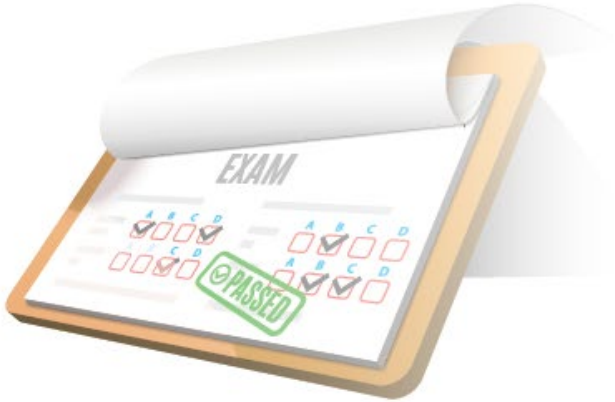
THE ANSWER SERIES *Your Key to Exam Success*

LIFE SCIENCES

SUMMARY & **TEACHING** TOOL



NATIONAL SENIOR CERTIFICATE 2022

DIAGNOSTIC REPORT

THE ANSWER SERIES *Your Key to Exam Success*

2022 LIFE SCIENCES NSC **PAPER 2**

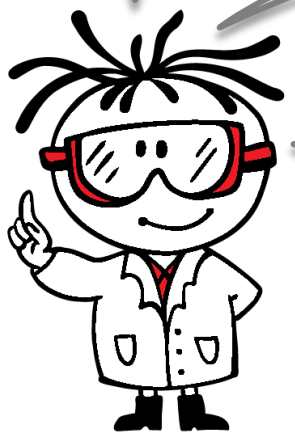
Life Sciences Paper 2

SUMMARY & **TEACHING** TOOL

Let's work through the paper and look at the problem areas as identified in the 2022 NSC Diagnostic Report.

Commentary from the Diagnostic Report is noted in grey blocks like the one below. Use these to guide discussions.

Candidates confused the centromere with the centrosome.



In some cases, revision or application options will be provided and can be identified by this symbol:

Let's revise this

Click to go to the specific section.

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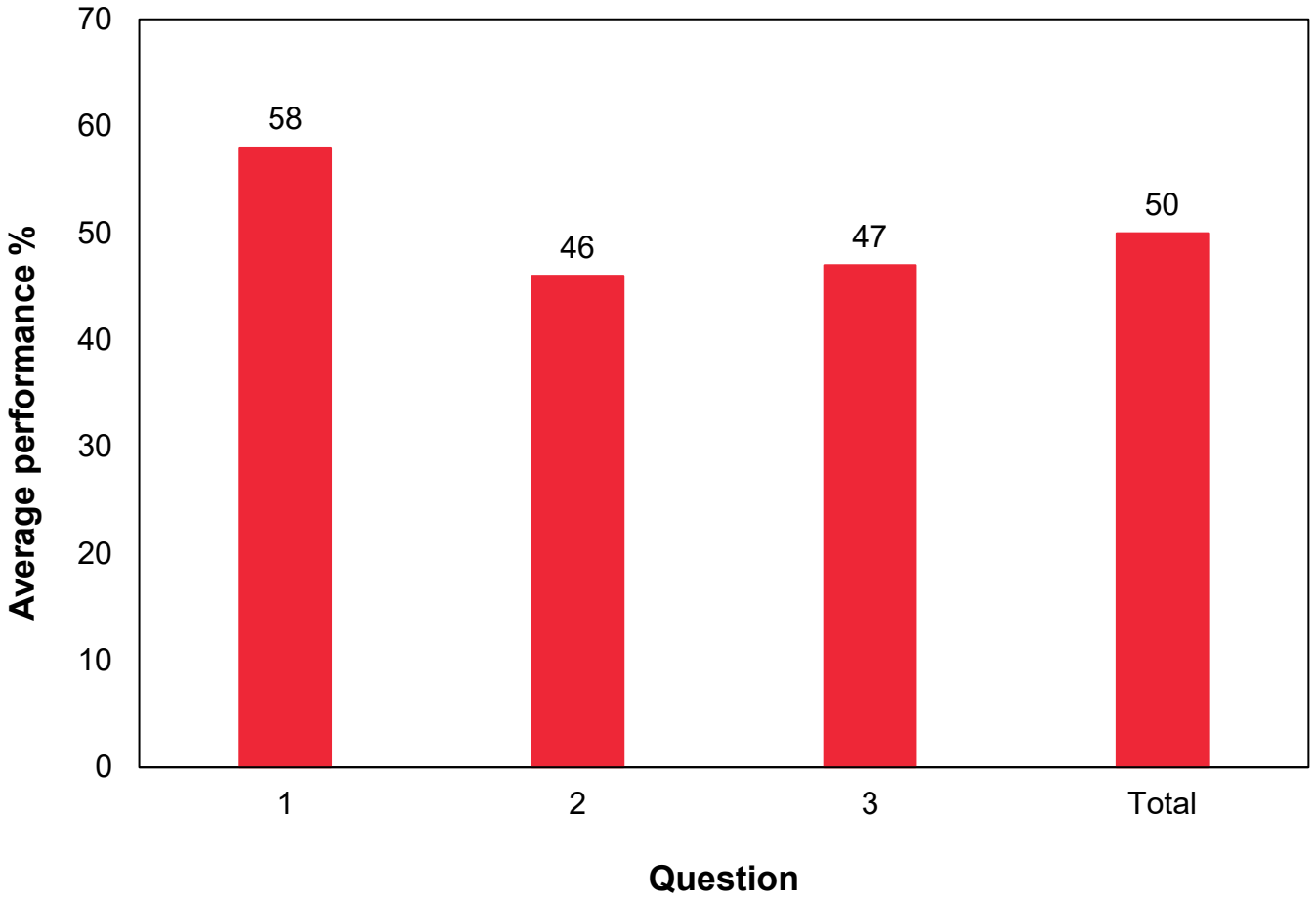
2022 LIFE SCIENCES NSC **PAPER 2**

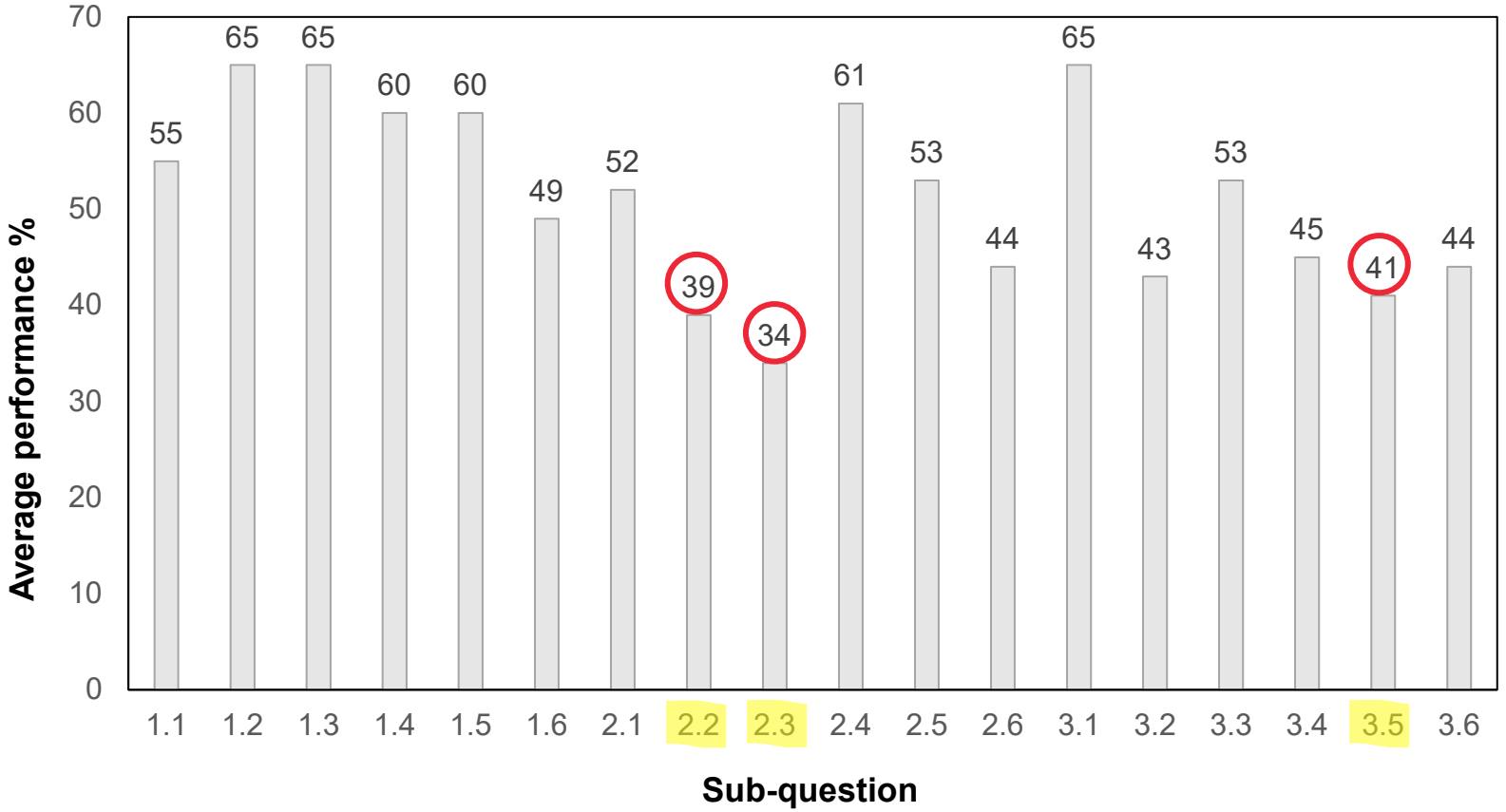
Average performance per question



Question	Topics
1	Multiple choice, Terminology, Matching Items, Pedigree diagram, Karyotype – abnormal meiosis, dihybrid cross
2	Transcription, Mutation on mRNA, Meiosis, Blood groups, DNA profile, Monohybrid cross (sex-linked)
3	Stem cells, Reproductive isolation, Human Evolution, Phylogenetic tree – transitional species and Lamarck, Scientific investigation – Evolution in present times & Natural selection

2022 LIFE SCIENCES NSC **PAPER 2**

Average performance per sub-question



Problem areas

2.2 Mutation on mRNA

2.3 Meiosis

3.5 Evolution (transitional species and Lamarck)

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2022 LIFE SCIENCES NSC **PAPER 2**

General Comments

- ! Correct **spelling** is very important
  - *crossing over*✓ *vs cross over*✖
  - *phylogenetic tree*✓ *vs phylogenic tee*✖
  - *canines*✓ *vs K-9 / K-nines*✖
- ! Emphasise difference between commonly **confused terms**
  - *centrosome vs centriole vs centromere*
  - *homologous chromosomes vs homologous structures*
  - *autosomes vs gonosomes*
  - *gene vs allele*
  - *species vs population*

Let's revise these

- ! Use the **correct genetic notations** given in the paper
  - *look at what is given and do not use your own*
  - *if a disorder is not sex-linked (i.e. autosomal disorder), only one letter is used:*
    - *in **upper case**, e.g. **D** to represent the **dominant allele***
    - *in **lower case**, e.g. **d** to represent the **recessive allele***
  - *if a disorder is sex-linked (i.e. gonosomal disorder), only one letter is written as a superscript on the X-chromosome:*
    - *in **upper case**, e.g. X^D to represent the **dominant allele***
    - *in **lower case**, e.g. X^d to represent the **recessive allele***

*Check out our videos on how to analyse pedigree diagrams for different types of inheritance **here**.*

SECTION A – Multiple Choice

1.1.1 The scientist who discovered the fossil 'Karabo' (*A. sediba*):

A Robert Brown
B Lee Berger
C Raymond Dart
D Ronald Clark

Grade 12 Life Sciences Part 2 p. 120

1.1.2 Which ONE of the following is a source of variation that occurs during normal meiosis?

A Random mating
B Random arrangement of chromosomes
C Chromosomal mutations
D Cloning

Grade 12 Life Sciences Part 2 p. 21

1.1.3 How many sex chromosomes does a normal human female inherit from her mother?

A 1
B 2
C 23
D 46

Grade 12 Life Sciences Part 2 p. 34

1.1.4 During which phase of meiosis does the nuclear membrane disappear?

A Metaphase
B Telophase
C Prophase
D Anaphase

Grade 12 Life Sciences Part 2 p. 16

1.1.5 Which ONE of the following is an example of discontinuous variation in humans?

A Height
B Heart rate
C Gender
D Weight

Grade 12 Life Sciences Part 2 p. 102

SECTION A – Multiple Choice

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B Heart rate
C Gender
D Weight

SECTION A – Multiple Choice

1.1.6 For a particular characteristic, the offspring inherits…

A one allele from the mother and one allele from the father.

B both alleles from the father.

C both alleles from the mother.

D the alleles from either the mother or the father randomly.

Grade 12 Life Sciences Part 2 p. 25

1.1.7 Which ONE of the following is CORRECT for speciation through geographic isolation?

A The populations undergo phenotypic changes only.

B Each population undergoes natural selection independently.

C The conditions on each side of the geographic barrier are the same.

D The new species formed are genotypically the same as the original species.

Grade 12 Life Sciences Part 2 p. 103

1.1.8 Below is a list of events that occurs during cell division.

(i) Homologous chromosomes line up at the equator of the cell.

(ii) Chromatids are pulled to opposite poles of the cell.

(iii) Chromosome pairs arrange themselves randomly at the equator of the cell.

(iv) Individual chromosomes line up at the equator of the cell.

Which ONE of the following combinations occur in both meiosis and mitosis?

A (ii), (iii) and (iv) only

B (i) and (iv) only

C (i), (iii) and (iv) only

D (ii) and (iv) only

Grade 12 Life Sciences Part 2 p. 23

SECTION A – Multiple Choice

1.1.6 For a particular characteristic, the offspring inherits…

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B both alleles from the father.

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Which ONE of the following combinations occur in both meiosis and mitosis?

A (ii), (iii) and (iv) only

B (i) and (iv) only

C (i), (iii) and (iv) only

(D) (ii) and (iv) only

Candidates could not differentiate between the events of meiosis I and mitosis.

SECTION A – Tricky Multiple Choice

1.1.9 A short piece of DNA, containing 19 nucleotides in each strand, was analysed. The number of some of the different nitrogenous bases in each strand is shown below.

	Number of nitrogenous bases			
	A	**T**	**C**	**G**
Strand 1	8	–	–	–
Strand 2	–	8	3	4

How many nucleotides containing Thymine (**T**) were present in strand **1**?

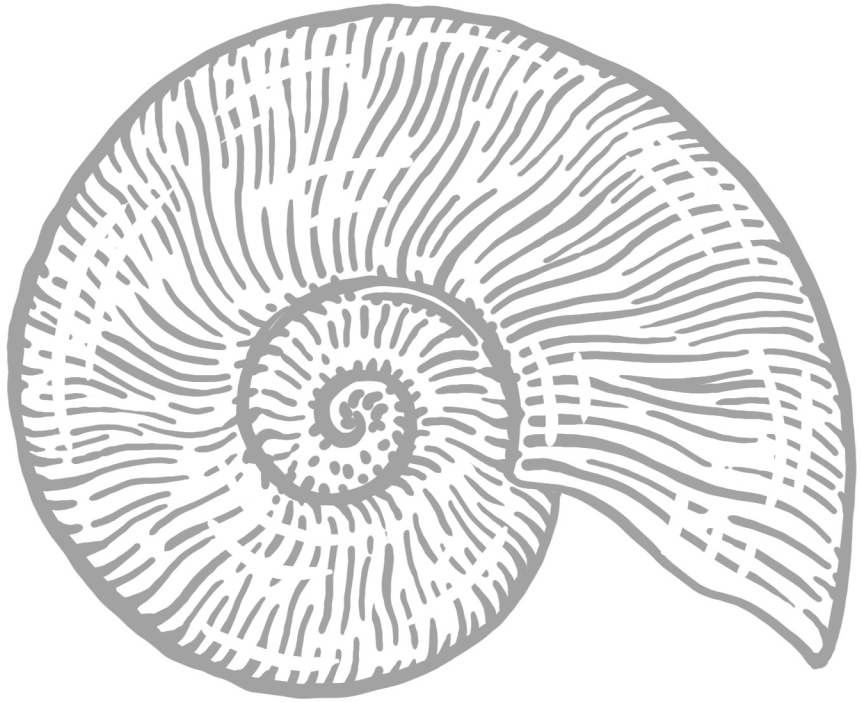
A 8

B 4

C 6

D 2

Grade 12 Life Sciences
Part 2 p. 4



SECTION A – Tricky Multiple Choice

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Strand 1	8	–	–	–
Strand 2	–	8	3	4

How many nucleotides containing Thymine (**T**) were present in strand **1**?

A 8
B 4
C 6
D 2

Candidates failed to read the information in the stem of the question and did not realise that the answer required a calculation based on complementary-base pairing.

Step 1

Note that there should be '**19 nucleotides in each strand**' of this DNA molecule

Step 2

Calculate the number of Adenine (A) bases in strand 2:

$A = 19 - (8 + 3 + 4) = 4$

Step 3

Realise that these are two strands in **ONE DNA molecule**, therefore A and T are complementary.

If there are 4 A's on Strand 2 then there should be 4 T's (Thymine) on Strand 1.

SECTION A – Terminology

Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.9) in the ANSWER BOOK.

