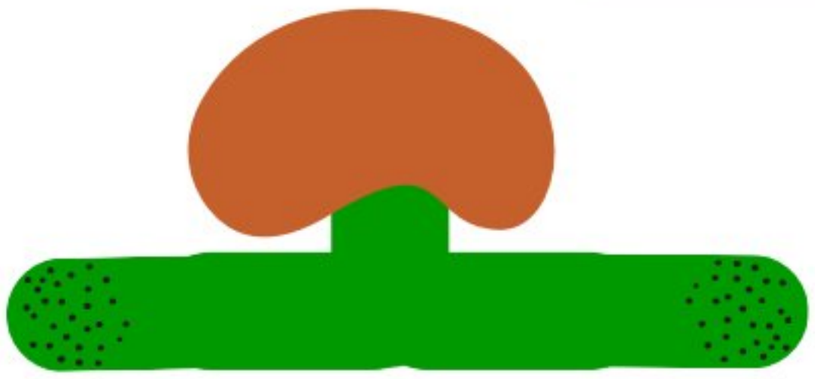
Roots are positively geotropic and grow towards gravity.



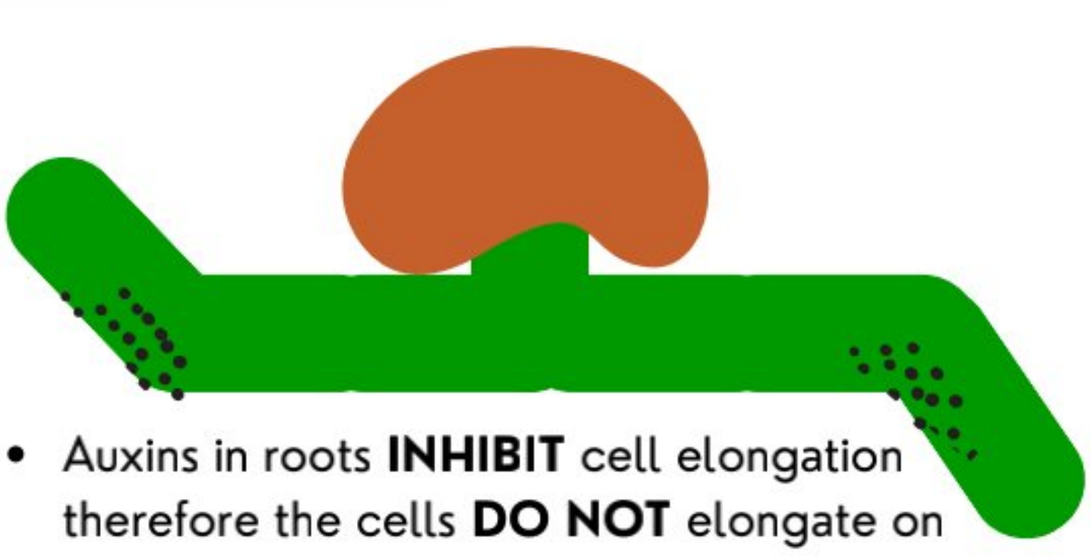
PRO-TIPS

- When describing geotropism, **ALWAYS** speak about what's happening to the cells with auxin and without.
- **REMEMBER** auxins have different effects in shoots and roots.
- If you cut the tip off of a root or shoot, it will **REMOVE** the auxins and no more bending towards the light or gravity will occur.

HOW TO EXPLAIN GEOTROPISM



- Auxins are produced in the tip of the stems and roots.
- In roots and stems auxins are attracted to gravity and sink to the lower region.



- Auxins in roots **INHIBIT** cell elongation therefore the cells **DO NOT** elongate on the underside of the root.
- In the stem the auxins **STIMULATE** cell elongation causing the stem to bend upwards.

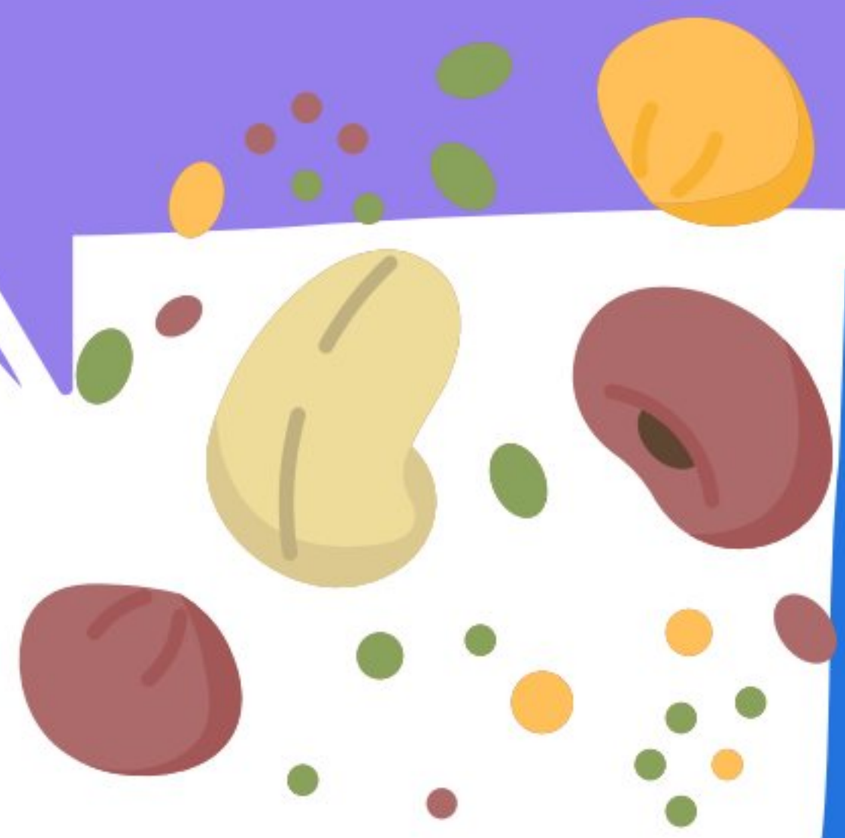
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OTHER PLANT HORMONES

GIBBERELLINS

- cause elongation in the main stem
- causes the the space between the internodes to lengthen
- stimulates seed germination
- encourages seeds to break out of their dormancy

NOTE: they **DO NOT** affect apical dominance.



ABSCISIC ACID

- growth inhibitor
- helps plants to survive adverse conditions
- causes stomata to close
- promotes dormancy in both seeds and buds
- promotes abscission in leaves and fruits when they are ready to fall

NOTE: Gibberellins and abscisic acid work in the **OPPOSITE**. As the levels of abscisic acid decrease the levels of gibberellins increase.

PHYSICAL AND CHEMICAL PROTECTION

CHEMICAL

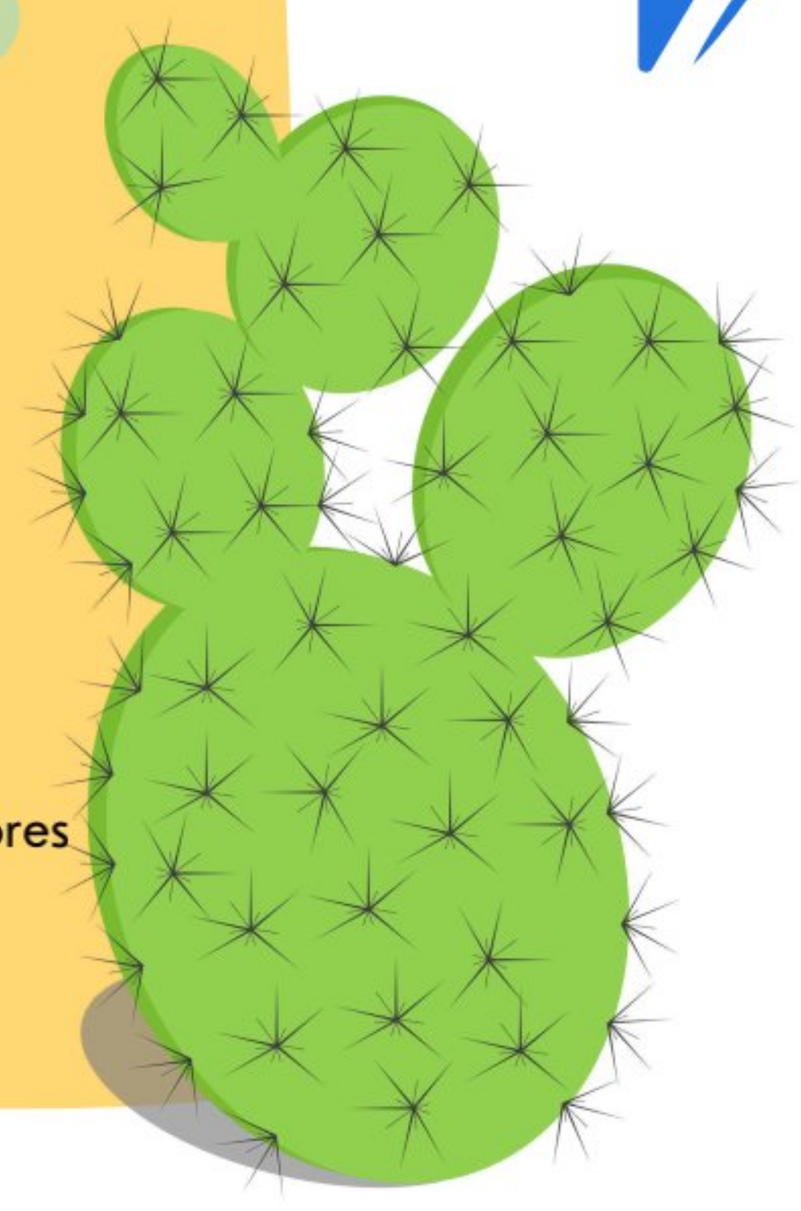
These substances are made in the leaves, stems and roots and make eating them difficult.