1.2.1 The process of change in the characteristics of biological species over time.

1.2.2 The type of bonds between nitrogenous bases in a DNA molecule.

1.2.3 The structure that joins two chromatids of a chromosome.

1.2.4 The division of the cytoplasm of a cell during cell division.

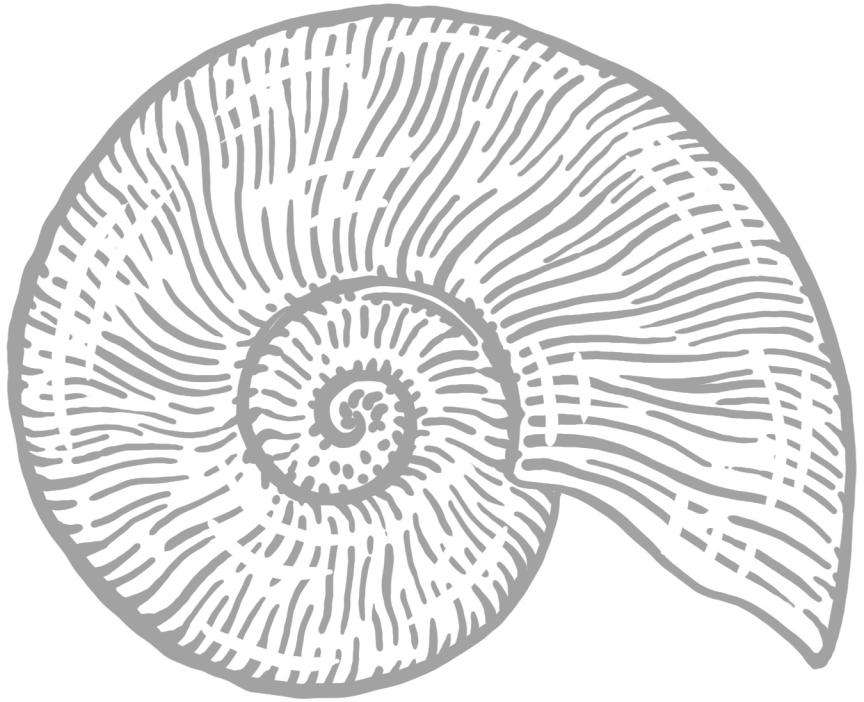
1.2.5 The process during meiosis where there is an exchange of genetic material between chromatids.

1.2.6 The structures in animal cells that give rise to spindle fibres during cell division.

1.2.7 Similar structures that are inherited from a common ancestor and are modified for different functions.

1.2.8 The phase in the cell cycle during which DNA replication takes place.

1.2.9 The organelle where translation occurs during protein synthesis.



SECTION A – Terminology

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Give the correct **biological term** for each of the following descriptions. Write only the term next to the question number (1.2.1 to 1.2.9) in the ANSWER BOOK.

		Memorandum	Common misconceptions & Errors
1.2.1	The process of change in the characteristics of biological species over time.	evolution✓	
1.2.2	The type of bonds between nitrogenous bases in a DNA molecule.	hydrogen✓ bonds	
1.2.3	The structure that joins two chromatids of a chromosome.	centromere✓	Provided *centrosome* ✗ / *centriole* ✗
1.2.4	The division of the cytoplasm of a cell during cell division.	cytokinesis✓	
1.2.5	The process during meiosis where there is an exchange of genetic material between chromatids.	crossing over✓	
1.2.6	The structures in animal cells that give rise to spindle fibres during cell division.	centrosomes✓/centrioles	Provided *centromere* ✗
1.2.7	Similar structures that are inherited from a common ancestor and are modified for different functions.	homologous✓structures	Provided *homologous chromosomes*✗ / *analogous structures*✗ / *modification by descent* ✗
1.2.8	The phase in the cell cycle during which DNA replication takes place.	interphase✓	
1.2.9	The organelle where translation occurs during protein synthesis.	ribosome✓	Provided *cytoplasm* ✗ (the site of translation)

SECTION A – Item/statement columns

Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
1.3.1	Type of evolution characterised by long periods of little or no change alternating with short periods of rapid change	A: Artificial selection B: Punctuated equilibrium
1.3.2	A plant with white flowers that is crossed with a plant with red flowers and produces offspring with pink flowers	A: Incomplete dominance B: Complete dominance
1.3.3	The separation of alleles during gamete formation	A: Law of Dominance B: Principle of Segregation

Grade 12 Life Sciences Part 2 p. 98

Grade 12 Life Sciences Part 2 p. 30

Grade 12 Life Sciences Part 2 p. 27

SECTION A – Item/statement columns

Indicate whether each of the descriptions in COLUMN I apply to **A ONLY**, **B ONLY**, **BOTH A AND B** or **NONE** of the items in COLUMN II. Write **A only**, **B only**, **both A and B** or **none** next to the question number (1.3.1 to 1.3.3) in the ANSWER BOOK.

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1.3.3	The separation of alleles during gamete formation	A: Law of Dominance B: Principle of Segregation

Memorandum

B only✓✓

A only✓✓

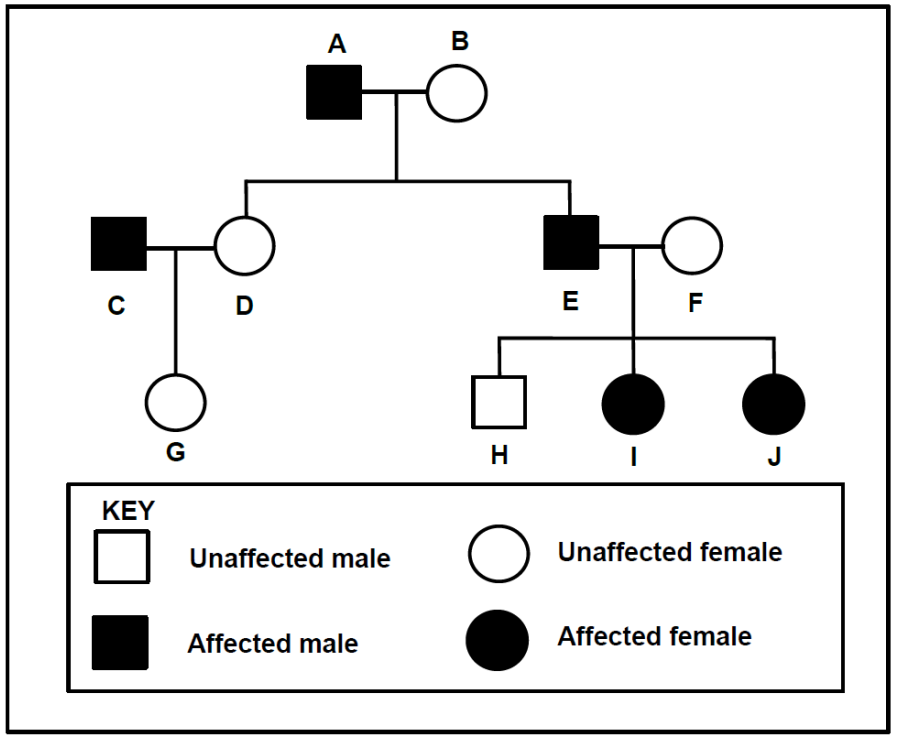
B only✓✓

Common misconceptions & Errors

SECTION A – Pedigree diagram

1.4 Moyamoya is a disorder caused by a dominant allele (R). This disorder damages the arteries supplying blood to the brain.

The pedigree diagram shows the inheritance of Moyamoya in a family.



1.4.1 How many generations are represented in the diagram?

1.4.2 Give the:

(a) LETTER(S) of unaffected males

(b) Genotype of individual **A**

(c) LETTER(S) of individuals not biologically related to **A** and **B**

Common misconceptions & Errors

SECTION A – Pedigree diagram

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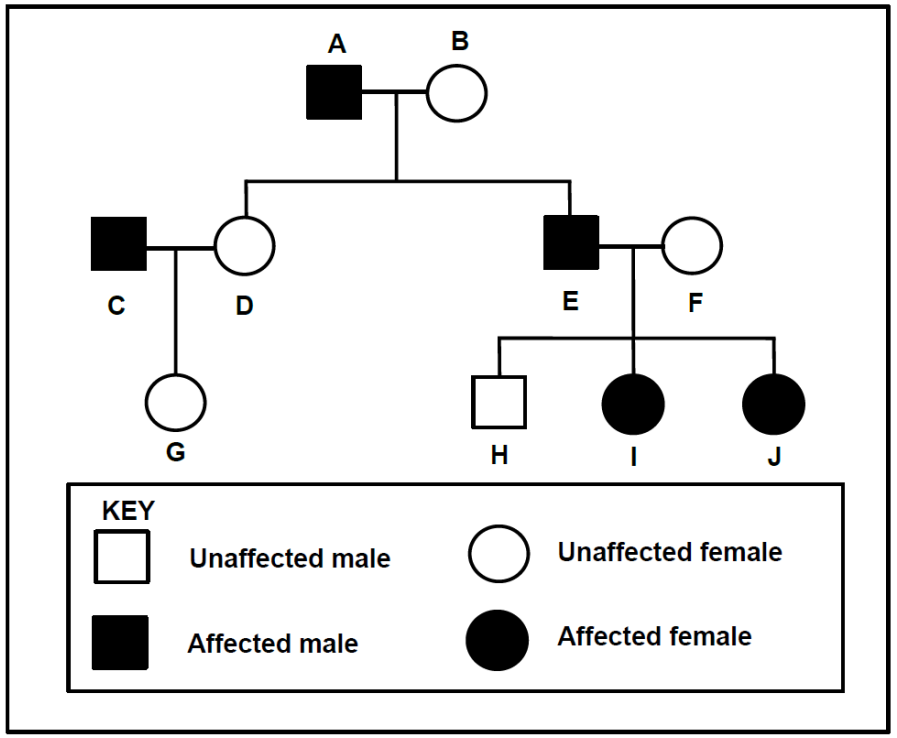


1.4.1 How many generations are represented in the diagram?

3/three✓ (1)

1.4.2 Give the:

(a) LETTER(S) of unaffected males H✓ (1)

(b) Genotype of individual **A** Rr✓ (1)

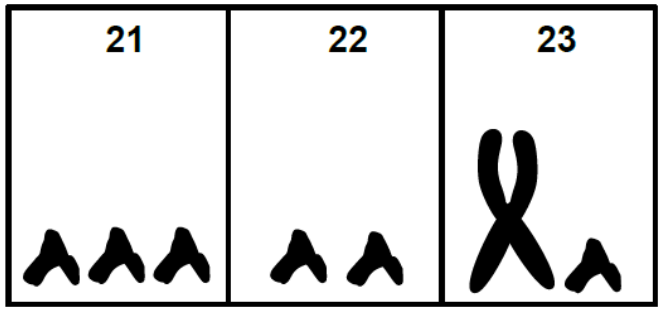
(c) LETTER(S) of individuals not biologically related to **A** and **B** C ✓ and F✓ (2)

Common misconceptions & Errors

1.4.2 (b) Candidates incorrectly provided the format required for a sex-linked trait (e.g. X^RX^r) and not the correct format for an autosomal trait (Rr).

SECTION A – Karyotype (abnormal meiosis)

1.5 The diagram represents part of an abnormal human karyotype.



1.5.1 How many autosomes are shown in the diagram?

1.5.2 Name the type of chromosomes represented by pair **23**.

1.5.3 Name the:

(a) Disorder represented in the diagram

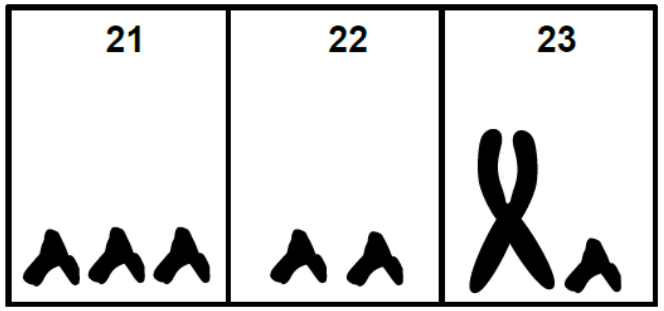
(b) Process during anaphase of meiosis that resulted in the abnormal number of chromosomes in this karyotype

1.5.4 State the gender of the person represented in this karyotype.

Common misconceptions & Errors

SECTION A – Karyotype (abnormal meiosis)

1.5 The diagram represents part of an abnormal human karyotype.



1.5.1 How many autosomes are shown in the diagram?

5/five✓ (1)

1.5.2 Name the type of chromosomes represented by pair **23**.

gonosomes/sex chromosomes✓ (1)

1.5.3 Name the:

(a) Disorder represented in the diagram Down syndrome/Trisomy 21✓ (1)

(b) Process during anaphase of meiosis that resulted in the abnormal number of chromosomes in this karyotype

non-disjuction✓ (1)

1.5.4 State the gender of the person represented in this karyotype.

male✓ (1)

Common misconceptions & Errors

1.5.1 & 1.5.2 Candidates could not differentiate between autosomes and gonosomes.

1.5.3 Candidates confused the disorder (Down syndrome) with the process that causes it (non-disjunction).

SECTION A – Dihybrid cross

1.6 In rabbits, brown fur (**B**) is dominant to white fur (**b**) and long ears (**E**) is dominant to short ears (**e**).

A rabbit, that is heterozygous for both characteristics, is crossed with a white rabbit with short ears.

1.6.1 Name the type of cross represented.

1.6.2 Give the:

(a) Phenotype of a rabbit that is dominant for both characteristics

(b) Genotype of the white rabbit with short ears

(c) Genotype of the gametes of a heterozygous brown rabbit with short ears

Common misconceptions & Errors

SECTION A – Dihybrid cross

1.6 In rabbits, brown fur (**B**) is dominant to white fur (**b**) and long ears (**E**) is dominant to short ears (**e**).

A rabbit, that is heterozygous for both characteristics, is crossed with a white rabbit with short ears.

1.6.1 Name the type of cross represented. Dihybrid ✓ cross (1)

1.6.2 Give the:

(a) Phenotype of a rabbit that is dominant for both characteristics

Brown ✓ fur and long ears ✓ (2)

(b) Genotype of the white rabbit with short ears

bbee ✓✓ (2)

(c) Genotype of the gametes of a heterozygous brown rabbit with short ears

Be ✓ be ✓ (2)

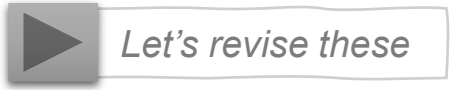
Common misconceptions & Errors

1.6.2 (a) Candidates did not write the phenotype correctly. They only wrote 'brown' or 'long' and not full descriptions, e.g. 'brown fur' and 'long ears'.

1.6.2 (c) Candidates confused the genotype of an individual with the genotype of a gamete.

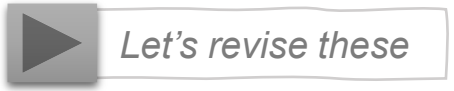
They failed to leave space between the alleles to show that they are separated into the gametes.

SECTION A – Suggestions for improvement

☑ Highlight the events that occur during meiosis I and II as well as the differences between the two divisions. 

☑ Do more exercises on dihybrid crosses.

- *Emphasise differences in writing the genotype of an organism and the genotype of gametes.*

☑ Teach abnormal meiosis with a karyotype. 

- *Emphasise that Down syndrome is a consequence of non-disjunction.*

☑ Pronounce words clearly and practice spelling them correctly.

SECTION B – Transcription

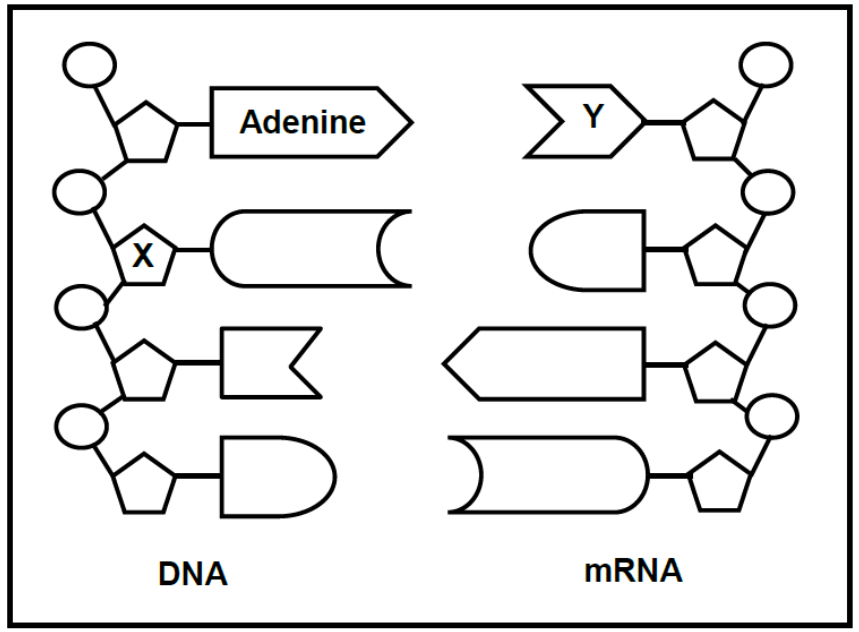
2.1 The diagram represents transcription during protein synthesis.