1. digestive enzyme inhibitors
2. bitter tasting chemicals
3. toxins
4. stinging hairs
5. essential oils

PHYSICAL

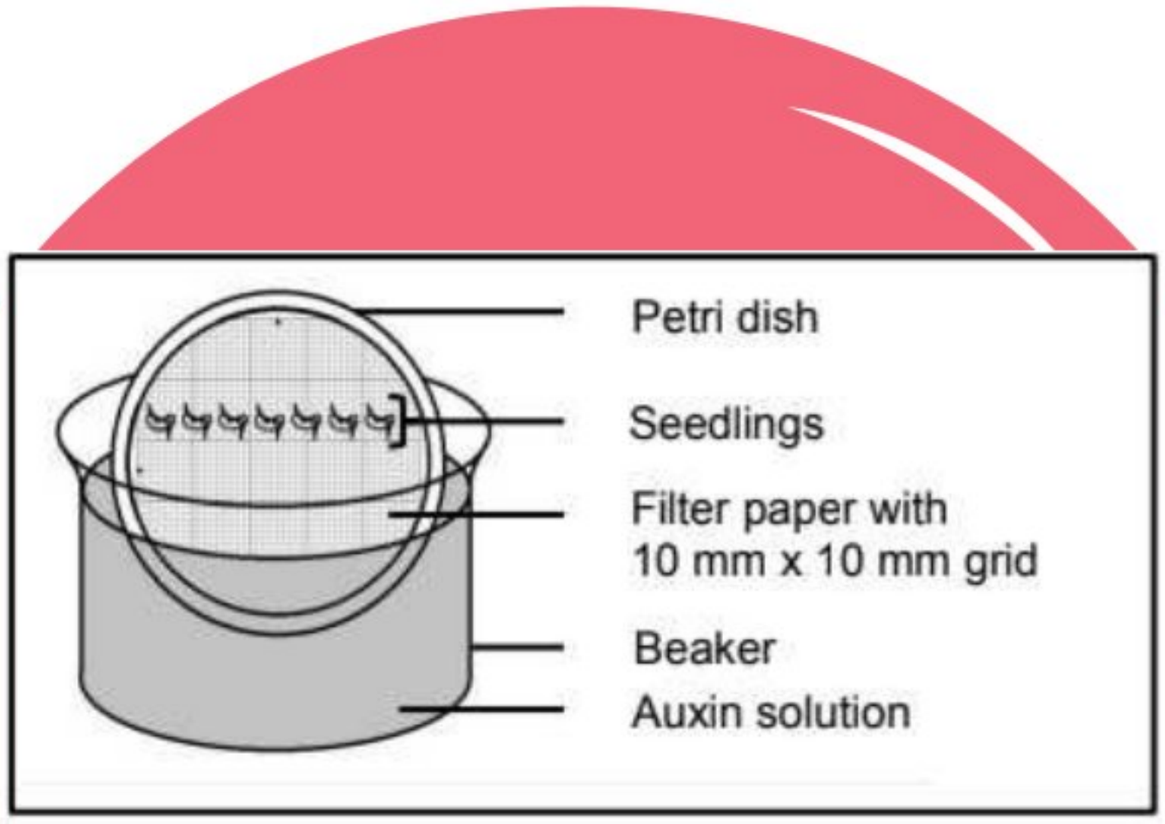
These are often spines or thorns that make it difficult for herbivores to eat them.

1. thorns
2. pathogenic bacteria on thorns
3. warning colours



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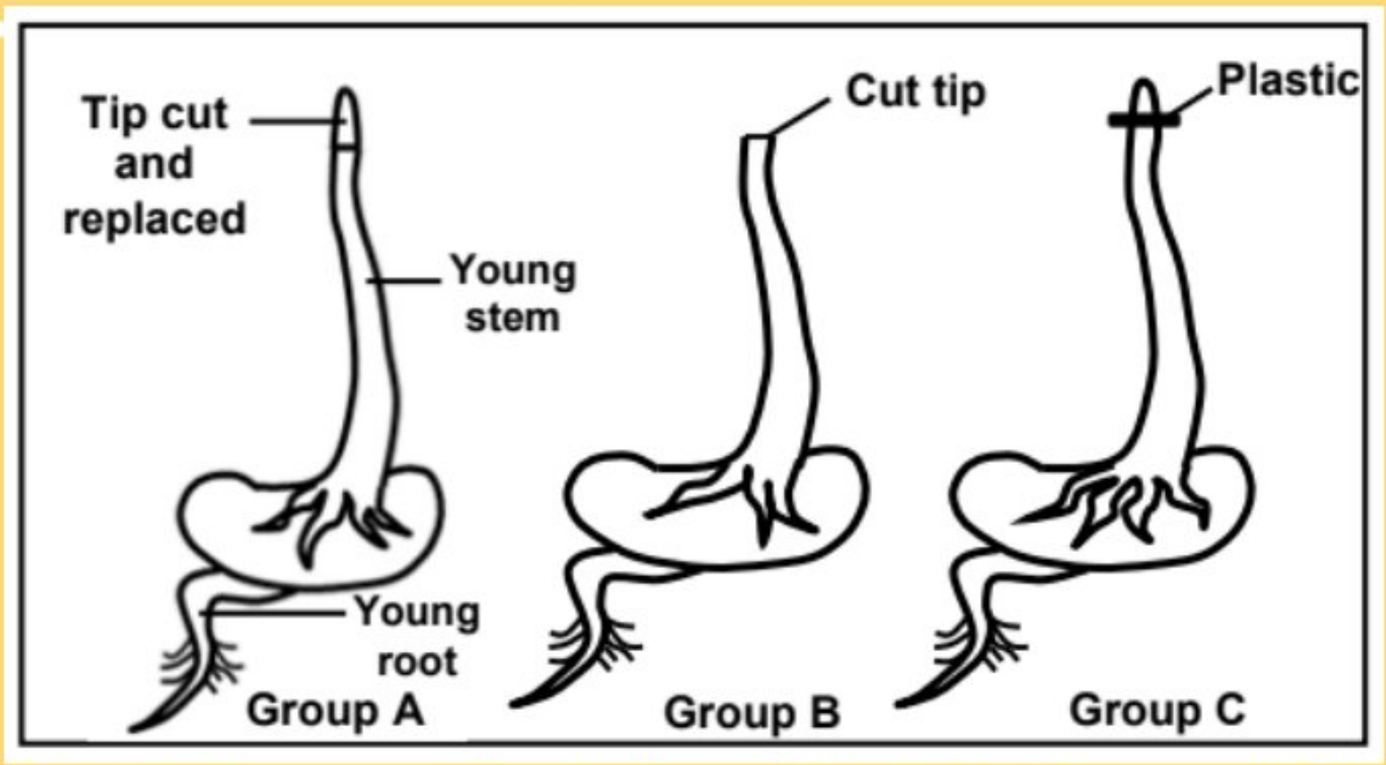
HOW WILL THEY ASK THIS?



Pictured above is a **CLINOSTAT** with bean seedlings. The clinostat can rotate, which evenly distributes the auxins. When it is still the auxins will sink down.
This set up often tests for **GEOTROPISM.**

1. **An investigation question is most commonly asked with an experimental set up as seen in the two pictures below.**
   You will have to provide the :
- independent variable
- dependent variable
- control experiment
- validity
- reliability
- conclusion

2. Describe the effect it would have on the shoot if we removed the tip and placed the seedling in unilateral light.
- **REMEMBER,** with your description, include what, why, when and where.
- You must now describe that there will **NOT BE ANY AUXINS** therefore the normal bending of the shoot will not happen.
- To do this take the description from above but say that the auxins won't move to the dark side, therefore they wont cause any cell elongation and the shoot will continue to grow straight.



Pictured above are seedlings that have had their shoot tip removed. This affects the shoot by stopping it from bending towards the light as you have removed the auxins.
This set up often tests for **PHOTOTROPISM.**

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CAUSES OF EVOLUTION AND EVIDENCE

EVOLUTION

OTHER MECHANISMS

1.Gene flow
- migration/ washed onto an island
- **physical barrier preventing** gene flow from one population to the next

2. Polyploidy
- **plants**
- 3 or 4 full **extra sets of chromosomes**

3. Genetic drift
- random changes in **frequency** of gene in population
- results of natural disaster
- occurs in **small populations**

EVIDENCE

1.Fossil
- increase in **complexity**
- increase in diversity
- **intermediate** fossils

2. Modification with descent
- start with same structure, modify over time to suit environment.

3. Biogeography
- **distribution** of **fossils**
- shows similarities

4.Genetics
- common ancestors
- all have **DNA/RNA**
- more sequences shared, more similar

SOURCES OF VARIATION

Within same species in particular habitat

CON. VS DIS.

- many genes
- range of phenotypes
- one gene
- different allele

MEIOSIS

1. crossing over
2. random arrangement

MUTATIONS

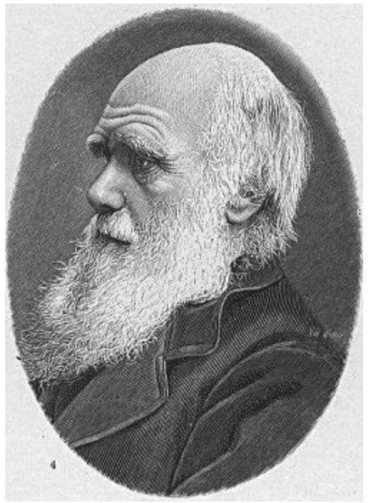
CHANCE FERTILISATION

CHANCE MATING

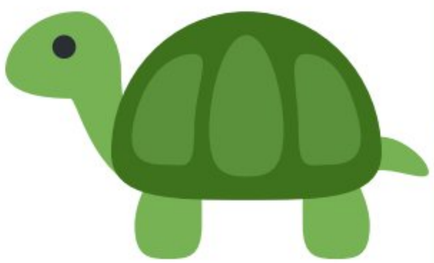
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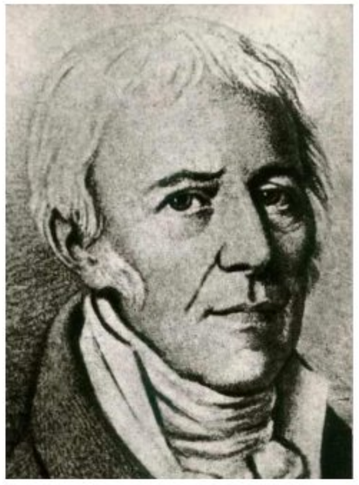
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DARWIN VS LAMARCK



NATURAL SELECTION	INHERITANCE OF ACQUIRED CHARACTERISTICS
Gradual changes	Rapid changes
Common ancestors	Organism chooses to change itself
Natural selection to select favourable trait	
How does it occur?	How does it occur?
1. More offspring than needed are produced	1. Use and disuse principle - environment changed organism - actively responds and adapts - more use/disue it will enhance/ shrink structure
2. Natural variation in population	2. Inheritance of acquired characteristics _ phenotypic changes acquired by parents and passed on to offspring
3. Change in environment leads to selection of favourable characteristic	
4. Must be inheritable trait	



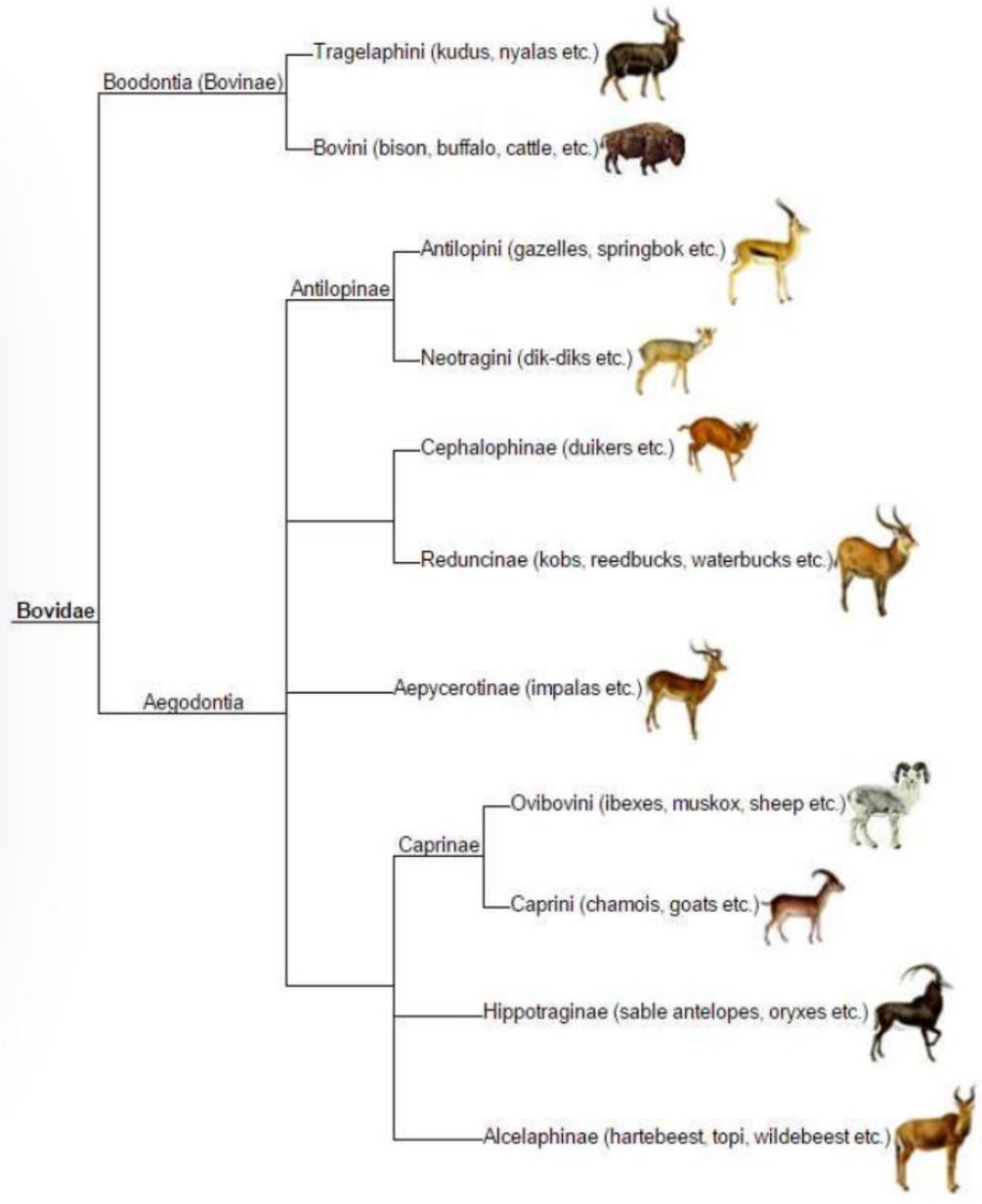




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HOW TO READ A PHYLOGENETIC TREE

1. **Name the common ancestor.**
- here you will need to look at the diagram and follow back to the point where all the lines join together.
2. **Name the genus most closely related.**
- looking at the phylogenetic tree, you will need to count back and find the last branch of the species you are looking for.
3. **When did species X become extinct.**
- looking at the timeline on the side of the diagram, count backwards from present. REMEMBER to include the unit of measurement EG: MYA (millions of years ago).
4. **Provide the biological term for (X).**
- here you will need to know many of the terms associated with evolution, some common ones are: natural and artificial selection.



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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

1. **Name the common ancestor.**

- here you will need to look at the diagram and follow back to the point where all the lines join together.

2. **Name the genus most closely related.**

- looking at the phylogenetic tree, you will need to count back and find the last branch off the species you are looking for.

3. **When did species X become extinct.**

- looking at the timeline on the side of the diagram, count backwards from present. REMEMBER to include the unit of measurement EG: MYA (millions of years ago).

4. **Provide the biological term for (X).**

- here you will need to know many of the terms associated with evolution, some common ones are: natural and artificial selection.

LONG QUESTIONS

1.**Describe how Lamarck would have described the way snakes lost their legs.**

- you will need to mention the **TWO** main principles of his theory.
- you **MUST** build in the example they have given you in this case. You need to talk about snakes using their legs less and this acquired trait being passed on to their offspring.
- **REMEMBER** this answer requires detail.

2.**Compare the differences between Darwin and Lamarck.**

- this may be a table you might need to draw.
- if its a paragraph then make sure you compare like with like don't mix your points.

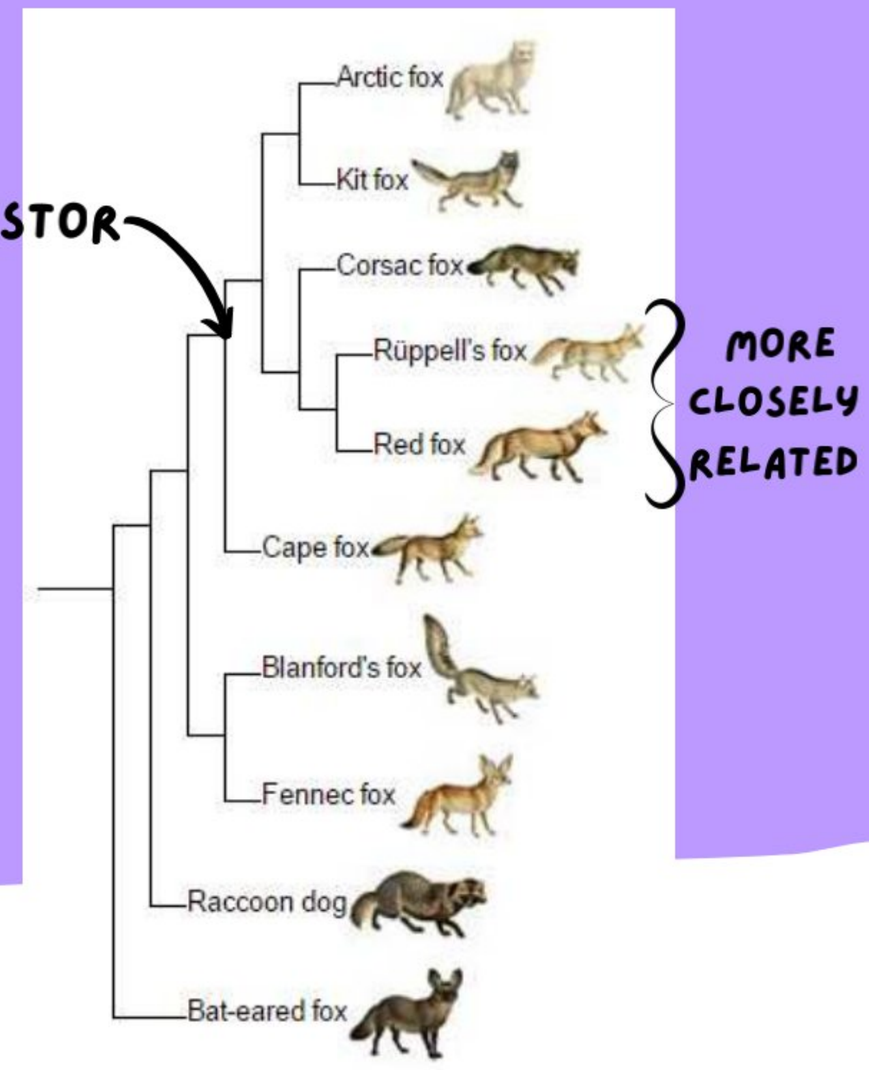
3. **Explain TWO sources of variation in evolution.**

- here you will need to **STATE** a source, like mutations or meiosis.
- then **EXPLAIN** what happens during this source of variation.

REMEMBER: when using meiosis as a source of variation you can't also mention crossing over or random arrangement, as these fall under the same source **HOWEVER** they can be matched separately with other sources.

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PHYLOGENETIC TREE



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NATURAL SELECTION

When: Change in environmental conditions
Where: Micro and macro populations
Why: To select the most favourable characteristic in order to improve chances of survival

PRO-TIPS

- If given a specific favourable characteristic like colour or size, use it in your answer.
- **DON'T** use the template answer below if they have given you an organism. You must substitute it into the template as you explain.
- you **MUST** mention the environmental change (food, space etc.) when answering.

HOW TO EXPLAIN

- large number of offspring created which have large amounts of **variation**
- some have **favourable** characteristics and others don't
- an **environmental** change occurs which leads to a competition for resources
- those more suited, with the **favourable** characteristic, **survive**
- whilst the organisms with **unfavourable** characteristics, which makes them less suited, **die**
- the organisms that survive, **reproduce**
- passing on the **allele** for the favourable characteristics to their **offspring**
- the next generation will therefore have a **higher proportion** of individuals with the favourable characteristics

IMPORTANT DEFINITIONS

1. **Species:** a group of organisms that live in the same **area** and who can **reproduce** to produce **fertile** offspring
2. **Population**: a species found in the same **place** at the same **time**.