2.1.1 Name the part of the cell where this process occurs.

2.1.2 Identify:

(a) Sugar **X**

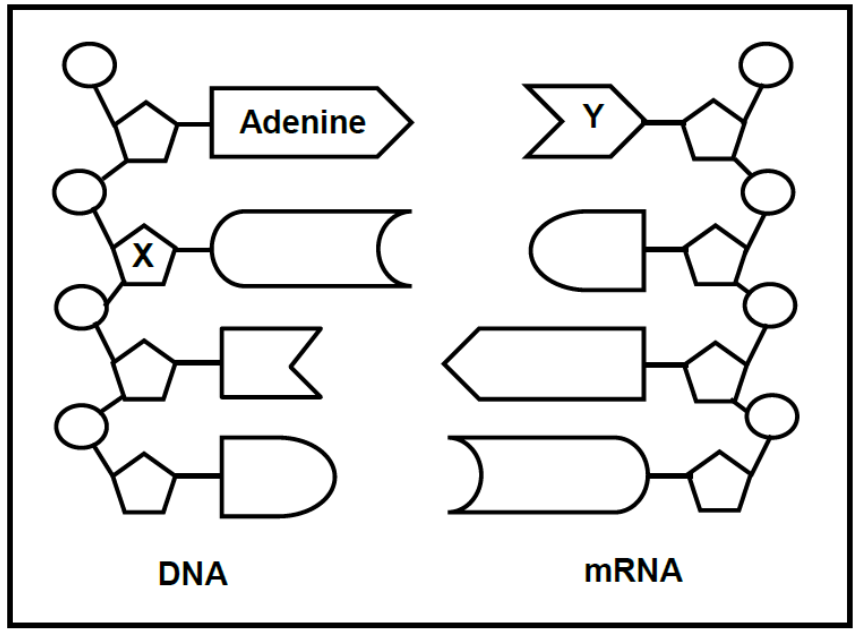
(b) Nitrogenous base **Y**



Common misconceptions & Errors

SECTION B – Transcription

2.1 The diagram represents transcription during protein synthesis.



2.1.1 Name the part of the cell where this process occurs.

Nucleus✓/nucleoplasm (1)

2.1.2 Identify:

(a) Sugar **X**

deoxyribose✓ (1)

(b) Nitrogenous base **Y**

Uracil✓/U (1)

Common misconceptions & Errors

SECTION B – Transcription

2.1 The diagram represents transcription during protein synthesis.

2.1.3 Tabulate TWO differences between *transcription* and *DNA replication*.

Common misconceptions & Errors

SECTION B – Transcription

2.1 The diagram represents transcription during protein synthesis.

2.1.3 Tabulate TWO differences between *transcription* and *DNA replication*.

TRANSCRIPTION	DNA REPLICATION
Only one strand acts as a template✓	Both strands act as templates✓
(Free) RNA nucleotides✓ are complementary	(Free) DNA nucleotides✓ are complementary
Adenine complements uracil✓/ (A complements U)	Adenine pairs with thymine✓/ (A pairs with T)
A mRNA molecule is formed✓	Two identical DNA molecules are formed✓
Only a short section of DNA✓ is used	The whole DNA molecule✓ is used
DNA unwinds and unzips partially✓	DNA unwinds and unzips completely✓

(Mark only first TWO) = 1 mark for table + any 2 x 2 (5)

Common misconceptions & Errors

2.1.3 Candidates did not present answers in a table format.

They wrote out the whole process and did not extract differences.

They gave differences for DNA and RNA.

SECTION B – Mutation on mRNA

2.2 A mutation has occurred on a section of an mRNA molecule as shown below.

Original sequence	AUG GAA AUA CCG CCA GGA
Mutated sequence	AUG GAA AUA CUG CCA GGA

2.2.1 Name the type of mutation that has occurred.

2.2.2 Give a reason for your answer in QUESTION 2.2.1.

Common misconceptions & Errors

SECTION B – Mutation on mRNA

2.2 A mutation has occurred on a section of an mRNA molecule as shown below.

Original sequence	AUG GAA AUA CCG CCA GGA
Mutated sequence	AUG GAA AUA CUG CCA GGA

2.2.1 Name the type of mutation that has occurred.

Gene✓ mutation (1)

2.2.2 Give a reason for your answer in QUESTION 2.2.1.

There is a change in the sequence (of nitrogenous bases) from CCG to CUG✓ (1)

Common misconceptions & Errors

2.2.1 Candidates referred to a genetic mutation instead of a gene mutation or stated causes of gene mutations, e.g. point mutation, which did not receive marks.

SECTION B – Mutation on mRNA

2.2 A mutation has occurred on a section of an mRNA molecule as shown below.

Original sequence	AUG GAA AUA CCG CCA GGA
Mutated sequence	AUG GAA AUA CUG CCA GGA

2.2.3 The table below shows some mRNA codons and amino acids that they code for.

mRNA codon	Amino acid
AUA	Isoleucine
AUG	Methionine
CCA	Proline
CCG	Proline
CUG	Leucine
GAA	Glutamic acid
GGA	Glycine

(a) State the number of different amino acids coded for by the original sequence of the mRNA molecule given above.

(b) Give the anticodon on the tRNA molecule that carries the amino acid isoleucine.

(c) Use information in the table to describe the effect of the mutation on the protein formed.

Common misconceptions & Errors

SECTION B – Mutation on mRNA

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CCG	Proline
CUG	Leucine
GAA	Glutamic acid
GGA	Glycine

(a) State the number of different amino acids coded for by the original sequence of the mRNA molecule given above.

5/Five✓ (1)

(b) Give the anticodon on the tRNA molecule that carries the amino acid isoleucine.

UAU✓ (1)

(c) Use information in the table to describe the effect of the mutation on the protein formed.

- The codon CCG changed to CUG✓/ 4th codon changed
- The anticodon/tRNA sequence changed✓
- The amino acid proline✓
- was replaced by leucine✓
- This resulted in a different protein✓/no protein being formed (any 4)

Common misconceptions & Errors

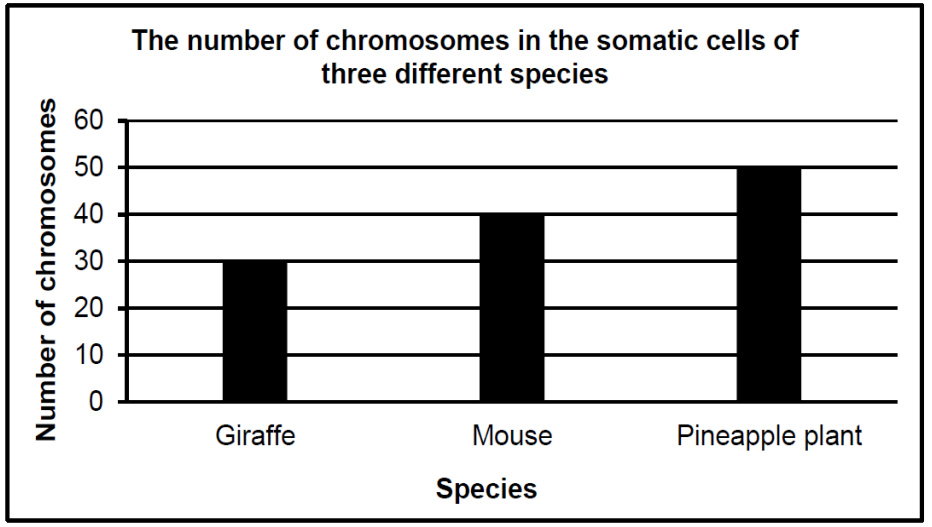
2.2.3 (a) Candidates incorrectly wrote 6. They counted the number of amino acids but did not exclude the ones that are repeated.

2.2.3 (c) Candidates gave general answers, not specific to the question. Instead of describing the exact change and position of the mutation that occurred in the codon/ anticodon, they generalised without referring to the specific codons/ anticodons.

They also did not specify the amino acids that changed.

SECTION B – Meiosis

2.3 The number of chromosomes in the somatic cells of organisms differs from species to species.
The graph shows the number of chromosomes in each somatic cell of THREE different species.



2.3.1 How many chromosomes will be present in :

(a) Mouse cells during Telophase II of meiosis

(b) A leaf cell of a pineapple plant

2.3.2 Explain why a sperm cell of a giraffe has 15 chromosomes.

Common misconceptions & Errors

SECTION B – Meiosis

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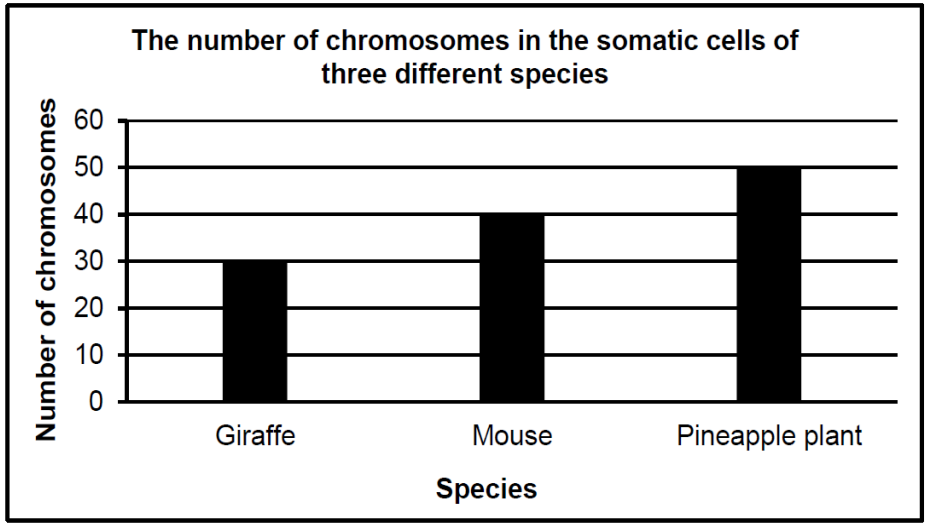


2.3.1 How many chromosomes will be present in :

(a) Mouse cells during Telophase II of meiosis 20✓ (1)

(b) A leaf cell of a pineapple plant 50✓ (1)

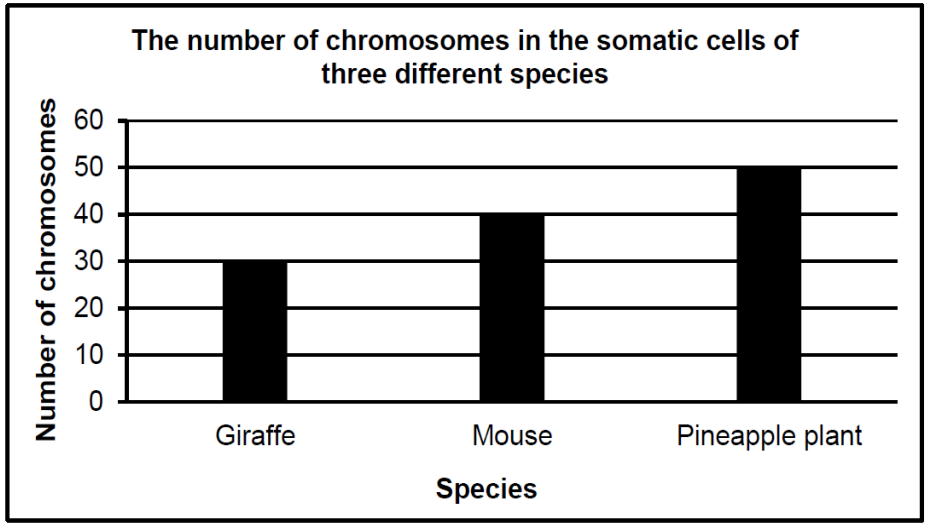
2.3.2 Explain why a sperm cell of a giraffe has 15 chromosomes.

- A sperm cell is a gamete✓
- formed by meiosis✓
- and must be haploid✓
- to overcome the doubling effect of fertilisation✓ (4)

Common misconceptions & Errors

2.3.2 Candidates incorrectly stated that the gamete or sperm cell underwent meiosis rather than diploid cells underwent meiosis to form the sperm.

2.3 The number of chromosomes in the somatic cells of organisms differs from species to species.
The graph shows the number of chromosomes in each somatic cell of THREE different species.



2.3.3 Name the phase of meiosis where the halving of the chromosome number begins.

2.3.4 Describe the events in the phase named in QUESTION 2.3.3.

Common misconceptions & Errors

SECTION B – Meiosis

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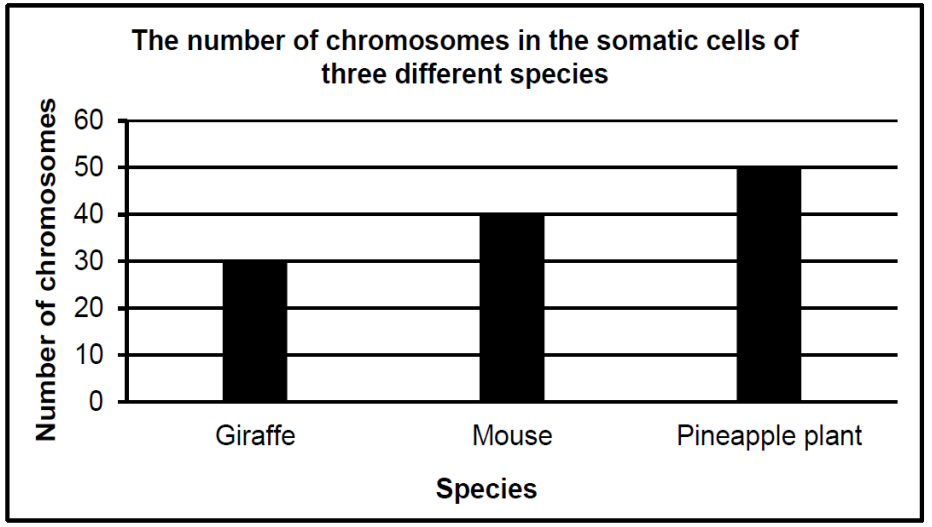


2.3.3 Name the phase of meiosis where the halving of the chromosome number begins.

Anaphase I✓ (1)

2.3.4 Describe the events in the phase named in QUESTION 2.3.3.

- Spindle fibres shorten/contract✓
- chromosome pairs separate✓ and
- move to the opposite poles✓ (3)

Common misconceptions & Errors

2.3.4 Candidates wrote that chromosomes were pulled to opposite poles without indicating that the homologous pairs first separate and are only then moved to opposite poles.

Some also wrote that spindle fibers 'constrict' instead of 'contract'.

SECTION B – Blood groups

2.4 The table shows information about blood groups in a certain population.

BLOOD GROUP	NUMBER OF PEOPLE	PERCENTAGE OF THE POPULATION
O	954 000	53
A	**X**	34
B	180 000	10
AB	54 000	3

2.4.1 How many people have the genotype ii?

2.4.2 The population size is 1 800 000. Calculate the value of **X**. Show ALL working.

2.4.3 Describe how a child inherits the blood group represented by 3 percent of this population.

Common misconceptions & Errors

SECTION B – Blood groups

2.4 The table shows information about blood groups in a certain population.

BLOOD GROUP	NUMBER OF PEOPLE	PERCENTAGE OF THE POPULATION
O	954 000	53
A	X	34
B	180 000	10
AB	54 000	3

2.4.1 How many people have the genotype ii? 954 000✓ (1)

2.4.2 The population size is 1 800 000. Calculate the value of **X**. Show ALL working.

1 800 000✓ – (954 000 + 180 000 + 54 000)✓ = 612 000✓ people

OR

34/100✓ x 1 800 000✓ = 612 000✓ people (3)

2.4.3 Describe how a child inherits the blood group represented by 3 percent of this population.

- The allele for blood group A/I^A is inherited from one parent✓ and
- the allele for blood group B/I^B is inherited from the other parent✓ therefore
- the child has blood group AB✓/genotype I^AI^B (3)

Common misconceptions & Errors

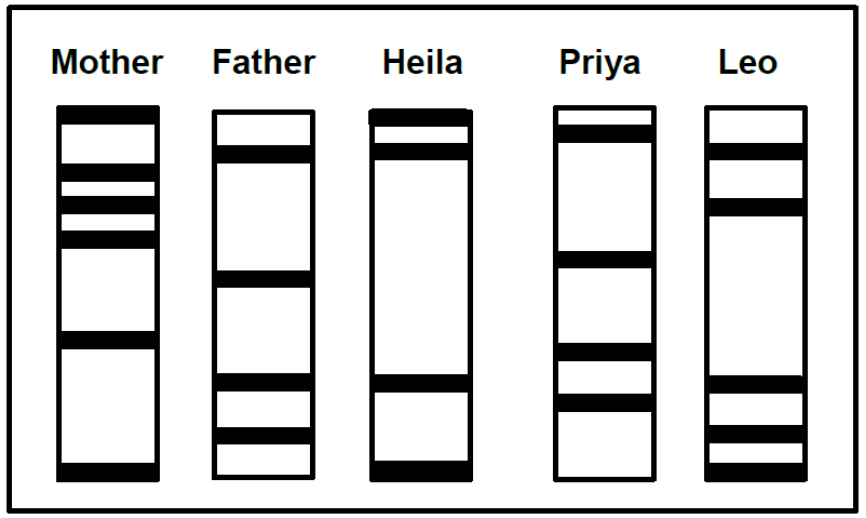
2.4.3 Candidates could not distinguish between alleles and genes and were not familiar with the concept of multiple alleles.

They could identify that the child was blood group AB, but failed to describe how this is inherited.

They incorrectly stated that the 'child inherited blood group A from the mother' instead of the correct phrasing, i.e. the 'child inherited the allele (I^A) for blood group A from the mother'.

SECTION B – DNA profiling

2.5 The diagram represents the DNA profiles of three children and their parents. Only two children are their biological children and one is adopted.