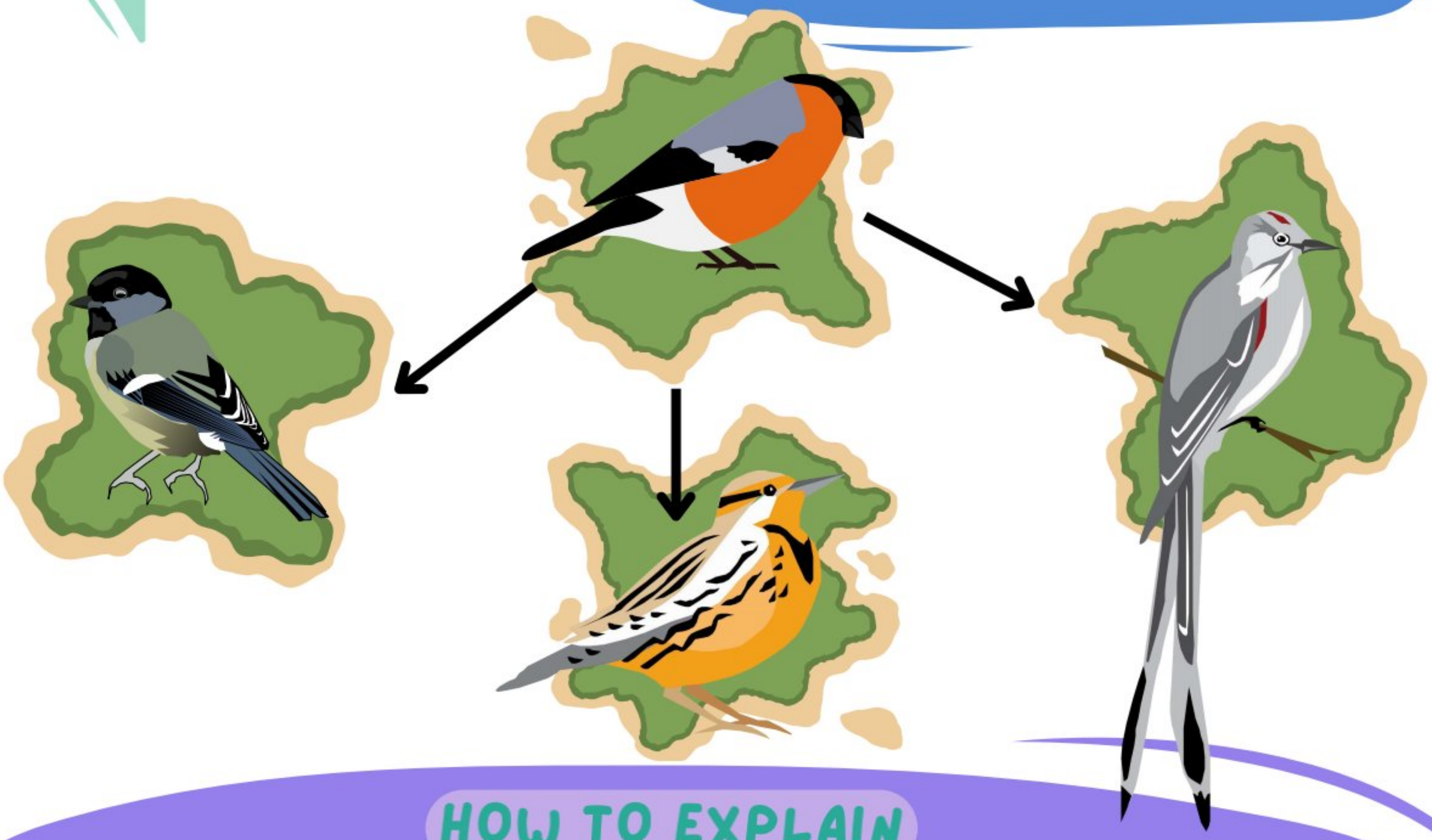
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SPECIATION

When: a population is separated by a geographical barrier
Where: Macro-populations
Why: When natural selection happens, changes in alleles and lack of gene flow occurs, and a newly adapted species forms.

PRO-TIPS

- If given a specific favourable characteristic like colour or size use it in your answer.
- **DON'T** use the template answer below if they have given you an organism. You must substitute it into the template as you explain.
- You **MUST** mention the environmental change (food, space etc.) when answering.



HOW TO EXPLAIN

- if a **POPULATION** of a single species becomes separated by a **GEOGRAPHICAL BARRIER**(sea, mountain etc.)
- then the population splits into **TWO**
- there is no **GENE FLOW** between the two **POPULATIONS**
- since each population may be exposed to different environmental conditions
- natural selection occurs **INDEPENDENTLY** in each of the two populations
- individuals become very different from each other
- genotypically and phenotypically
- even if they were to **MIX** again
- they will **NOT** be able to **INTERBREED**
- the two populations are now different species

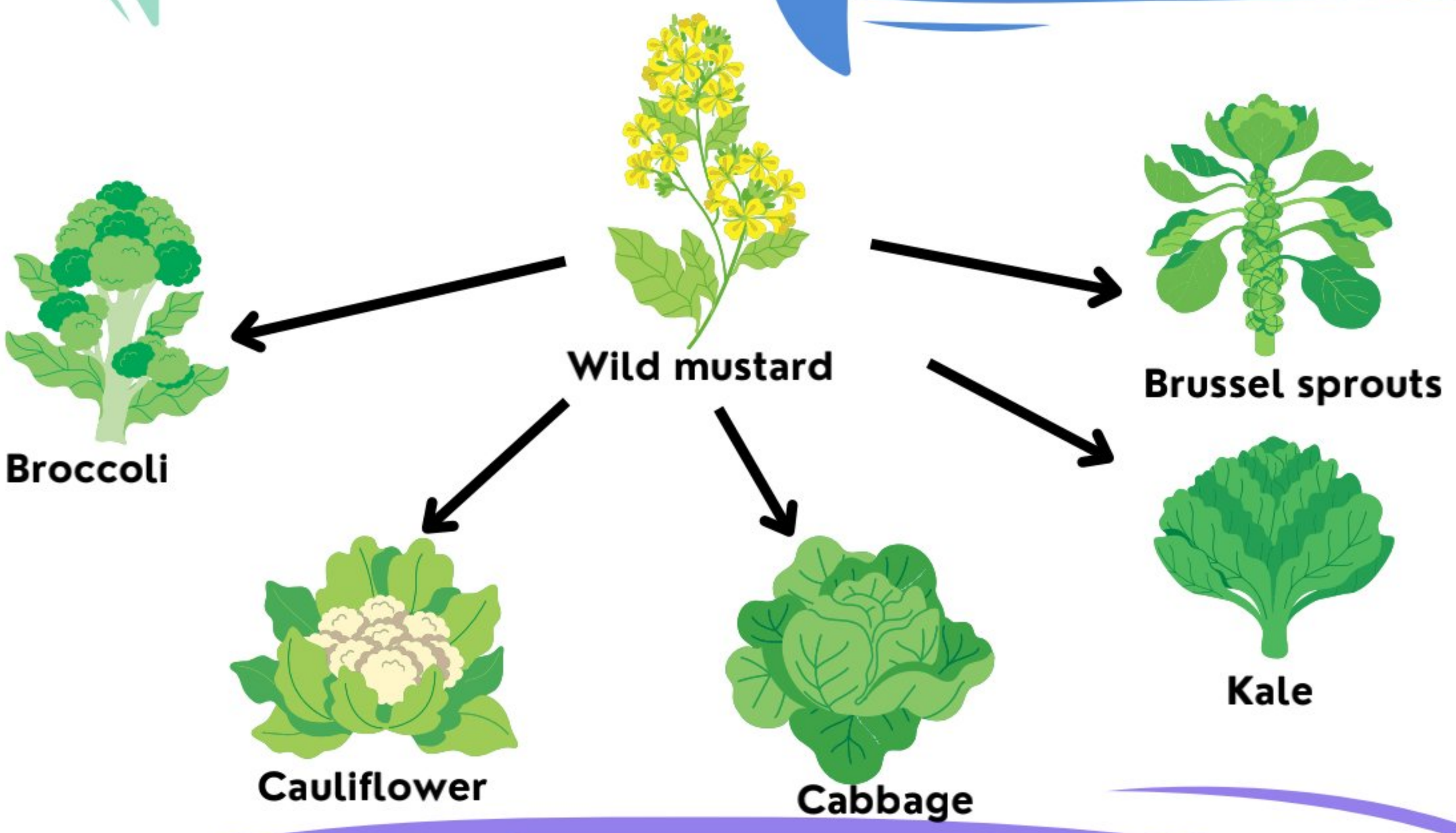
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ARTIFICIAL SELECTION

When: humans chose a desirable trait they want to enhance
Where: Macro-populations/micro-populations
Why: to produce plants and animals with desired characteristics that may have a high yield, high nutrient value, bright colour and long shelf life

PRO-TIPS

- If given a specific desirable characteristic like yield or disease resistance, use it in your answer.
- **DON'T** use the template answer below if they have given you an organism. You must substitute it into the template as you explain.
- You **MUST** mention that the trait is **DESIRABLE** not **FAVOURABLE**.
- **HUMANS** have chosen this trait for their own **BENEFIT**.



HOW TO EXPLAIN

- if a **POPULATION** of a single species has a **DESIRABLE TRAIT** that humans want to enhance
- those organisms with **DESIRABLE TRAIT** will be allowed to reproduce
- those organisms with the **UNDESIRABLE TRAIT** trait will not be allowed to reproduce
- any organisms born into the **NEXT GENERATION** with the **UNDESIRABLE TRAIT** will be removed from the population
- this will increase the **FREQUENCY** of the **DESIRABLE TRAIT**

- **PLEASE NOTE**: artificial selection does **NOT** increase the chances of the organisms survival. Sometimes it could decrease their chances of survival in the wild.

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REPRODUCTIVE ISOLATION

WHAT: how species maintain their ability to produce fertile offspring.
WHY: maintains chromosome number and prevents chromosomal mutations.
HOW: different species have specific mechanisms to prevent interbreeding between two **DIFFERENT** species so as to ensure the healthiest offspring.

BREEDING AT DIFFERENT TIMES OF THE YEAR

- Also known as: **TEMPORAL/SEASONAL**.
- different organisms reproduce at different times of the year.
- female organisms are often only fertile during a specific time of the year.



ADAPTATIONS TO DIFFERENT POLLINATORS

- different plants have evoloved to attract different **POLLINATORS**
- **OR** have evolved to not need animal pollinators but rather **WIND**.
- these adaptations can include: colour, smell, size and shape of the flower.



HOW TO TEST: in order to test if two organisms are the same species they must be able to do the following:
1.) Interbreed
AND
2.) produce **FERTILE** offspring

SPECIES-SPECIFIC COURTSHIP

- also known as: **BEHAVIOURAL/RITUALS**
- it is important to **ALWAYS** mention **SPECIES** specific.
- can include mating calls, dances, building of nests.



PREVENTION OF FERTILISATION

- also known as: **MECHANICAL/GENITALIA DIFFERENCE**
- this occurs when genitals are incompatible in size or shape
- this occurs when sperm are prevented in fertilising the egg even if the genital can match.

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EVOLUTION TODAY

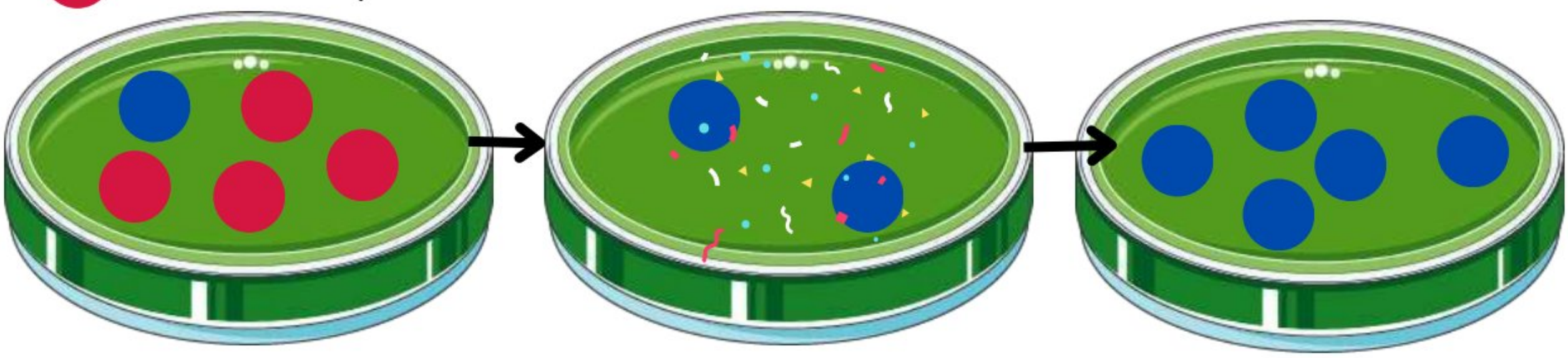
When: Often when animals are exposed to environments influenced by humans
Where: Macro-populations
Why: When natural selection occurs due to possible human influence and the response has caused new species to arise in order to survive new environments.

PRO-TIPS

- **The MOST COMMON** question linked to this is an investigation question about antibiotic resistance.
- You **MUST** use the natural selection explanation but **SUBSTITUTE** in the example in the question.
- **REMEMBER** to include the force acting upon this population (medicine, insecticide etc.).

Antibiotic resistant bacteria

Antibiotic susceptible bacteria



Original population

Antibiotic added to petri dish and susceptible bacteria die

Only antibiotic resistant bacteria left

HOW TO EXPLAIN : ANTIBIOTIC RESISTANCE

- bacteria breed **RAPIDLY**
- there is variation in the population as a result of **MUTATIONS**
- an antibiotic is given, which changes the **ENVIRONMENT** acting as a selective force
- those who have the **FAVOURABLE** antibiotic resistant gene survive
- those with the **UNFAVOURABLE** gene, who are affected by the antibiotic, die
- those who **SURVIVE** go on to **REPRODUCE**
- this favourable **ALLELE** will be passed on to the next generation
- **INCREASING** the frequency of antibiotic resistance

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HOW WILL THEY ASK THIS?

LONG QUESTIONS

1. **Explain how <u>speciation</u> occurred in organism X.**
   - You will need to take the template answer as seen above and **SUBSTITUTE** in the animal population they are talking about.
   - **DONT FORGET** to name the specific geographical barrier that they may have mentioned in the text.
   - You may also have to identify the barrier simply from the picture.

2. **Explain how <u>natural selection</u> took place in population X.**
   - Here you will take the template answer for natural selection and **SUBSTITUTE** in the example they are referring to.
   - **DONT FORGET** to mention which characteristic is favourable and which one is not.

<u>PLEASE REMEMBER:</u>
It is so easy to mix up these two explanations, especially speciation as it mentions natural selection, but you **DO NOT** need to explain what natural selection is if asked just about speciation.

INVESTIGATION QUESTIONS

1. **A population of mice that come in the colours black or brown are placed in a brown desert and are exposed to predators. They measured how many of each colour survived.**
   - These type of questions are building scientific method and theory into one.
   - They will ask - independent variable
     - dependent variable

(Answer: - colour of mouse)
- survival rate

   - Other questions, like "How did/how should validity and reliability be maintained?".

2. Use the theory of natural selection to explain why more brown mice survived.
- Use the template answer for natural selection but include the mice and their colour along with the predators as the selective force.

TRICKY QUESTIONS

1. **Describe how antibiotic resistance occurred in TB as seen in the South African population.**

- **REMEMBER** your description must have how, where, when and why.
- You can take the antibiotic explanation provided above **BUT** make sure to adapt it to the question given (specific gene mentioned or the type of disease caused by the bacteria).
- **TRICKY ANSWER**: you must remember that it is the **BACTERIA** that is resistant **NOT** the animal or human and **NOT** the actual antibiotic.

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SKELETAL SIMILARITIES

Apes and humans share the following characteristics:

1. apposable thumbs
2. no external tails
3. bare finger tips
4. binocular vision
5. colour vision
6. males larger than females

HOW WILL THEY ASK THIS?

- you will often need to know at least **THREE** similarities in an exam.
- this question often builds onto the differences of the skeleton.
- you **MUST** know the advantages of having these structures.
- you may be asked **HOW** some of these structures formed (**DON'T PANIC** - its all linked to the natural selection and how our ancestors moved from living in trees to living on land and walking.





SKELETAL DIFFERENCES

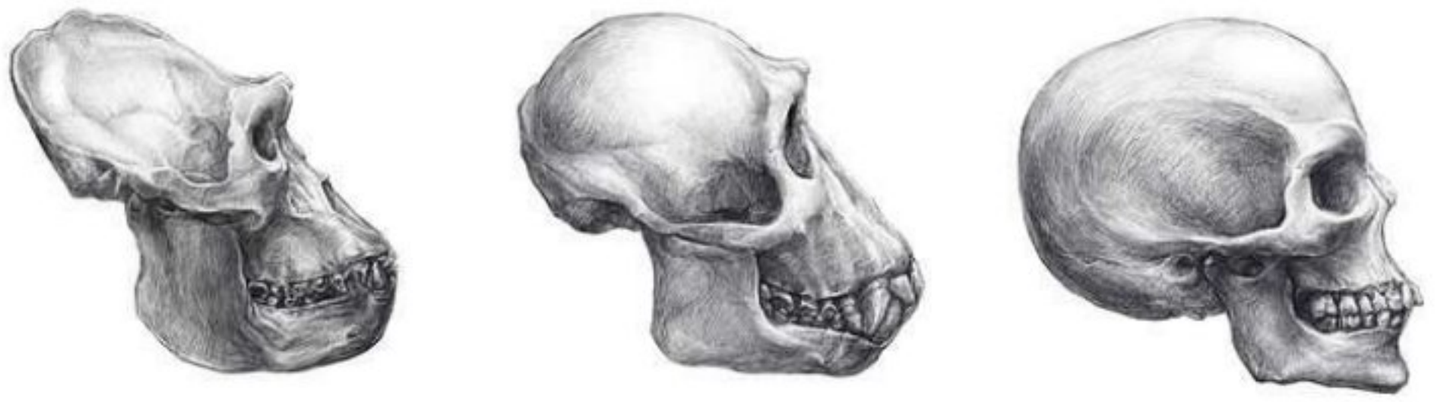
APE	HUMANS
foramen magnum more backwards	foramen magnum more forwards
prognathous jaw	non-prognathous jaw
rectangular-shaped palate	parabolic-shaped palate
brow ridges present	brow ridges absent
small cranium	large cranium
large canines	small canines
narrow, long pelvis	broad, short pelvis
divergent big toe	convergent big toe

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WHAT TO LOOK FOR IN SKELETONS IN EXAMS

During exams and tests you will often be asked to identify or arrange skulls/fossils. Use the following structures to guide your identification, as well as being the visual reason you may need to give to support your answer.



Gorilla | Australopithecine | Homo sapiens

Cranium size: the size will increase and also will have a more rounded appearance.

Prognathous jaw: all fossils show a prognathous jaw except for Homo sapiens. This is in reference to the large lower jaw bone and how the face starts to slope and becomes flatter.

Sagittal crest: above we can see a defined sagittal crest on top of the gorilla cranium as it becomes reduced in the Australopithecine and finally absent in the Homo sapiens.

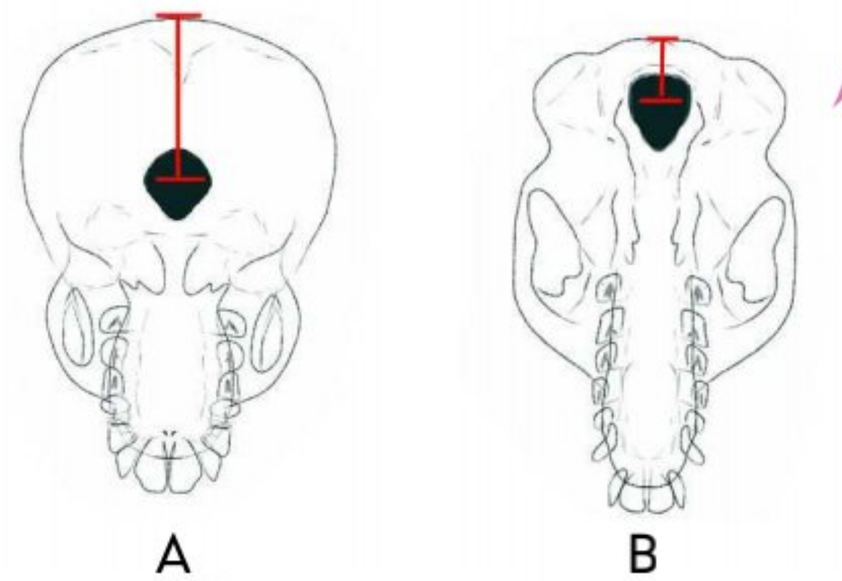
Brow ridge: above we can also see a very pronounced brow ridge in the gorilla but it gradually gets smaller until absent in Homo sapiens.