2.5.1 Identify the TWO biological children.

2.5.2 Explain your answer in QUESTION 2.5.1.

2.5.3 State THREE other uses of DNA profiling.

Common misconceptions & Errors

SECTION B – DNA profiling

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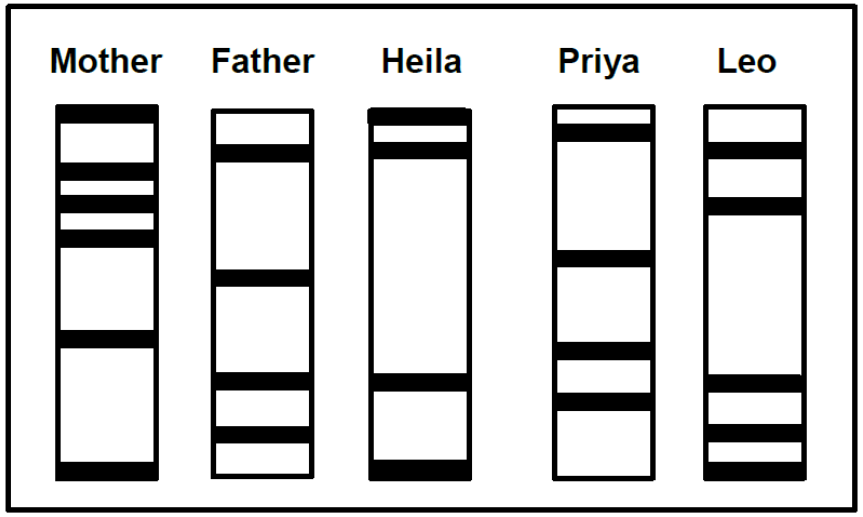

2.5.1 Identify the TWO biological children.

Heila✓ and
Leo✓ (first 2 only)

2.5.2 Explain your answer in QUESTION 2.5.1.

- All of the (DNA) bands from Heila and Leo✓
- match with the (DNA) bands of the mother and the father✓ OR
- None of the (DNA) bands from Priya✓
- match with the (DNA) bands of the mother and the father✓ (2)

2.5.3 State THREE other uses of DNA profiling.

- Tracing missing persons✓
- Identification of genetic disorders✓
- Identification of suspects in a crime✓
- Matching tissues for organ transplants✓
- Identifying dead persons✓ (any 3; first 3 only)

Common misconceptions & Errors

2.5.2 Candidates incorrectly wrote that the 'DNA matched' instead of saying that the 'DNA profile/bands of the children matched with that of the parents'.

2.5.3 Candidates could not give other uses of DNA profiling that are not in the question.

Candidates gave incorrect descriptions, e.g. 'develop cures for genetic disorders' instead of 'identifying genetic disorders'
OR
'to identify criminals/solve crimes' instead of 'to identify suspects in a crime'
OR
'organ transplants' instead of 'identification of matching tissues for organ transplants'

SECTION B – Monohybrid cross (Sex-linked)

2.6 Brown enamel of the teeth is a sex-linked trait. A dominant allele on the **X** chromosome causes brown teeth in humans.

2.6.1 Explain why more males than females have white teeth.

2.6.2 A man with brown teeth married a woman with white teeth.

Use a genetic cross to show the possible phenotypic ratios of their children.
Use X^B for brown teeth and X^b for white teeth.

Common misconceptions & Errors

SECTION B – Monohybrid cross (Sex-linked)

2.6 Brown enamel of the teeth is a sex-linked trait. A dominant allele on the **X** chromosome causes brown teeth in humans.

2.6.1 Explain why more males than females have white teeth.

- Males have only one X chromosome✓/The Y-chromosome does not have this allele and
- have to inherit only one recessive allele✓ to have white teeth
- whereas females have two X chromosomes✓ and have to
- inherit two recessive alleles to have white teeth ✓ (4)

2.6.2 A man with brown teeth married a woman with white teeth.

Use a genetic cross to show the possible phenotypic ratios of their children.
Use X^B for brown teeth and X^b for white teeth.

Continue next slide…

Common misconceptions & Errors

2.6.1 Candidates could not deduce that 'white teeth' was caused by a recessive allele because 'brown teeth' was caused by a dominant allele.

SECTION B – Monohybrid cross (Sex-linked)

THE ANSWER SERIES Your Key to Exam Success

2.6 Brown enamel of the teeth is a sex-linked trait. A dominant allele on the **X** chromosome causes brown teeth in humans.

2.6.2 A man with brown teeth married a woman with white teeth.

Use a genetic cross to show the possible phenotypic ratios of their children. Use X^B for brown teeth and X^b for white teeth.

P_1 **Phenotype** Male with brown teeth x Female with white teeth ✓

Genotype X^BY x X^bX^b ✓

Meiosis

Gametes X^B ; Y x X^b ; X^b ✓

Fertilisation

✓

✓ **Correct gametes**

Gametes	X^B	Y
X^b	X^BX^b	X^bY
X^b	X^BX^b	X^bY

✓ **correct genotypes**

F_1 **Phenotype** 1 female with brown teeth : 1 male with white teeth ✓*

*1 compulsory mark + any 5 (6)

Common misconceptions & Errors

2.6.2 Candidates did not write complete phenotypes in the monohybrid cross, i.e.

brown teeth x white teeth

instead of

male with brown teeth x female with white teeth

Candidates made up their own genetic notations, e.g. X^D and did not stick to the annotation given.

They gave the phenotypic ratio as 2:2 instead of the most simplified version **1:1.**

SECTION B – Monohybrid cross (Sex-linked)

THE ANSWER SERIES Your Key to Exam Success

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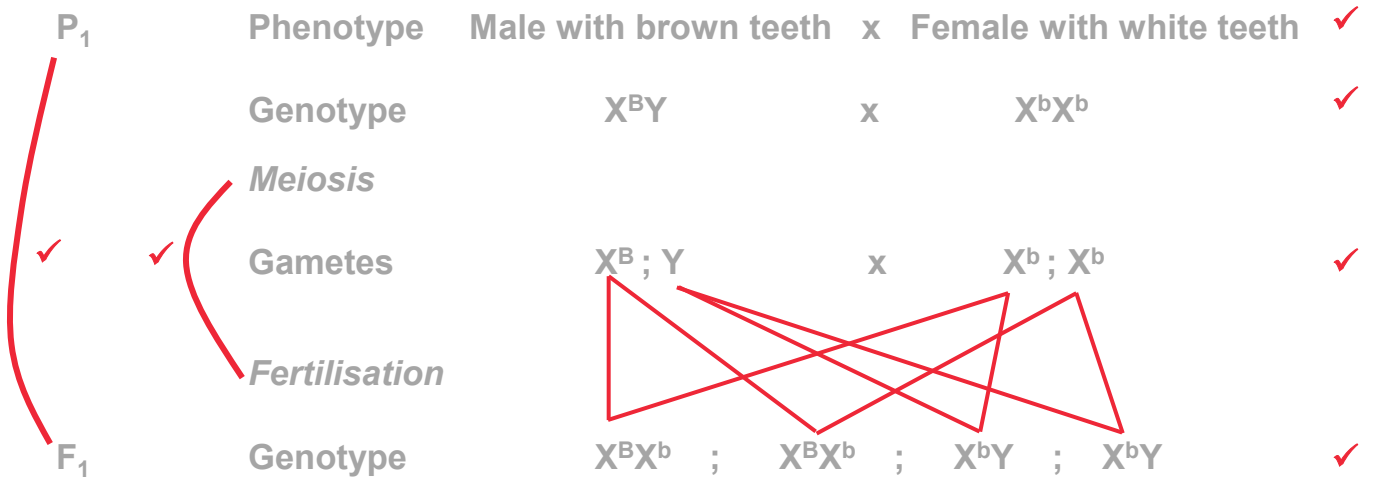

*1 compulsory mark + any 5 (6)

Common misconceptions & Errors

2.6.2 Candidates did not write complete phenotypes in the monohybrid cross, i.e.

brown teeth x white teeth

instead of

male with brown teeth x female with white teeth

Candidates made up their own genetic notations, e.g. X^D and did not stick to the annotation given.

They gave the phenotypic ratio as 2:2 instead of the most simplified version **1:1.**

SECTION B QUESTION 2 – Suggestions for improvement

- ☑ Practice how to do base-pairing in protein synthesis forwards and backwards:
  - *Forwards: DNA (nitrogenous bases) → mRNA (codons) → tRNA (anticodon) → amino acids*
  - *Backwards: Amino acids → tRNA (anticodon) → mRNA (codon) → DNA (nitrogenous bases)*
- ☑ Teach only chromosome and gene mutations. No further details (e.g. point/frame shift) is required.
- ☑ More practice on sex-lined inheritance where dominant/recessive alleles are involved.
- ☑ Review the haploid and diploid status of cells.
- ☑ Use the correct terminology when interpreting DNA profiles

  - *bands or bars* NOT *lines or barcodes*
  - *For paternity tests, each band on the child's DNA profile must match with a band on either the mother's or the father's profile*
  - *For criminal cases, all the bands on the evidence sample must match that of the suspect (they remain a suspect until proven guilty in a court of law)*

SECTION B QUESTION 2 – Suggestions for improvement

- ☑ When asked why males/females have more/less of a specific trait, the gonosomes or the recessive/dominant allele must be used in the explanation.
- ☑ Always use the genetic notation given in the question and do not make up your own.
- ☑ When discussing inheritance of traits, remember that we inherit *alleles* and not *genes*. Ensure that learners understand the general format of how to answer genetics questions.

SECTION B – Stem cells

3.1 Read the extract below.

> When a child is born, the umbilical cord is cut and stem cells can be obtained from it. Many people think that the stem cells for treating human conditions should be obtained from umbilical cords, rather than from human embryos.
>
> Recently, stem cells have also been obtained from bone marrow. These stem cells are used to treat conditions such as heart disease and spinal injuries.

3.1.1 Name THREE sources of stem cells mentioned in the extract.

3.1.2 Explain why the characteristics of stem cells make them useful for treating some disorders.

3.1.3 Name ONE condition in the extract that can be treated with stem cells.

Common misconceptions & Errors

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>
> Recently, stem cells have also been obtained from bone marrow. These stem cells are used to treat conditions such as heart disease and spinal injuries.

3.1.1 Name THREE sources of stem cells mentioned in the extract.

- embryos✓
- umbilical cord✓
- bone marrow✓ (any 3; first 3 only)

3.1.2 Explain why the characteristics of stem cells make them useful for treating some disorders.

- Stem cells are undifferentiated✓
- and have the potential to develop into any type of cell✓
- to replace affected/defective cells✓ causing a disorder (any 2)

3.1.3 Name ONE condition in the extract that can be treated with stem cells.

- Heart disease✓
- Spinal injuries✓ (any 1; first 1 only)

Common misconceptions & Errors

3.1.1 Candidates could not extract information from the text.

3.1.2 Candidates incorrectly referred to using stem cells for 'replacing organs' instead of 'replacing cells/tissues'.

SECTION B – Species, population & reproductive isolation

3.2 Read the extract below.

> Samango and vervet are two species of monkeys that occupy the same habitat. Researchers have recently discovered that a population of samango monkeys were able to interbreed with vervet monkeys to produce offspring. These offspring were infertile.

3.2.1 Define the term *population*.

3.2.2 Give ONE reason why samango and vervet monkeys are considered to be two different species.

3.2.3 List THREE mechanisms of reproductive isolation that are NOT mentioned above.

Common misconceptions & Errors

SECTION B – Species, population & reproductive isolation

3.2 Read the extract below.

> Samango and vervet are two species of monkeys that occupy the same habitat. Researchers have recently discovered that a population of samango monkeys were able to interbreed with vervet monkeys to produce offspring. These offspring were infertile.

3.2.1 Define the term *population*.

- A group of organisms of the same species✓
- occupying the same habitat✓
- at the same time✓ (3)

3.2.2 Give ONE reason why samango and vervet monkeys are considered to be two different species.

They produce infertile offspring✓ (only first 1)

3.2.3 List THREE mechanisms of reproductive isolation that are NOT mentioned above.

- Breeding at different times of the year✓
- Species-specific courtship behaviour✓
- Adaptation to different pollinators✓
- Prevention of fertilisation✓ (any 3; first 3 only)

Common misconceptions & Errors

3.2.1 Candidates failed to give all three parts of the definition of a population and confused this definition with that of a species / community.

3.2.3 Candidates lost marks for describing examples of reproductive isolation instead of listing mechanisms of reproductive isolation.

SECTION B– Human evolution

3.3 Scientists find evidence for human evolution by comparing humans to other hominids. The upper limbs of humans and African apes show similar characteristics, whereas there are differences between the dentition (teeth) of the two.

3.3.1 Why do scientists look for similarities between humans and African apes?

3.3.2 Explain the importance of the positioning of the thumbs for humans and African apes.

3.3.3 State ONE difference between the teeth of humans and African apes.

Common misconceptions & Errors

SECTION B– Human evolution

3.3 Scientists find evidence for human evolution by comparing humans to other hominids. The upper limbs of humans and African apes show similar characteristics, whereas there are differences between the dentition (teeth) of the two.

3.3.1 Why do scientists look for similarities between humans and African apes?

- To show a possible common ancestor✓
- To identify trends in evolution✓ (any 1)

3.3.2 Explain the importance of the positioning of the thumbs for humans and African apes.

- Both have opposable thumbs✓
- to allow for a power grip✓/precision grip/any example thereof (2)

3.3.3 State ONE difference between the teeth of humans and African apes.

- Humans have smaller teeth✓/canines whereas African apes have larger teeth✓/canines

OR

- There are no gaps✓/diastema between the teeth in humans whereas African apes have gaps✓/diastema between the teeth

(any 1 x 2; first 1 only)

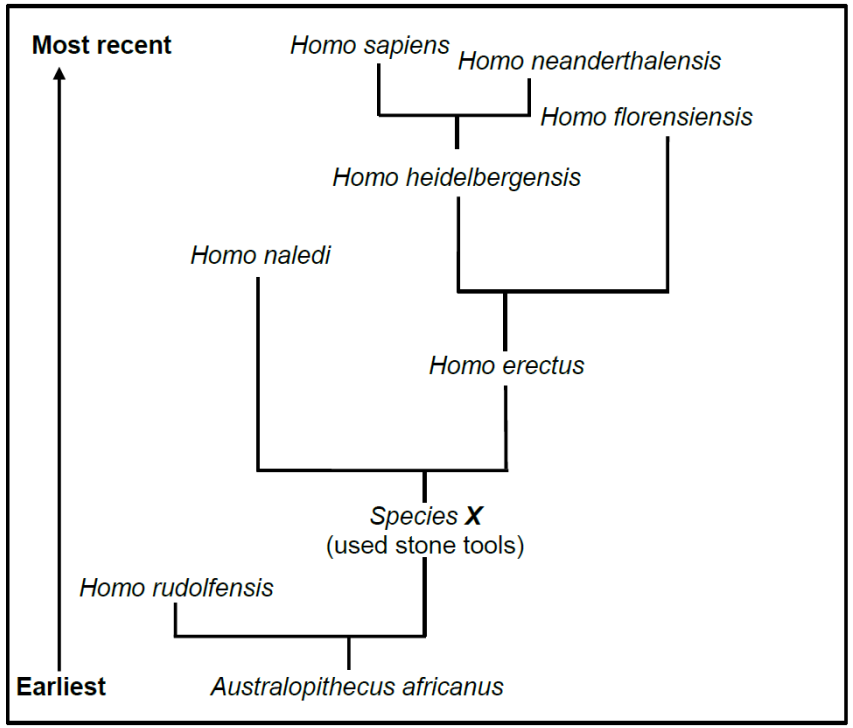
Common misconceptions & Errors

3.3.1 Candidates incorrectly wrote to 'share a common ancestor' instead of 'to show a common ancestor'.

3.3.2 Candidates incorrectly stated that opposable thumbs are for 'holding things' rather than 'providing a power grip' or 'a precision grip'.

SECTION B – Phylogenetic tree

3.4 The diagram represents a model of the evolution of some hominids.



3.4.1 Identify the type of diagram shown.

3.4.2 How many genera are represented by the diagram?

3.4.3 Name the species:

(a) Represented by **X** on the diagram

(b) That shares a common ancestor with *Homo erectus*

3.4.4 Which species of the genus *Homo* is the only one in existence today?

Common misconceptions & Errors

SECTION B – Phylogenetic tree

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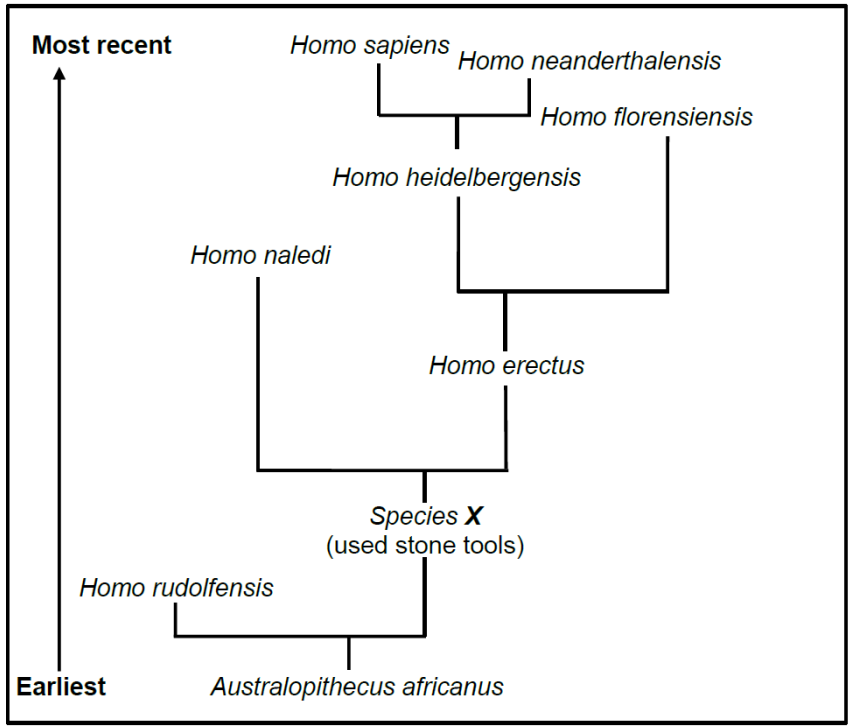

3.4.1 Identify the type of diagram shown.

Phylogenetic tree✓/ cladogram (1)

3.4.2 How many genera are represented by the diagram?

2✓/Two (1)

3.4.3 Name the species:

(a) Represented by **X** on the diagram

Homo habilis✓ (1)

(b) That shares a common ancestor with *Homo erectus*

(Homo) naledi✓ (1)

3.4.4 Which species of the genus *Homo* is the only one in existence today?

(Homo) sapiens✓ (1)

Common misconceptions & Errors

3.4.1 Candidates could not spell 'phylogenetic tree'. Marks were not awarded for 'polygenetic tree' or 'phylogenic tree'.