FORAMEN MAGNUM

The position of the foramen is very important is it reveals whether or not an organism is bipedal. As the foramen moves more forward the organism becomes more bipedal

A: The foramen magnum is further forward
THEREFORE this organism is most likely bipedal

B: The foramen magnum is further backward
THEREFORE this organism is most likely quadrupedal



A B

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PELVIS SHAPE

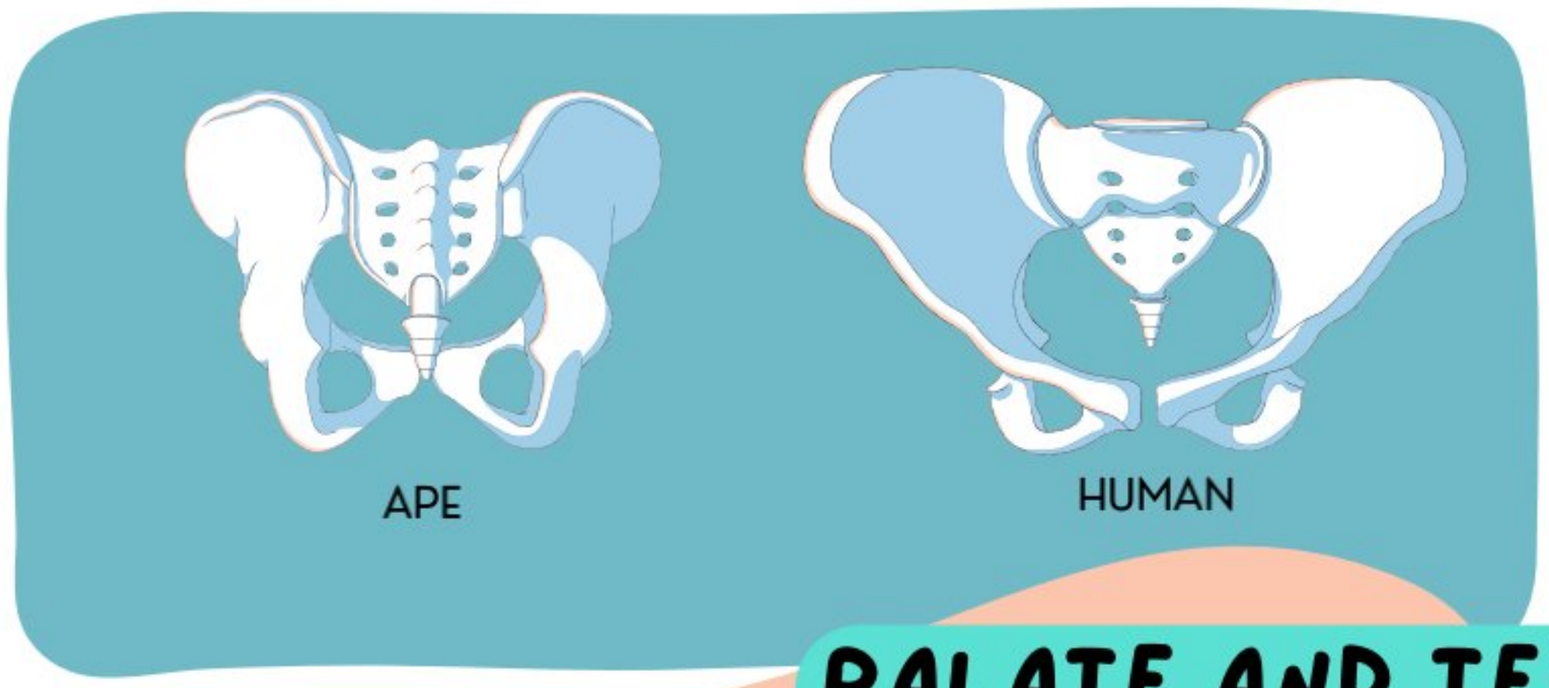
When looking at the fossil evidence provided and you need to determine the order of evolution and you need to determine if the organisms was bipedal, the best structure at look for is the pelvis.

A **short**, **broad** pelvis is perfect for **bipedalism** and ensuring the body weight is carried directly over the mid point of the body.
Often we link the **pelvis** and the **foramen magnum** together to support our answers as to whether or not an organism is bipedal.

HOW TO DESCRIBE THE PELVIS SHAPE

APE: pelvis is long and narrow

Human: pelvis is short and broad



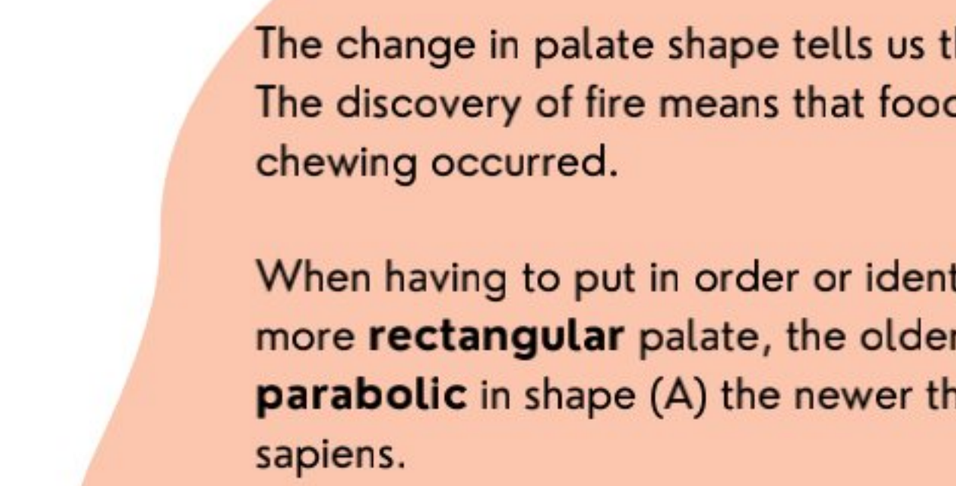
PALATE AND TEETH

The change in palate shape tells us that a change in **diet** has occurred. The discovery of fire means that food can now be cooked and less chewing occurred.

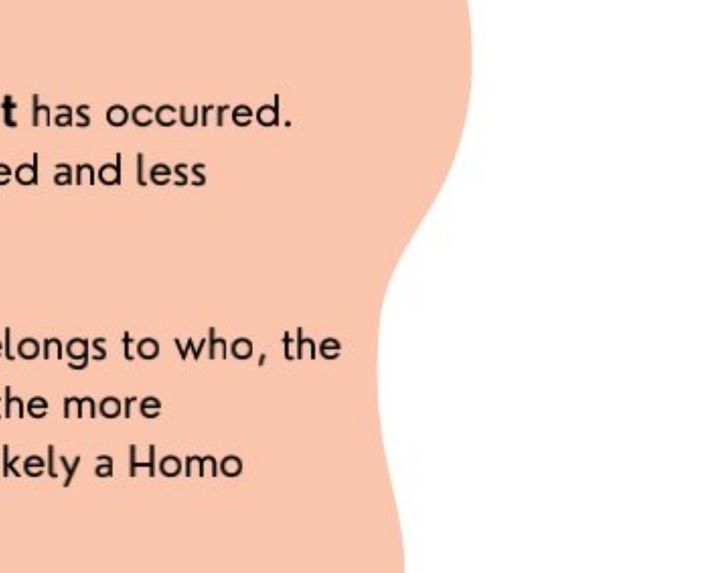
When having to put in order or identify which palate belongs to who, the more **rectangular** palate, the older the fossil (C) and the more **parabolic** in shape (A) the newer the fossil. It is most likely a Homo sapiens.

REMEMBER: as food was cooked more nutrients were available therefore brains could grow larger.

When looking at teeth we focus on the canines getting smaller. Older fossils will have big canines where as younger fossils will have smaller canines.



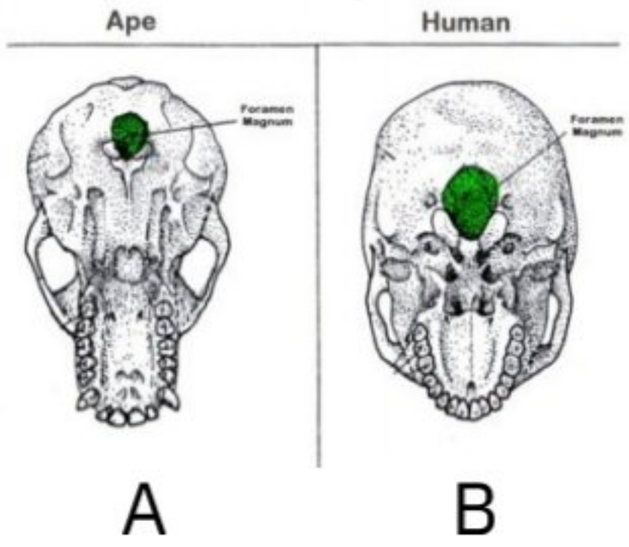
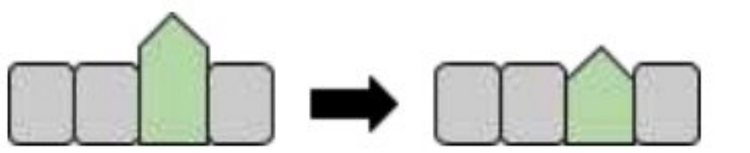
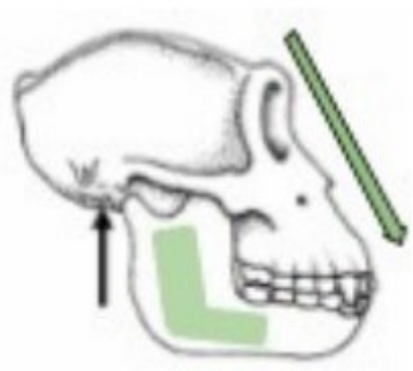
A B C