3.4.2 Candidates did not know the difference between a 'genus' and a 'species'. They counted the number of species instead of counting the genera. Many did not know that 'genera' is the plural of 'genus'.

3.4.4 Candidates only wrote the species name instead of the full scientific name with the genus and species.

SECTION B – Phylogenetic tree

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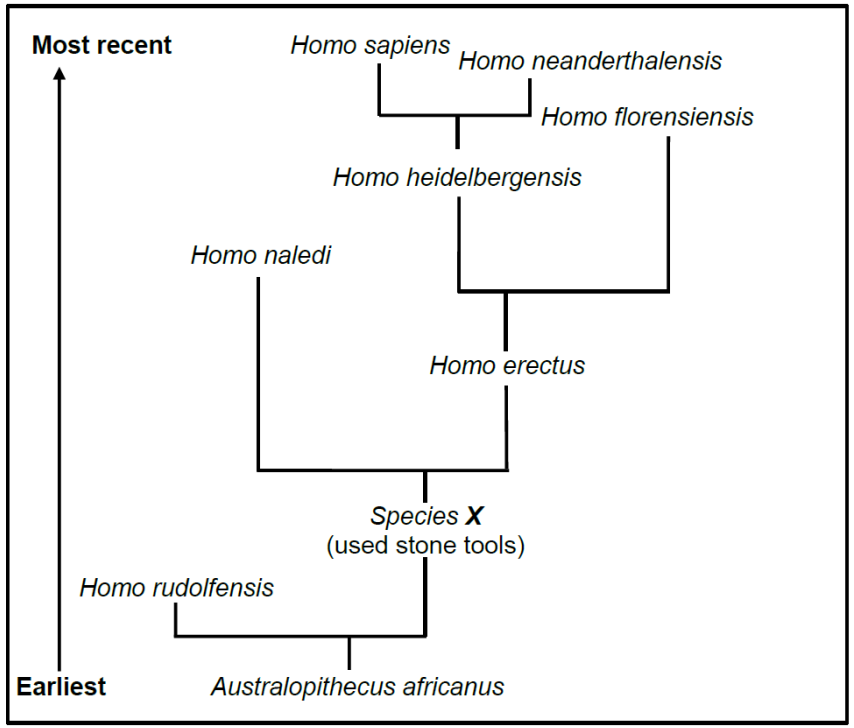

3.4.5 Name TWO forms of evidence that would have been used to support the information in the diagram.

3.4.6 The average cranial capacity of *Homo sapiens* is 1 500 cm^3 compared to 520 cm^3 in *Australopithecus africanus*. Explain the significance of the difference in cranial capacity.

Common misconceptions & Errors

SECTION B – Phylogenetic tree

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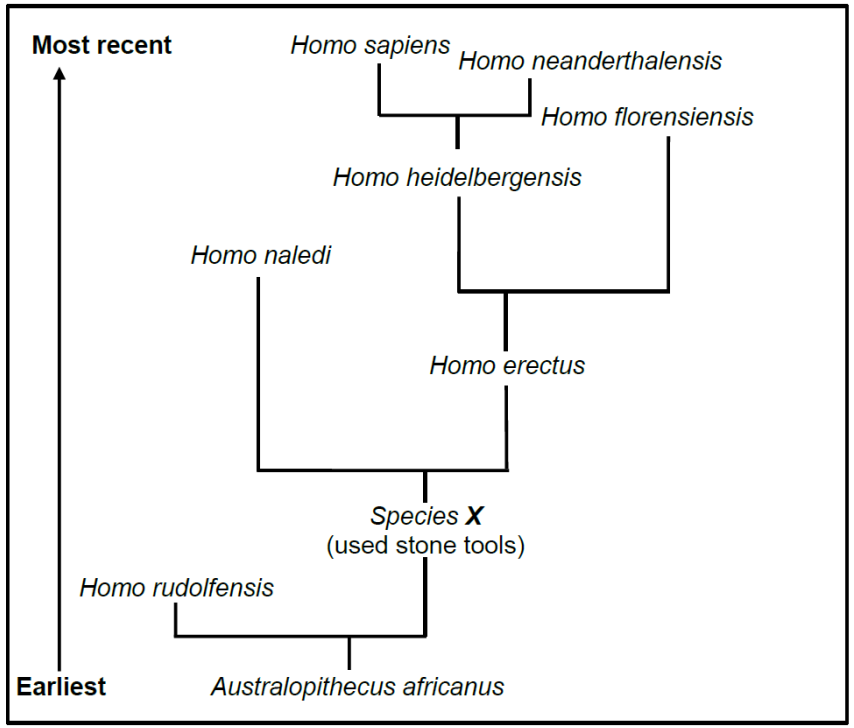


3.4.5 Name TWO forms of evidence that would have been used to support the information in the diagram.

- Fossil✓ evidence
- Cultural✓ evidence
- Genetic✓ evidence

(any 2; first 2 only)

3.4.6 The average cranial capacity of *Homo sapiens* is 1 500 cm^3 compared to 520 cm^3 in *Australopithecus africanus*. Explain the significance of the difference in cranial capacity.

- A large cranial capacity✓ in *Homo sapiens*
- indicates a larger brain✓
- leading to greater intelligence✓ (3)

OR

- A small cranial capacity✓ in *Australopithecus africanus*
- indicates a smaller brain✓
- leading to lower intelligence✓ (3)

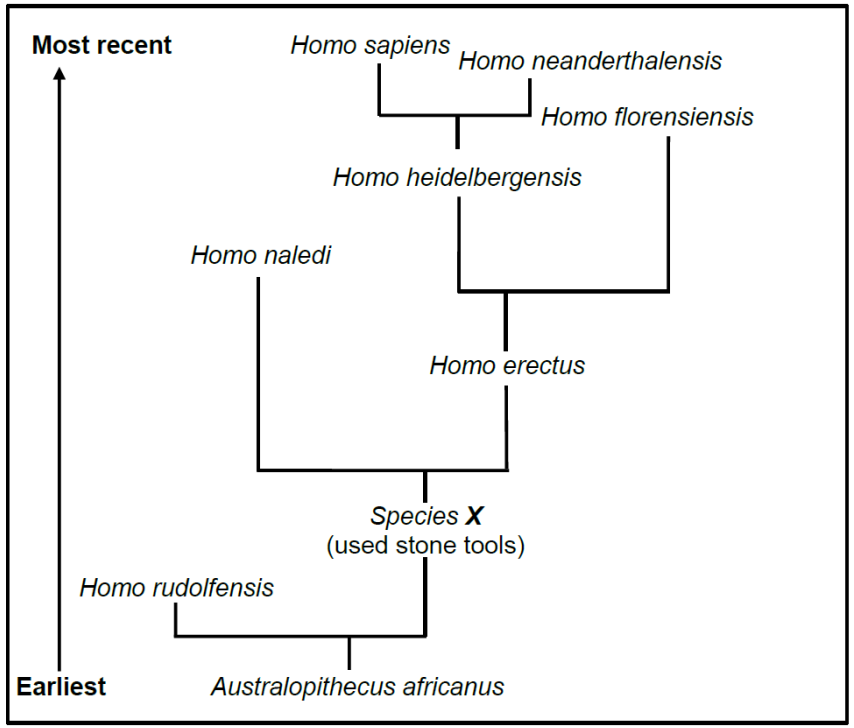
Common misconceptions & Errors

3.4.5 Candidates confused evidence to support the theory of evolution with evidence to support trends in human evolution. Some of the incorrect responses given included 'modification by descent', 'biogeography' and 'genetic evidence from mitochondrial DNA', 'rock paintings' and 'artefacts'.

SECTION B – Phylogenetic tree

3.4 The diagram represents a model of the evolution of some hominids.

3.4.7 Explain how fossils of *Australopithecus africanus*, *Species **X*** and *Homo erectus* are used to support the 'Out of Africa' hypothesis.



Common misconceptions & Errors

SECTION B – Phylogenetic tree

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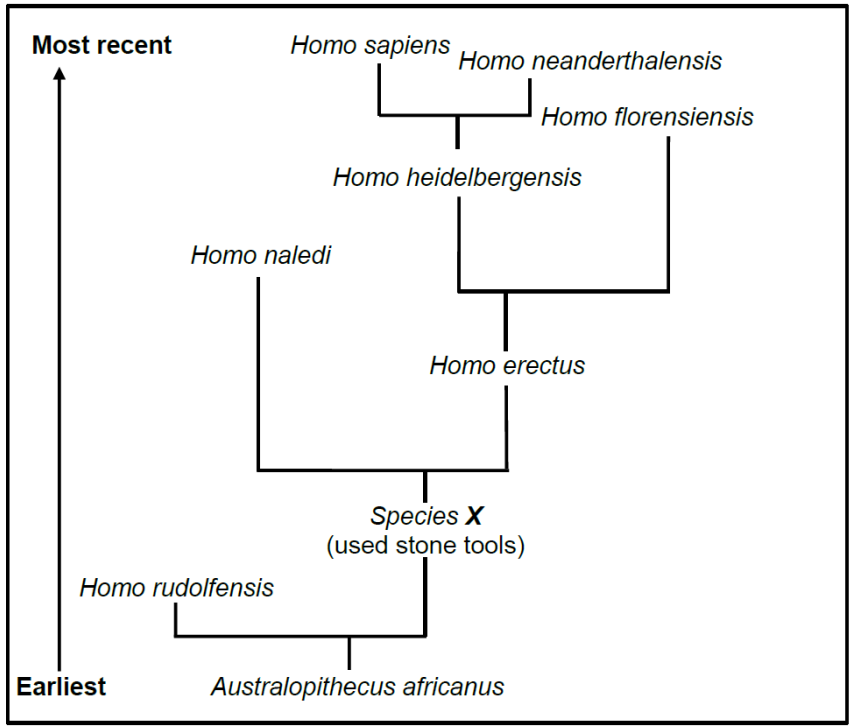

- Fossils of *Australopithecus spp.* were found in Africa only✓ and
- fossils of *species X*/*Homo habilis* were found in Africa only✓
- The oldest fossils of *Homo erectus* were found in Africa✓ /the younger fossils were found elsewhere
- indicating that modern humans originated in Africa and migrated out of Africa✓ (4)

Common misconceptions & Errors

3.4.7 Candidates were not clear on how fossil evidence supports the 'Out of Africa hypothesis'. Many wrote fossils/organisms originated in Africa instead of 'modern humans originated in Africa'.

SECTION B – Transitional species & Lamarck

3.5 Modern-day whales are aquatic mammals, spending their entire lives in the ocean. They are thought to have evolved from four-legged ancestors, as represented below.

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

3.5.1 Which ancestor of whales most likely lived both in water and on land?

3.5.2 Give ONE reason for your answer to QUESTION 3.5.1.

3.5.3 Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales.

Common misconceptions & Errors

SECTION B – Transitional species & Lamarck

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***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

3.5.1 Which ancestor of whales most likely lived both in water and on land?

Ambulocetus✓ (1)

3.5.2 Give ONE reason for your answer to QUESTION 3.5.1.

It had flipper-like large feet and a tail✓✓ (2)

3.5.3 Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales.

- They share characteristics✓/have intermediate characteristics
- of the ancestor/*Pakicetus* and the present-day species✓/*Balaena*

OR

-they have legs like *Pakicetus*✓ and
-flippers of the present day *Balaena*✓ (2)

Common misconceptions & Errors

3.5 Candidates could identify *Ambulocetus* as a transitional species between *Pakicetus* and whales but could not explain why this is the case. This indicated that they were not familiar with the characteristics of a transitional species.

3.5.2 Candidates omitted 'flipper-like' or 'large' when describing the feet of *Ambulocetus*.

3.5.3 Candidates failed to extract relevant characteristics from the table to support their answer.

SECTION B – Transitional species & Lamarck

3.5 Modern-day whales are aquatic mammals, spending their entire lives in the ocean. They are thought to have evolved from four-legged ancestors, as represented below.

3.5.4 Explain, according to Lamarck, why modern-day whales do not have legs.

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
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Common misconceptions & Errors

Grade 12 Life Sciences
Part 2 p. 90 – 94 & 96

SECTION B – Transitional species & Lamarck

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SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

3.5.4 Explain, according to Lamarck, why modern-day whales do not have legs.

- Ancestral species of whales all had legs✓/lived on land
- As more time was spent in the water✓ in search of food
- the legs were used less✓ and disappeared
- the acquired characteristic was passed on to the next generation✓ (any 3)

Common misconceptions & Errors

3.5.4 Candidates referred to 'Lamarck's law of use and disuse' but could not apply it to the question. Many incorrectly wrote 'legs were not needed' instead of 'the legs were used less'.

SECTION B – Scientific Investigation Evolution in present times

3.6 Patients infected with the HI virus (HIV) are treated with antiretroviral drugs. When they miss their treatment, it can increase the chances (probability) of the virus developing resistance to the drug.

Scientists conducted an investigation to determine the effect of the number of missed treatments on the probability of the HI virus developing resistance to antiretroviral drugs.

The results are shown in the table.

Number of missed treatments (in days)	Probability of the HI virus developing resistance to antiretroviral drugs (%)
2	0
7	20
14	35
21	40
37	60

3.6.1 State the following for this investigation:

(a) the dependent variable

(b) the independent variable

3.6.2 Based on the results, state ONE precaution for patients receiving antiretroviral treatment.

Common misconceptions & Errors

SECTION B – Scientific Investigation Evolution in present times

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21	40
37	60

3.6.1 State the following for this investigation:

(a) the dependent variable — Probability of developing resistance✓ to antiretroviral drugs (1)

(b) the independent variable — Number of missed treatments✓ (1)

3.6.2 Based on the results, state ONE precaution for patients receiving antiretroviral treatment.

Treatment must not be missed✓ (1)

Common misconceptions & Errors

3.6.1 Candidates could not extract the variables from the aim of the investigation.

SECTION B – Scientific Investigation Evolution in present times

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3.6.3 State a conclusion for this investigation.

Common misconceptions & Errors

SECTION B – Scientific Investigation Evolution in present times

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2	0
7	20
14	35
21	40
37	60

3.6.3 State a conclusion for this investigation.

- The probability of HIV developing resistance to antiretroviral drugs increases with the increase in the number of missed treatments✓✓

OR

- The more days of treatment missed, the greater the probability of the virus developing resistance to antiretroviral drugs✓✓ (2)

Common misconceptions & Errors

3.6.3 Candidates could not show the relationship between the two variables to formulate a conclusion.

Many incorrectly wrote 'directly proportional'.

The answers often did not have all the relevant aspects (variables, virus name, drug name and relationship).

SECTION B – Scientific Investigation Evolution in present times

3.6 Patients infected with the HI virus (HIV) are treated with antiretroviral drugs. When they miss their treatment, it can increase the chances (probability) of the virus developing resistance to the drug.

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3.6.4 Describe the evolution of resistance to antiretroviral medication in the HI virus.

Common misconceptions & Errors

SECTION B – Scientific Investigation Evolution in present times

3.6 Patients infected with the HI virus (HIV) are treated with antiretroviral drugs. When they miss their treatment, it can increase the chances (probability) of the virus developing resistance to the drug.

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7	20
14	35
21	40
37	60

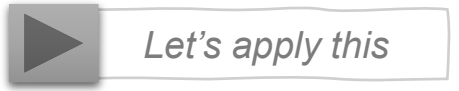
3.6.4 Describe the evolution of resistance to antiretroviral medication in the HI virus.

- There is variation in the resistance✓ of HIV to antiretroviral drugs
- Some viruses are resistant✓ to the drugs and
- others are not resistant✓
- Those that are not resistant do not survive✓
- When treatments are missed✓
- the resistant viruses survive and reproduce✓
- passing the resistance to their offspring✓ (any 5)

Common misconceptions & Errors

3.6.4 Candidates gave a generic description of natural selection without contextualising it. They also did not elaborate on the variation as it applied to the resistance of HIV to antiretroviral medication.

SECTION B QUESTION 3 – Suggestions for improvement

- ☑ Do not use 'slang' language in answers, e.g. K-9 or K-nines instead of canines.
- ☑ Consolidate taxonomy (from Grade 10) to ensure learners understand: 

  - *species vs genus vs genera*
  - *how to write a scientific name / species name*
- ☑ Consolidate what a transitional fossil is (from Grade 10). 

- ☑ Learn the 'Natural Selection Rhyme' and always tailor it to the context of the question given. 