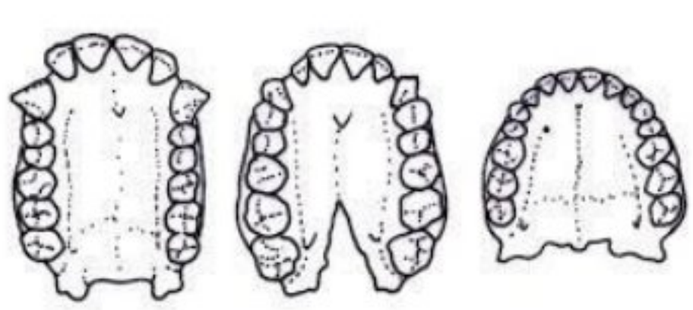
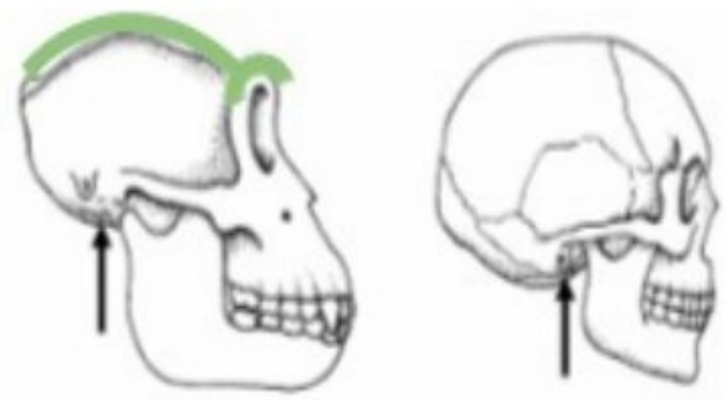
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FOSSIL EVIDENCE (WITH EXPECTED QUESTIONS)

FEATURE	EXAMPLE	HOW TO EXPLAIN
1.Bipedalism	1.Spinal column 2.Short, broad pelvis 3.Foramen magnum  **Example question:** Q:List the features of bipedalism. Q:What in the pictures shows that the animal is bipedal?	1.Look for the S-shape spine = this shows flexibility. 2.Explain how the shape supports upright movement (i.e. habitual bipedalism). 3.(B) has more forward placement than (A).
2.Brain size	**Example question:** Q: Compare the brain case/ cranium of A & B, and explain its impact on its intelligence.	**Answer:** A: Compare the sizes (in cc, cubic centimeters). A: As volume increases, a large brain is present ∴more intelligence.
3.Dentition (focusing on canines , but also sometimes molars)	**Example question:** Q:Place the skulls in the correct order according to development.  big canines to small canines	**Answer:** A: Order skull from biggest canine to smallest. NOTE: Be able to explain why the teeth got smaller. The answer is that the diet changed - it went from raw to cooked.
4.Prognathism	**Example question:** Describe the trend of prognathism seen in the skull.	**Answer:** A: 1.Prognathous jaw = large jaw bone and sloping face  2.Non- prognathous jaw = small jaw bone and flat face  ∴ Talk about how the jaw gets smaller over time and how the face slopes less

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		<u>WARNING!</u> There is **NO** intermediate jaw ∴ you **CANNOT** say less prognathous! (It has to be option 1 or 2, as it is a complete state. However you can talk about the bone getting smaller and the slope getting smaller.)
5.Palate shape	**<u>Example question</u>:** Q:Place the palates in order:  A B C	**<u>Answer</u>:** A:(A to B to C) -A = African ape due to the rectangular palate shape -B = Transitional species due to the U-shaped palate -C = Human due to the parabolic shape of the palate **NOTE:** The reason for the change in palate shape is due to a change in diet (cooked food).
6.Cranial and brow ridge	**<u>Example question</u>:** Q:Identify the African ape:  A B	**<u>Answer</u>:** A:A - presence of cranial/ sagittal crest - presence of brow ridge B - absence of cranial/ sagittal crest - absence of brow ridge

PRO-TIPS

- When studying this section focus on the skeletal features that lead to **BIPEDALISM.**
- When speaking about the foramen magnum **ONLY** speak about it being **MORE FORWARDS** or **MORE BACKWARDS**, you **CANNOT** say more central or in the middle of the skull.
- You should know at least **THREE** sources of fossil evidence.
- You must understand the connection between each piece of fossil evidence and how it contributed to bipedalism.

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HOW WILL THEY ASK THIS?

SHORT QUESTIONS

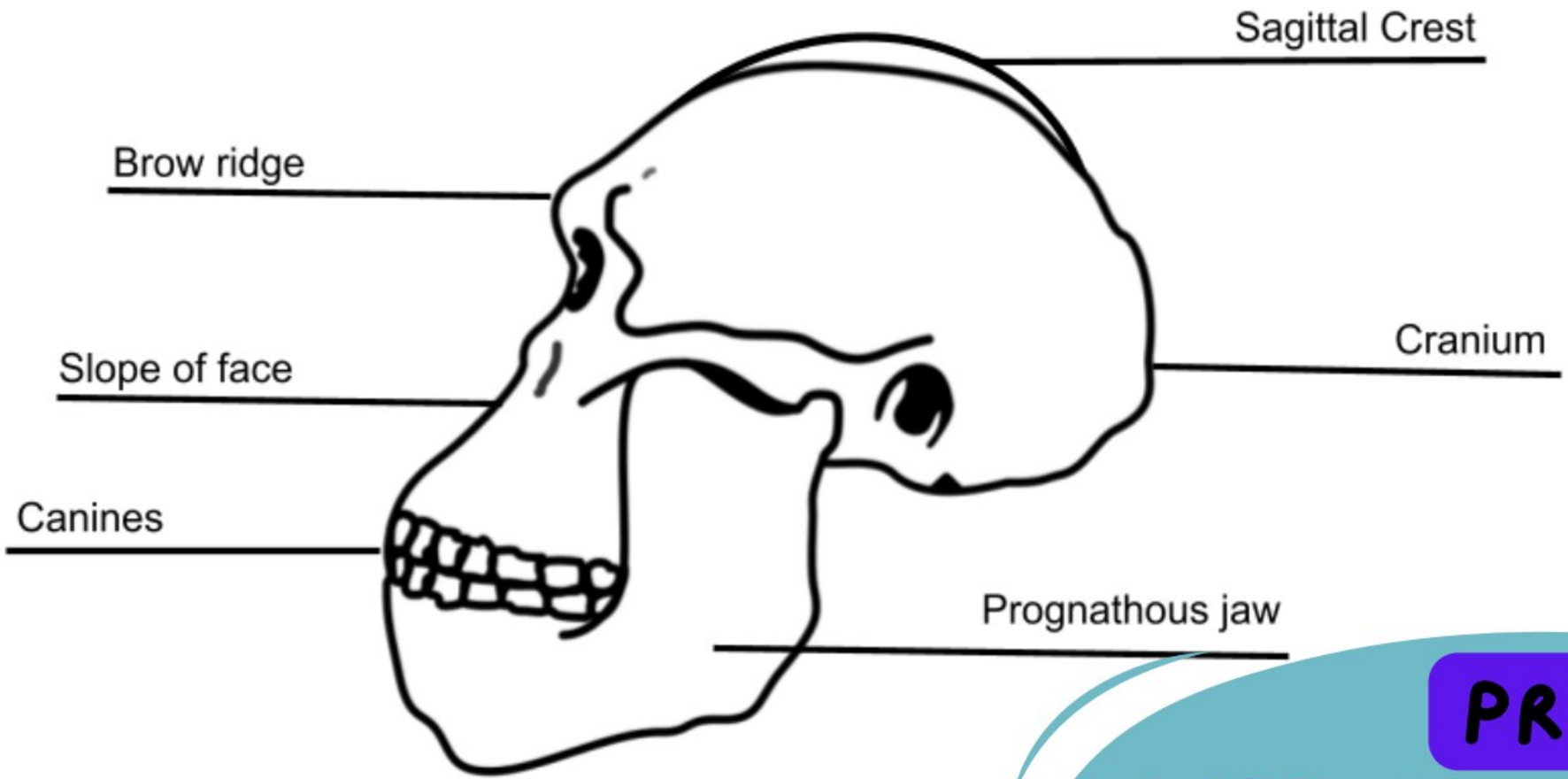
1. **Identify which pelvis is human and which is ape.**
- here you will need to know what visual differences to look for (this can be applied to ANY skeletal differences).
2. **Give a VISUAL reason for your answer for identifying**.
- remember with this question you can ONLY mention what you can see in the diagram.
3.**Tabulate THREE differences in the skeleton between apes and humans.**
- the differences must read from left to right, DON'T mix and match them.
4. **Explain how the location of the foramen magnum is linked to bipedalism.**
- make a statement: the foramen is positioned more forward
- give a reason: to assist with bipedal movement by carrying the body weight directly over the pelvis, supporting upright posture.

LONG QUESTIONS

1.Explain how the age of fossils of Homo sapiens and the location of fossils of Homo habilis support the "Out of Africa" hypothesis.
- here you will need to know the hypothesis directly from your exam guidelines.
-use the ages of fossils to support this statement by referring to which fossil was the **OLDEST** and which is the **YOUNGEST**.
-also don't forget to include **ONLY** as some of these fossils are only found in certain locations which makes them key points of human evolution.
2**. Explain what is meant by a transitional fossil**
- refer to the definition of transitional fossils found in the guideline
-transitional fossils contain characteristics of both species
3.**Explain the significance of an increased cranium size in the evolution of Homo sapiens.**
- **REMEMBER** explain questions need a statement and a reason
-Statement: an increased size of cranium means that there is a greater volume inside of it
-Reason: a greater volume will allow for a bigger brain thus having a greater intelligence
4. **Explain how canine size reveals diet in Hominids**
- Statement: canines are linked to tearing fibrous food
-Reason: Large canine reveal that early hominids ate raw, fibrous food where as smaller canines indicate food became easier to chew.