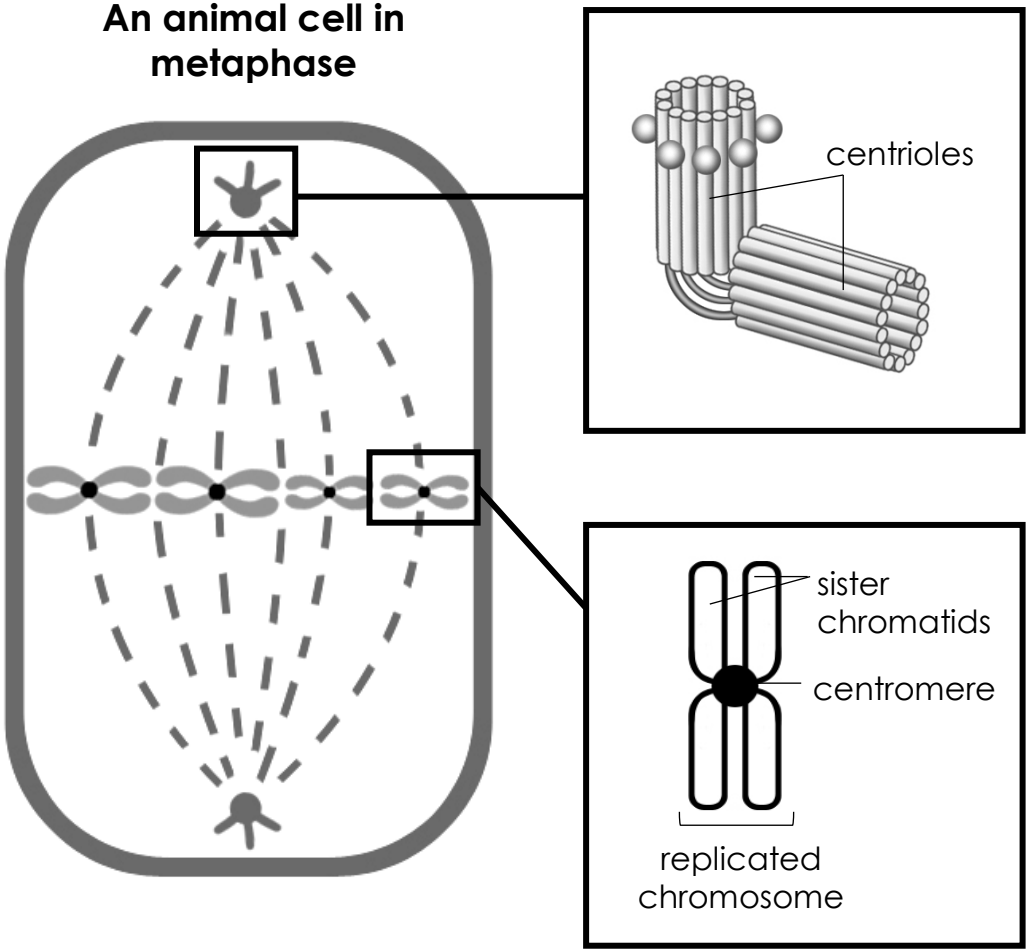
- ☑ Remember that a conclusion of an investigation comes from the aim.
  - *change the wording of the aim to show the relationship that was deduced from the experiment*

END

COMMONLY CONFUSED TERMS – Centrosome, Centrioles, Centromere

Return to home

An animal cell in metaphase



Centrosome

- ✓ An organelle found in **animal cells**.
- ✓ Contains two cylinder-shaped structures called **centrioles**.
- ✓ **Moves to the poles** during cell division.
- ✓ Plays a role in the **formation of the spindle** during cell division.
- ✓ Remember 'centro**SOME**' for '**SOME** centrioles together'.

Centrioles

- ✓ Cylinder-shaped structures that are collectively referred to as the centrosome.
- ✓ **Move to the poles** during cell division.
- ✓ Play a role in the **formation of the spindle** during cell division.
- ✓ Remember 'centri**OLES**' at the 'p**OLES**'

Centromere

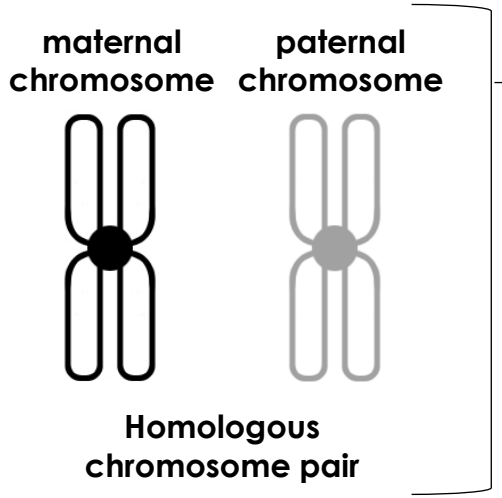
- ✓ The structure that **joins** the two **sister chromatids** of a **replicated chromosome**.
- ✓ Remember 'centro**m**ere' for '**M**iddle of a chromosome'.

Extract from The Answer Series Grade 10 Life Sciences p. 25 & 26

Continue learning – homologous structure vs homologous chromosome

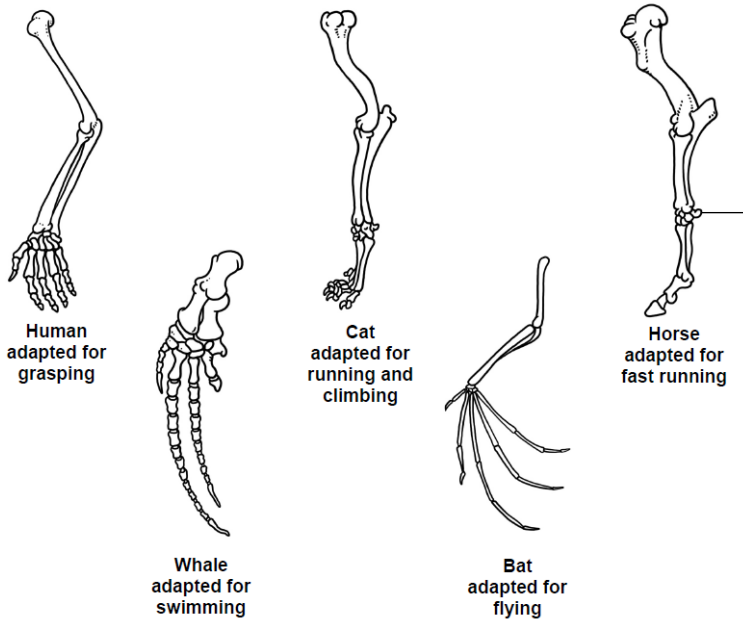
THE ANSWER SERIES *Your Key to Exam Success*

COMMONLY CONFUSED TERMS – Homologous chromosomes vs Homologous structures



Homologous chromosomes

- ✓ Chromosomes 1 to 22 occur in pairs, i.e. **two of each chromosome**.
- ✓ **One** chromosome comes **from the mother** (maternal chromosome) and the **other from the father** (paternal chromosome).
- ✓ The pairs are homologous because the chromosomes:
  - are the **same length**
  - are the **same size** and **shape**
  - have the same **centromere position**
  - carry the **same genes** at the **same positions**



Homologous structures

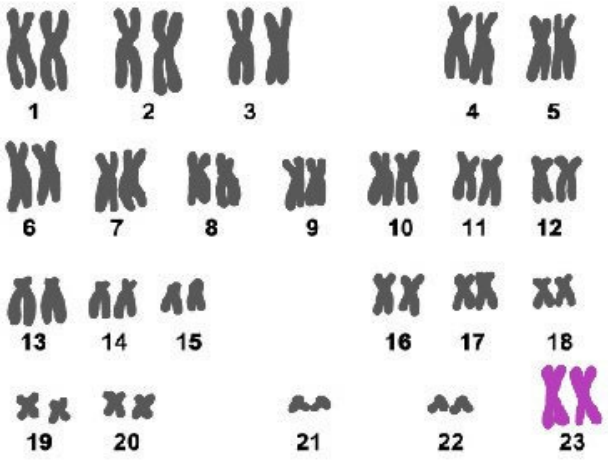
- ✓ Similar structures (e.g. forelimbs of vertebrates) with the **same body plan** that perform **different functions**.
- ✓ Provide **evidence for evolution** / descent with modification, because the similarities **suggest a common ancestor**.

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 13 & 92

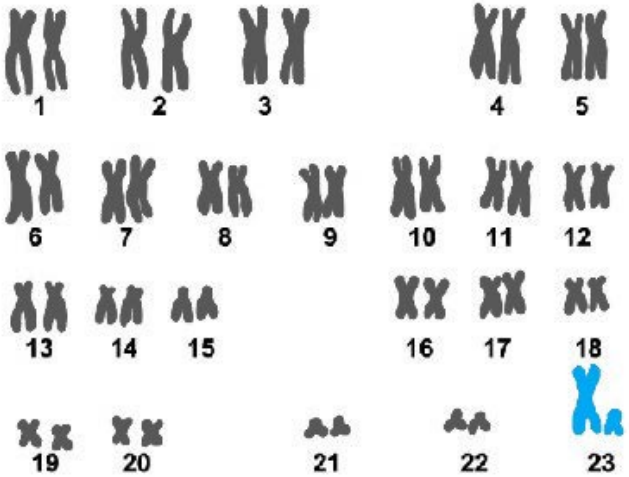
Return to home

Continue learning – autosomes vs gonosomes

COMMONLY CONFUSED TERMS – Autosomes vs Gonosomes



Normal female karyotype (44 + XX)



Normal male karyotype (44 + XY)

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 13

Return to home

Autosomes

- ✓ Chromosomes that are **not involved in sex determination**.
- ✓ Chromosome **pairs 1 to 22** / the **first 22 chromosome pairs**.
- ✓ Humans have **44 autosomes**.

Gonosomes

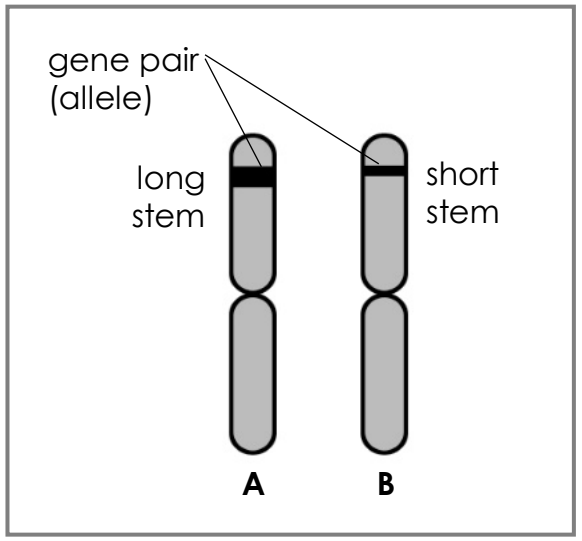
- ✓ Chromosomes **involved in sex determination**, i.e. X or Y.
- ✓ Chromosome **pair 23** / the **last chromosome pair**.
- ✓ **Females** have an **XX** pair.
- ✓ **Males** have an **XY** pair.

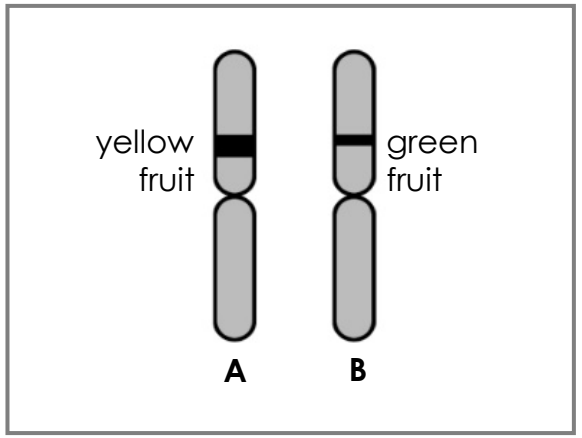
NOTE

*The **XX chromosomes** of females are considered **homologous** chromosomes, but the **XY chromosomes** of males are **not**.*

Continue learning – gene vs allele

COMMONLY CONFUSED TERMS – Gene vs Allele





Two different homologous chromosome pairs (A and B) with different alleles (for plant length and seed colour) at different loci

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 25

Return to home

Gene

- ✓ Specific **sequence of nitrogenous bases** in DNA.
- ✓ Controls a particular **heritable trait**, e.g. length of a plant's stem.

Allele

- ✓ **Alternative forms** of the **same gene**.
- ✓ A particular gene occurs in two (sometimes more) different forms that **affect the same characteristic** in different ways, e.g. long stem or short stem.
- ✓ The alleles of a particular gene occur **at the same locus** on a specific homologous chromosome pair.

Continue learning – species vs population

COMMONLY CONFUSED TERMS – Species vs Population

Extract from The Answer Series
Grade 12 Life Sciences Part 2 p. 102

Return to home

A pine tree plantation represents a population of trees of the same species living in the same area at the same time

Species

- ✓ Organisms that **look the same**.
- ✓ **Can interbreed** with each other.
- ✓ Produce **fertile offspring**.

A colony of ants represents a population of the same species living in the same area at the same time

Population

- ✓ Group of organisms of the **same species**.
- ✓ Living in the **same area**.
- ✓ At the **same time**.
- ✓ *Because they are the same species they can also **interbreed** to produce fertile offspring.*

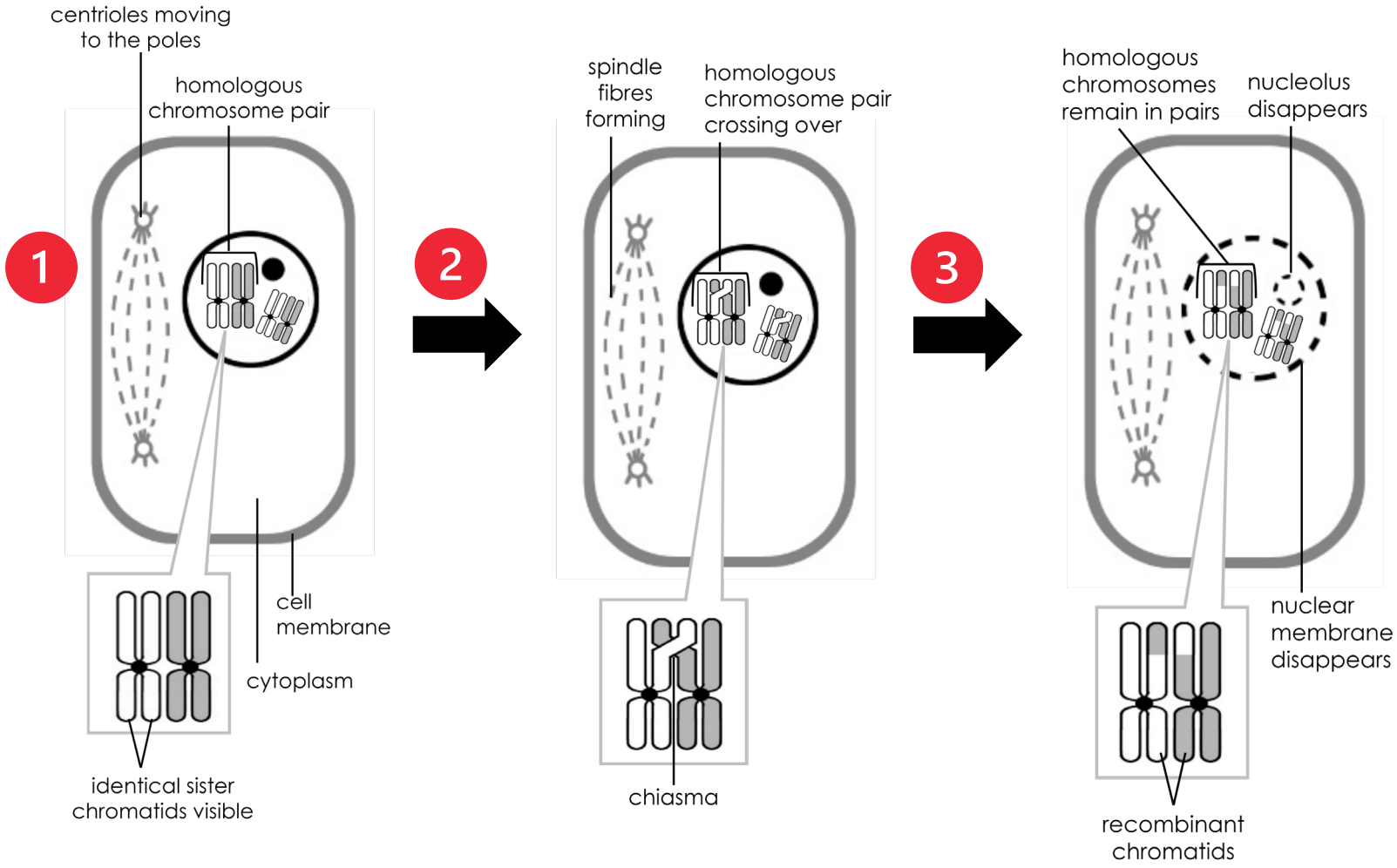
MEIOSIS I vs MEIOSIS II – Major events

✓ Prophase I

1. homologous chromosomes lie in close association (in pairs), next to one another in preparation for crossing over
2. crossing over between adjacent non-sister chromatids
3. chromatid segments (genetic material) are exchanged

NOTE

*Crossing-over is a **source of variation** during meiosis*



Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

Return to home

Continue to Metaphase I

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MEIOSIS I vs MEIOSIS II – Major events