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PHASES OF HOMINID EVOLUTION

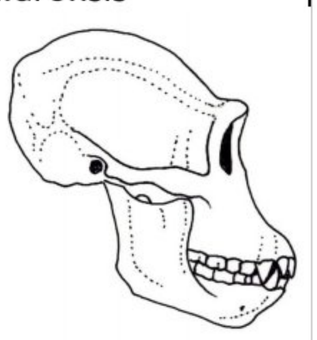


NOTE: Use these structures to classify skulls. Follow the "trend" of the skull.

PRO-TIPS

- You **DON'T** need to know massive amounts of detail for these skulls.
- **FOCUS** on the labelled structures and how they change over time.
- You **MUST** know the names of fossils and who discovered them.
- **PLEASE NOTE**: a jaw can be **PROGNATHOUS or NON-PROGNATHOUS**, you cannot say "more" or " less".

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Species	Cranium	Sagittal Crest	Slope of face	Brow ridge	Teeth	Prognathous jaw	Fossil name	Place	Scientists
Ardipithecus ramidus	Small ↓	Present ↓	Sloped ↓	Present ↓		Prognathous ↓	Ardi	Ethiopia	Tim White
Australopithecus afarensis 	Small ↓	Present ↓	Sloped ↓	Present ↓	Large Canines ↓	Prognathous ↓	1. Lucy 2. Laetoli footprints	Ethiopia Tanzania	Donald Johanson Mary Leakey
Australopithecus Africanus *fully bipedal	Increasing ↓	Reducing ↓	Sloped ↓	Reducing ↓	Large canines ↓	Prognathous ↓	1. Taung child 2. Mrs Ples 3. Little foot	South Africa South Africa South Africa	Raymond Dart Robert Brown Ronald Clarke
Homo habilis *tool maker	Increasing ↓	Reducing ↓	Sloped ↓ No forehead	Reducing ↓	Reducing canines ↓	Prognathous ↓	N/A	N/A	N/A

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Homo ergaster *1st to use fire	Increasing ↓	Reducing ↓ Absent	Sloped ↓ More vertical	Reducing ↓	↓	Prognathous ↓ Chinless	Turkana boy	Kenya	N/A
Homo Heidelbergenes *possible human ancestor	Increasing ↓	Absent ↓	More vertical ↓ Flatter	↓	Reduced canines	Chinless ↓ Non-prognathous	N/A	N/A	N/A
Homo sapiens	Largest Cranium	Absent	Flat face	Absent	Small canines	Non-prognathous + Chin	N/A	N/A	N/A

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OUT OF AFRICA HYPOTHESIS

KEY POINTS TO MENTION WHEN EXPLAINING

- Humans originated in **AFRICA** and moved out.
- The **OLDEST** human fossils are found in Africa.
- Ardipithecus is **ONLY** found in Africa.
- Australopithecus **ONLY** found in Africa.
- **OLDEST h**omo sapiens found in Africa.
- **YOUNGER** fossils found in other parts.

REMEMBER TO USE THE WORDS ONLY AND OLDEST WITH EACH OF THESE, AS ITS VITAL!



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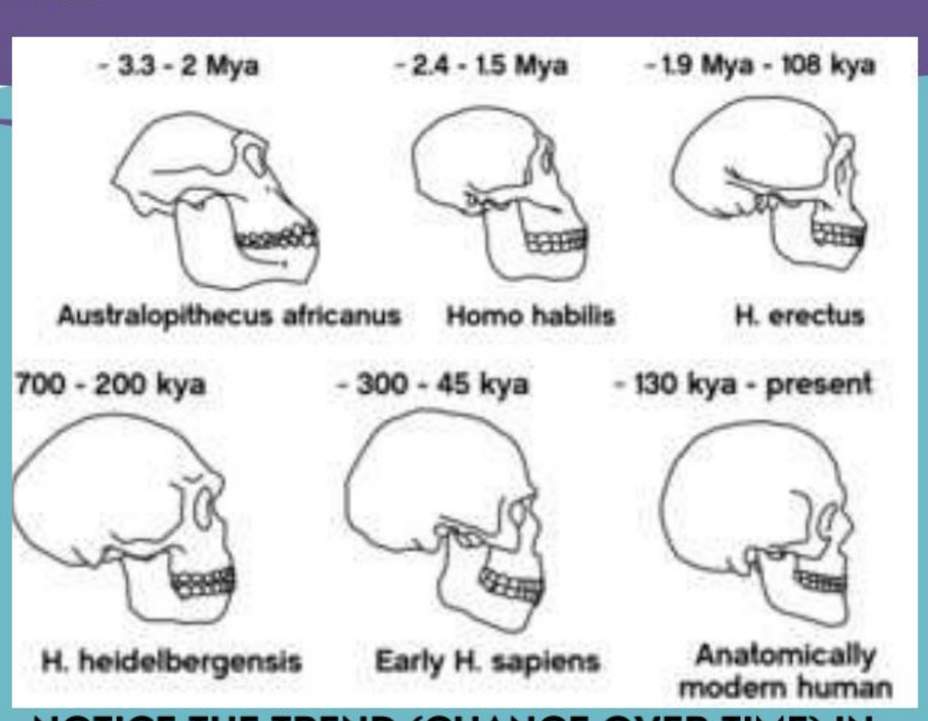
HOW WILL THEY ASK THIS?

SHORT QUESTIONS

1.**Identify which of the skulls is human.**
- here you will need to look for the skull that shows the largest cranium and the smallest canines.

2. **Place the skulls from oldest to newest in developmental order.**
- looking at the skull, order them from **SMALLEST** cranium to the **LARGEST.**
- also look at the jaw and place them from **LARGEST** lower jaw to **SMALLEST**.

3. **Tabulate 3 skull differences.**
- simply draw a table focusing in on cranium, prognathous jaw, canines, brow ridge, sagittal crest.



NOTICE THE TREND (CHANGE OVER TIME) IN THE SKULL SHAPES AND KEY FEATURES

LONG QUESTIONS

1.**Explain how the change in canines/teeth showed a change in diet.**
- here you will need to speak about how canines started off **LARGE** due to raw vegetative diet.
- then explain how the discovery of **FIRE** allowed cooked food which was easier to chew.

2. **Explain how the change in cranium size affected intelligence.**
- start by explaining that the size of the cranium increases as the brain grows bigger.
- more **VOLUME** inside the cranium allowed for more brain development which meant greater intelligence.

3. **Describe the trend of the skull development in terms of the size of the jaw.**
- this is a **HARD** and **DETAILED** answer!
- for "trend" they mean how has it changed over time
- but also, they want to know why it was changing over time AND what the outcome or advantage of having a small jawbone (non-prognathous jaw) was.
- **ANSWER:** the jaw moved from prognathous to non-prognathous, due to diet and tools, this led to smaller chewing muscles, needing less space, making more room for the tongue and language development.

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SCIENTIFIC METHOD

EXAMPLE INVESTIGATION

Lizards of a certain species on an island are usually brown in colour. A mutation in one gene for body colour results in red or black lizards. Black lizards camouflage well against the dark rocks and warm up faster on cold days which will give them energy to avoid predators.

INDEPENDENT VARIABLE

DEPENDENT VARIABLE

Scientists investigated the relationship between the colour of lizards in a population and their survival rate on an island.

They conducted the investigation as follows:

- selected a species of lizards
- recorded the percentage of each colour
- repeated the investigation over 30 generations

Each investigation point will have:

1. **Where** to find it.
2. **How** to write it.
3. **Purpose** of it

HOW TO FIND THE FOLLOWING:

AIM

Where: find the aim in the sentence above that says, **"to investigate" or "to determine".**
Answer: "Scientists investigated the relationship….etc."
How: must contain the independent and dependent variable.
Purpose: to outline the intention of the investigation.

HYPOTHESIS

Where: using the aim, we take the structure and turn it into a prediction.
How: here you will make an assumption about the outcome by stating how the **independent variable** will influence the **dependent variable.**
Answer: Black coloured lizards will survive better on the island.
Purpose: to produce a possible outcome based off of facts presented or data in table given.

VARIABLES

Where: select variables from the aim statement as mentioned above.
How: the one variable influences the other
Answer: Independent - **colour of lizard** (chosen variable we want to test)
dependent - **survival rate** (cannot be predicted, is measured)
Purpose: influences the outcome of the experiment as well as informs us of a potential **control experiment** (an experiment missing the independent variable)

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HOW TO FIND THE FOLLOWING:

CONCLUSION

Where: this can be taken from the aim, confirming what did or did not happen.
Answer: the colour of the lizards does influence the survival rate.
How: must contain the independent and dependent variable, must be a statement but it **MUST NOT** contain any results or discussion of results.
Purpose: to establish whether the hypothesis was true/false.

VALIDITY

Where: experiment may mention that they kept certain variables "constant/same".
How: use the word **"same"** and be **specific** with **amounts.**
Answer: same species of lizard
same habitat of lizard
same length of time conducted
Purpose: to increase validity/to make sure the variables where constant so as to create a consistent experiment.

RELIABILITY

Where: experiment may mention something like **"repeated"** or "**carried over a long time**"
How: depending on the experiment you may use:
Answer: increase sample size (use more individuals **BUT DON'T** change the type!!)
calculate an average
repeat experiment
Purpose: influences how reliably the **outcome** of the investigation was because if you don't do the experiment again or with more participants how do you know if your results are true?

WHICH GRAPH DO I DRAW?

LINE: **continuous** data like - temperature, weight, mass, length etc. (measurements with in-between values)

BAR: dis**continuous** date like- categories, colours, species, groups of people, substances. (can also be used as a double bar graph to show **BEFORE** and **AFTER**.)

HISTOGRAM: used to show **averages** or **ranges**, like average rainfall each month for a year. Ranges of age groups that have certain diseases.

PIE CHART: shows parts of a whole, often used for **percentages,** like percentage of population with different diseases (often you will need to calculate the percentage first **BEFORE** drawing the graph.)

PRO-TIPS

- **IDENTIFY** the independent and dependent variables first before writing an aim or hypothesis.
- when asked what **WAS** done to improve validity vs what **COULD** be done.... the answer is different.
- **WAS :**means what did they do (your answer **MUST** come from the text)
- **COULD:** means what could they add to improve it, so **DON'T** mention what is in the paragraph come up with **NEW** ideas.

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