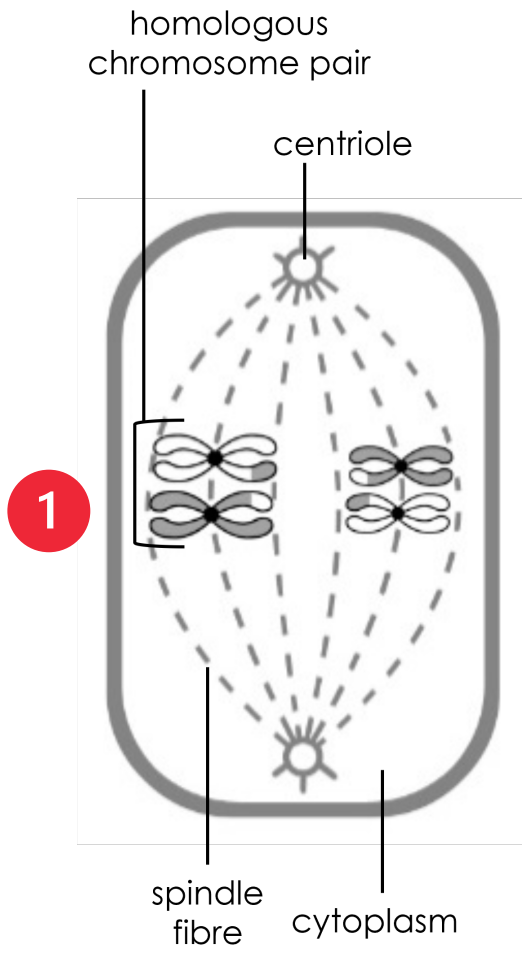
Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

✓ Metaphase I

1. homologous chromosome pairs randomly arranged in a double row on the equator

NOTE

*Which homologous chromosome lies on which side of the equator is completely random. This is called **random arrangement** of chromosomes and is another **source of variation** during meiosis.*



Return to home

Continue to Anaphase I

MEIOSIS I vs MEIOSIS II – Major events

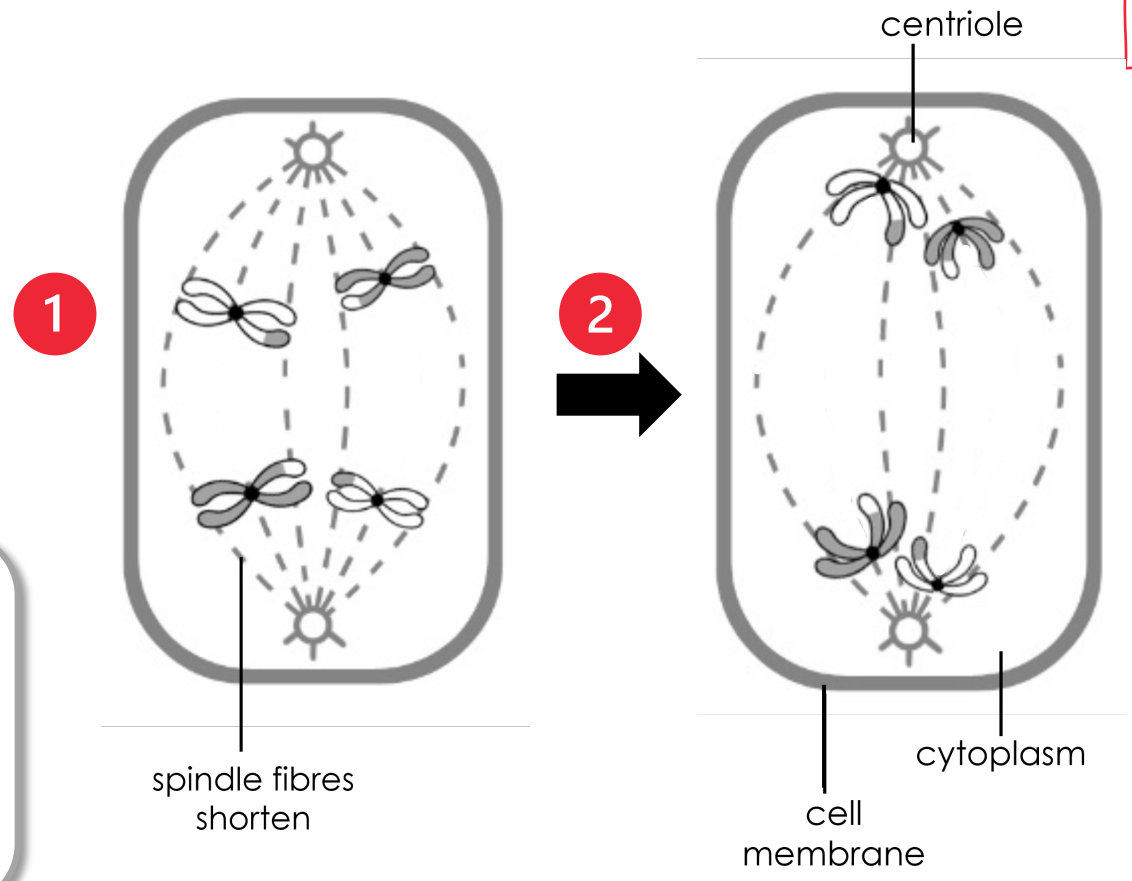
Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

✓ Anaphase I

1. one chromosome of a homologous pair moves to one pole and its partner moves to the other pole
2. chromosomes group at the poles

NOTE

*No division of centromeres occurs. Therefore, it is replicated **chromosomes** (each with 2 chromatids), and not single chromatids, that move to the poles. Homologous chromosome pairs are separated, thus the chromosome number is halved in **Anaphase 1**.*



Return to home

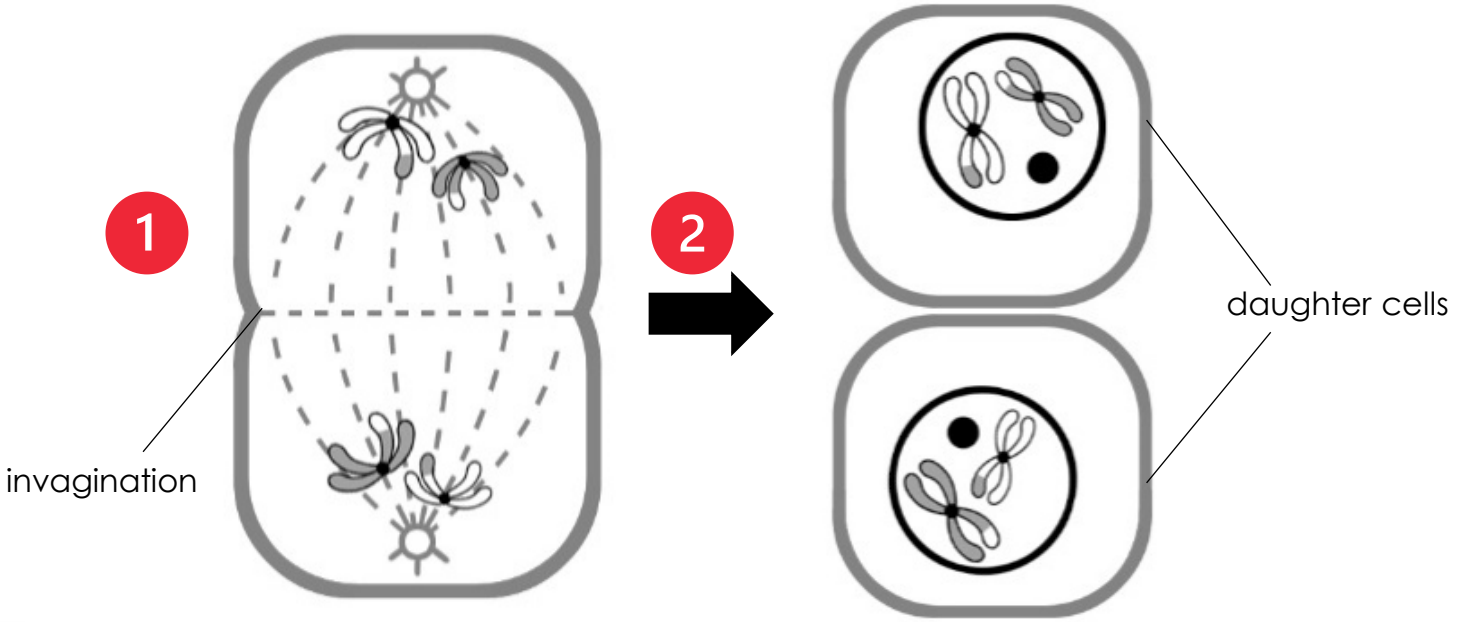
Continue to Telophase I

MEIOSIS I vs MEIOSIS II – Major events

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

✓ Telophase I

1. invagination occurs (animal cells only)
2. two, genetically different daughter cells with half the original chromosome number (n) is formed



NOTE

*Division of the nucleus is called **karyokinesis** and division of the cytoplasm is called **cytokinesis.***

Return to home

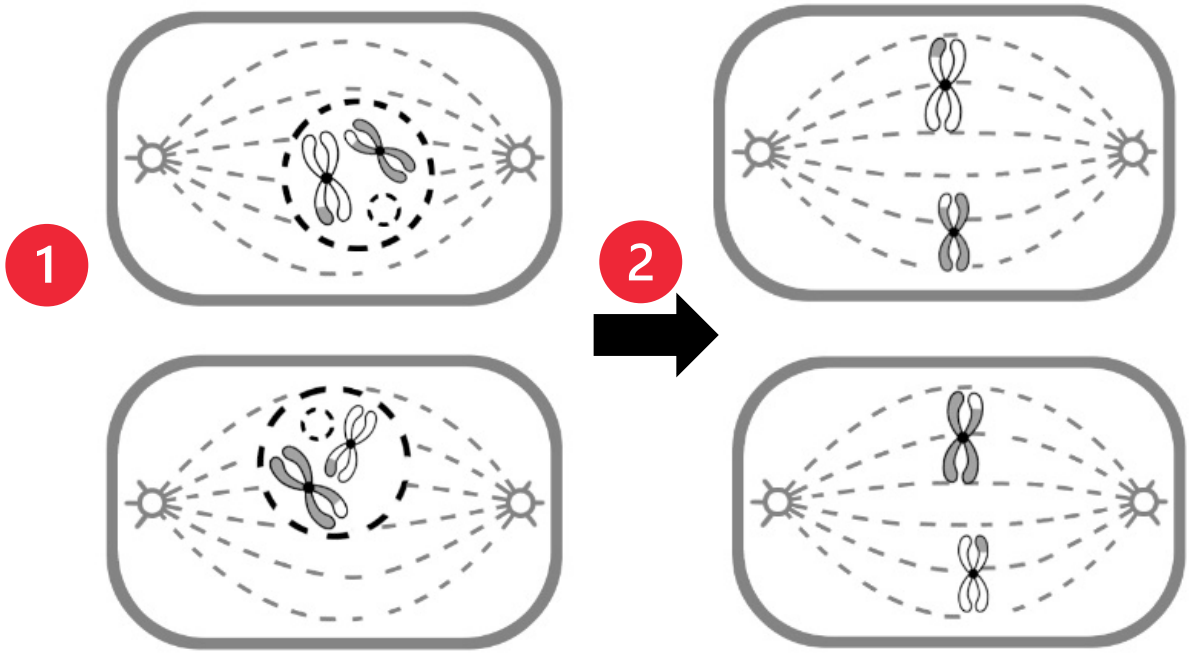
Continue to Meiosis II

MEIOSIS I vs MEIOSIS II – Major events

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

✓ Prophase II and Metaphase II

1. no homologous chromosome pairs present
2. chromosomes randomly align in a single row on the equator



NOTE

Meiosis II is the same process as mitosis.

Return to home

Continue to Anaphase II

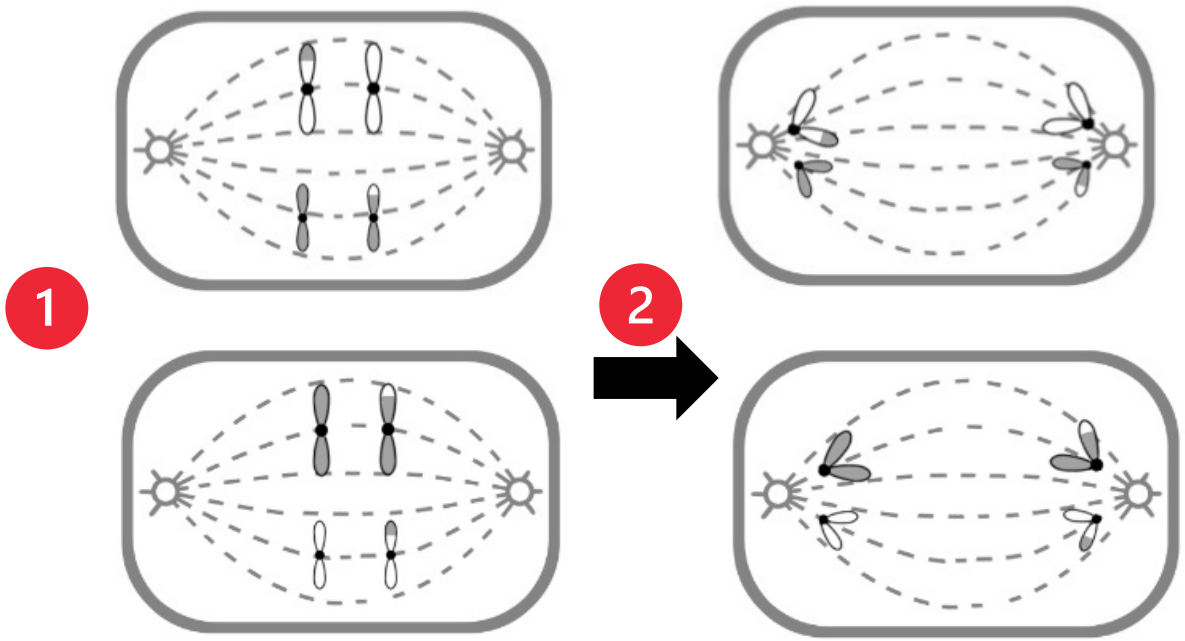
MEIOSIS I vs MEIOSIS II – Major events

Extract from The Answer Series
Grade 12 Life Sciences Part 2
p. 16 - 17

✓ Anaphase II

1. centromeres divide; chromatids (unreplicated daughter chromosomes) move to opposite poles

2. chromatids (unreplicated daughter chromosomes) arrange at poles



Return to home

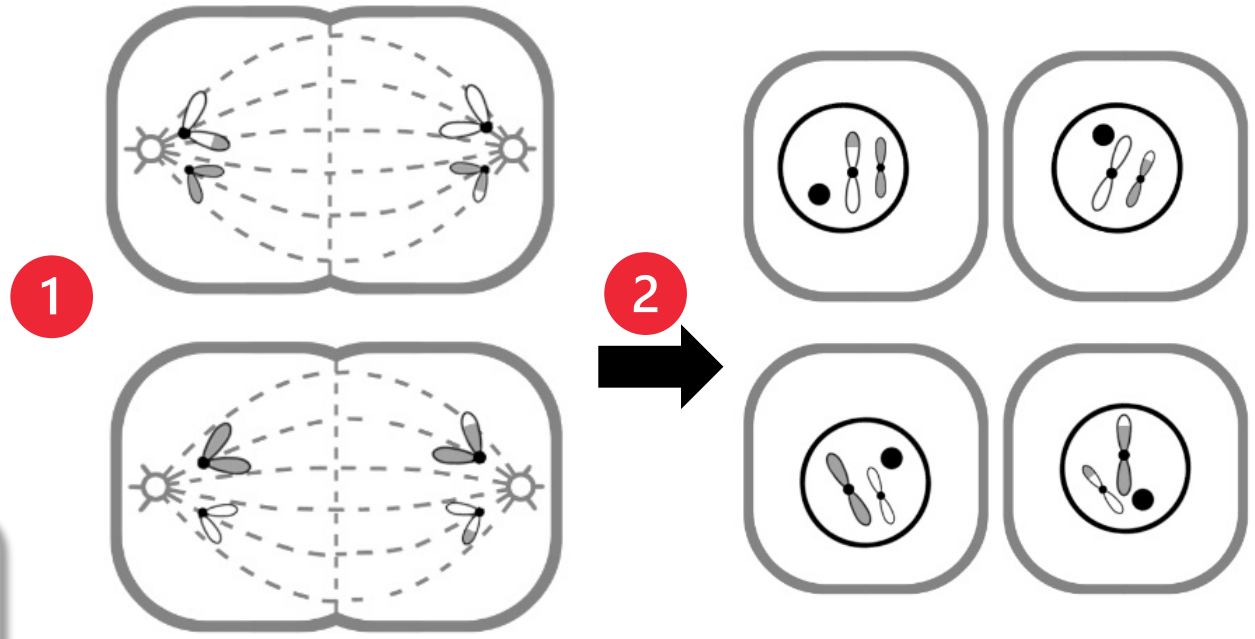
Continue to Telophase II

MEIOSIS I vs MEIOSIS II – Major events

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 16 - 17

✓ Telophase II

1. invagination occurs (animal cells only)
2. four daughter cells – each with the haploid (n) chromosome number and a different genetic makeup is formed



NOTE

*The 4 **daughter cells** formed at the end of **meiosis** will always be **haploid** and contain **chromatids** with **exchanged genetic material.***

Return to home

Continue to comparison of Meiosis I and II

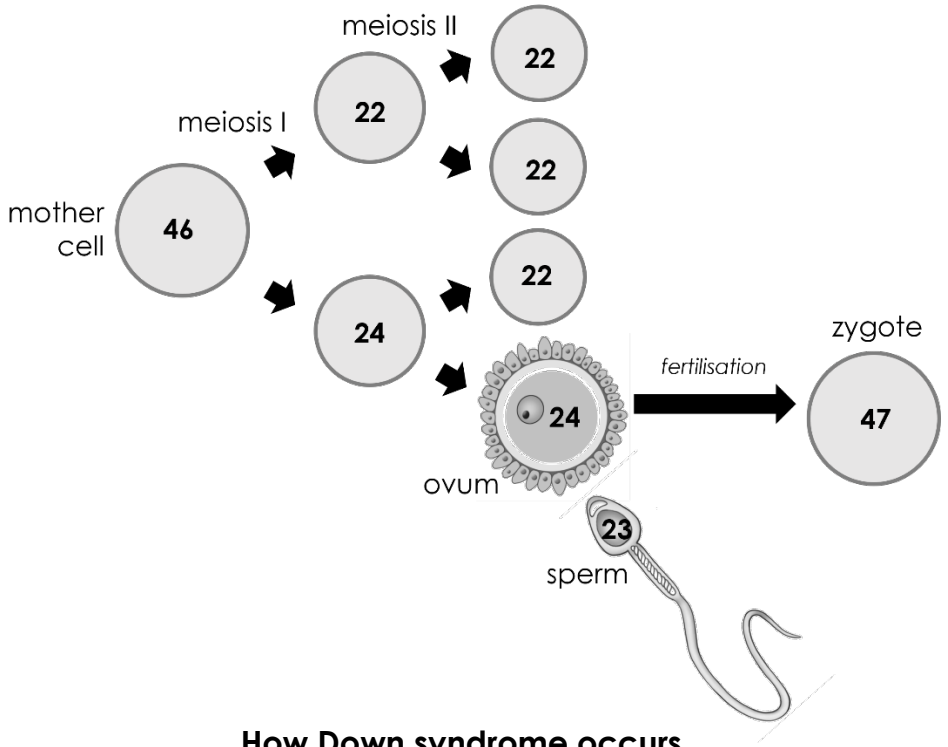
MEIOSIS I vs MEIOSIS II – Differences

Extract from The Answer Series
Grade 12 Life Sciences Part 2
p. 16 - 17

Return to home

COMPARISON OF MEIOSIS I AND II		
PHASE	**MEIOSIS I**	**MEIOSIS II**
Prophase	Crossing-over occurs	Crossing-over does not occur
Metaphase	Chromosomes lie in a double row (homologous pairs) on the equator	Chromosomes lie in a single row on the equator
	Centromeres of chromosomes do not divide	Centromeres of chromosomes divide
Anaphase	Homologous chromosomes separate and whole/replicated chromosomes move to opposite poles	Chromatids separate and unreplicated chromosomes move to opposite poles
Telophase	Two non-identical, haploid daughter cells are formed	Four non-identical, haploid daughter cells are formed
General	Chromosome number changes from diploid (2n) to haploid (n)	The chromosome number stays the same (i.e. haploid)

ABNORMAL MEIOSIS– Down syndrome



How Down syndrome occurs

NOTE

An individual with Down syndrome has 47 chromosomes in each of his/her somatic cells due to three copies of chromosome 21.

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 22

Return to home

- ✓ Down syndrome is a chromosomal disorder **caused by non-disjunction**.
- ✓ Non-disjunction of **homologous chromosome pair 21** occurs during Anaphase I or II. Both copies of chromosome 21 move to one pole of the cell, and none to the other.
- ✓ Leads to the formation of a **gamete** (e.g. an egg cell) that has an **extra chromosome 21**, i.e. 24 chromosomes in total.

REMEMBER

Gametes are haploid cells and should only contain one copy of each chromosome.

- ✓ If this gamete (with 24 chromosomes) fuses with a normal gamete (e.g. a sperm cell) with 23 chromosomes during fertilisation, a zygote with **three copies of chromosome 21** is formed.
- ✓ The zygote develops into an individual with **47 chromosomes** in every somatic cell.
- ✓ This chromosomal abnormality is called **Trisomy 21** and causes the disorder **Down syndrome**.

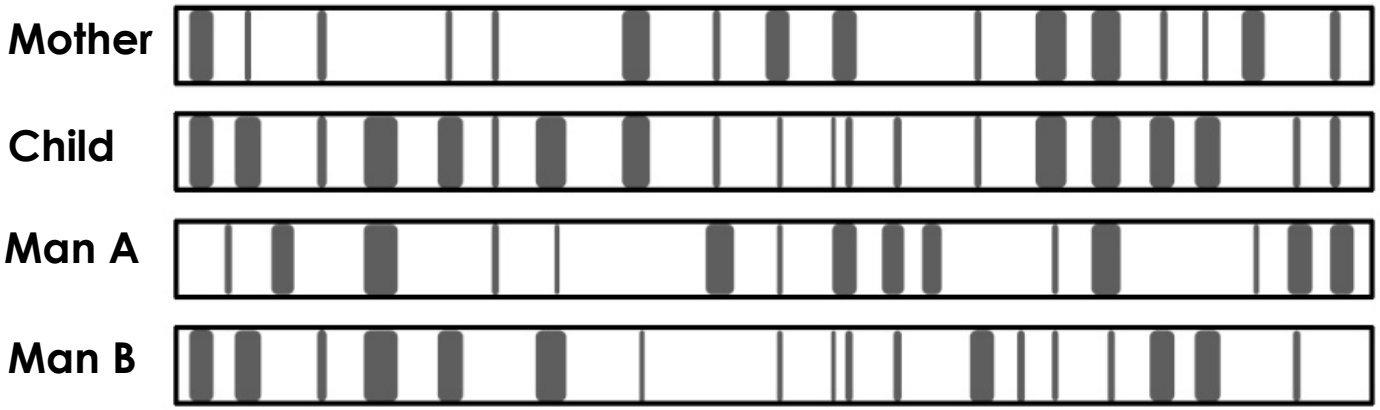
THE ANSWER SERIES Your Key to Exam Success

DNA PROFILING – Proving paternity

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 7

Return to home

1 Compare the DNA profiles of a mother, her child and two potential fathers. Start on the left-hand side of the child's DNA profile and **compare** the **thickness** and **position of** the **bands** with those on the mother's DNA profile. Identify all the bands that match and mark them.



NOTE

Use a ruler to guide you as you move down the DNA profile of the child.

Continue learning

THE ANSWER SERIES Your Key to Exam Success

DNA PROFILING – Proving paternity

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 7

Return to home

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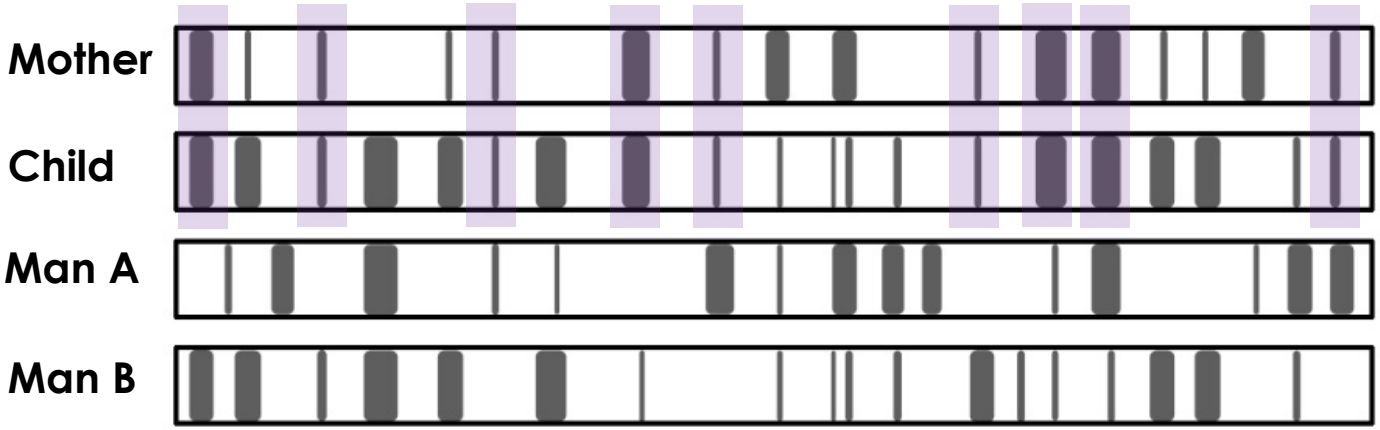


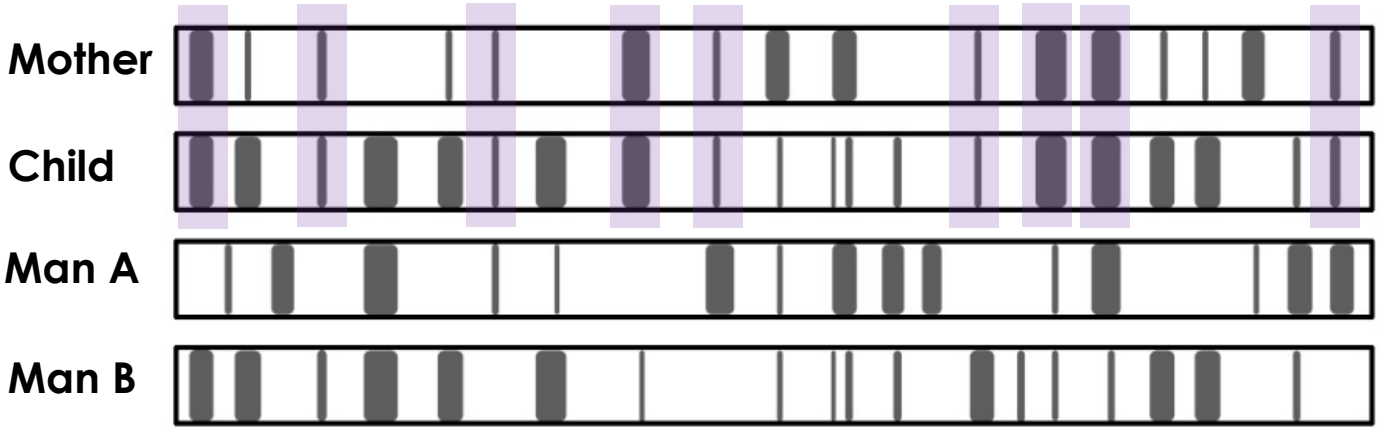
Continue learning

DNA PROFILING – Proving paternity

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 7

Return to home

2 **Compare** the **thickness** and **position of** the **remaining bands** on the child's DNA profile to the DNA profiles of the two potential fathers. All the **remaining bands** will **match** with that of the **biological father.**



Continue learning

THE ANSWER SERIES Your Key to Exam Success

DNA PROFILING – Proving paternity

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 7

Return to home

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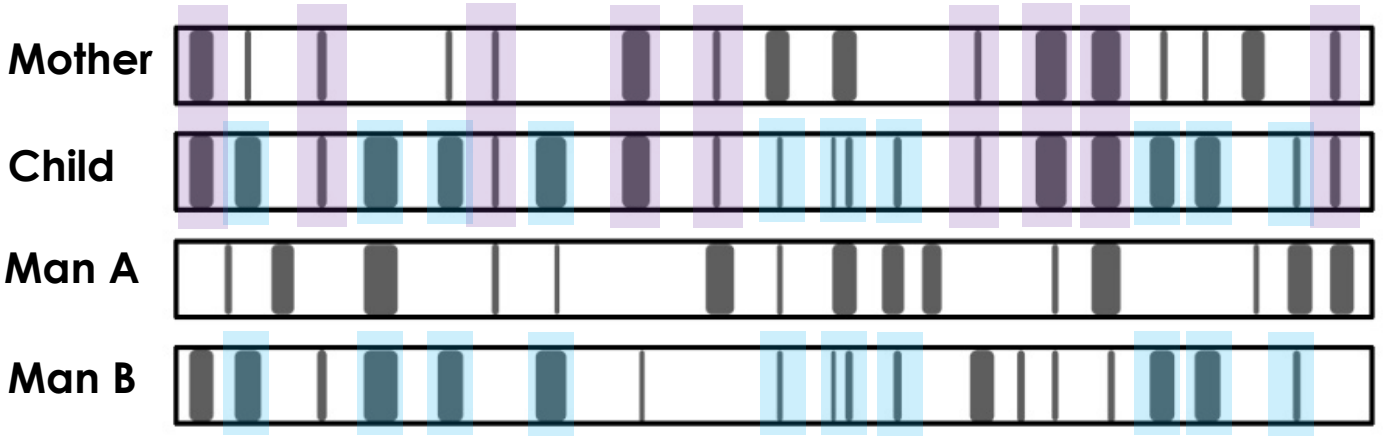


NOTE

Man B is the biological father of the child.

NOTE

*Some of the bands on the child's DNA profile match Man A's DNA profile as well. This is because all humans share certain gene sequences. However, Man B shares **all** the remaining bands of the child's DNA profile and he is the biological father.*

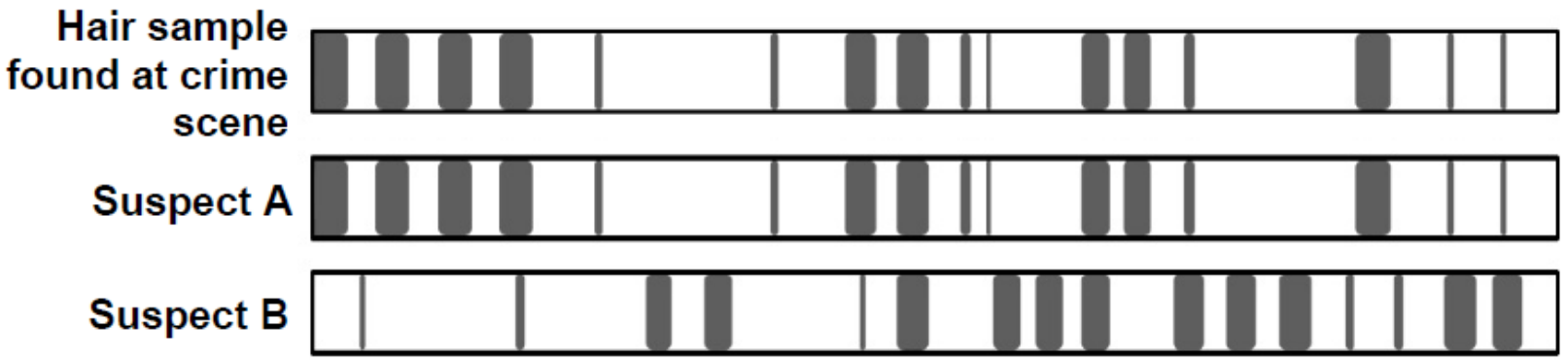
Use DNA profiles to identify crime suspects

DNA PROFILING – Identify potential suspects

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 8

1 Compare the DNA profiles of a hair sample found at a crime scene with that of two potential suspects for the crime.

The hair sample found at the scene could belong to the person who committed the crime. Therefore, we are **looking for** an **exact match** between two DNA profiles, i.e. all the bands on the DNA profile from the hair sample must match with the banded pattern on the suspect's DNA profile.



Return to home

Continue learning

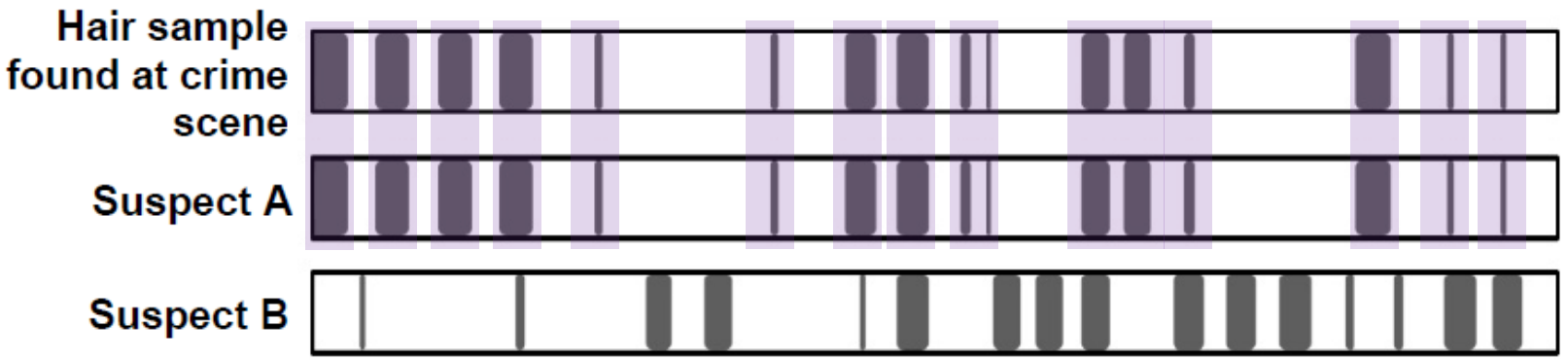
DNA PROFILING – Identify potential suspects

Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 8

Return to home

2 Start on the left-hand side of the DNA profile from the hair sample and **compare** the **thickness** and **position of** the **bands** with those on the DNA profiles of the two potential suspects**.**

The DNA profile from the hair sample match **Suspect A's** exactly and therefore links them to the crime scene.



NOTE

DNA profiles cannot be used as the sole evidence in a forensic case to convict someone or solve the case. A matching DNA profile only places a suspect at the scene but cannot prove that they committed the crime.

Use DNA profiles to identify relatives

DNA PROFILING – Identify relatives

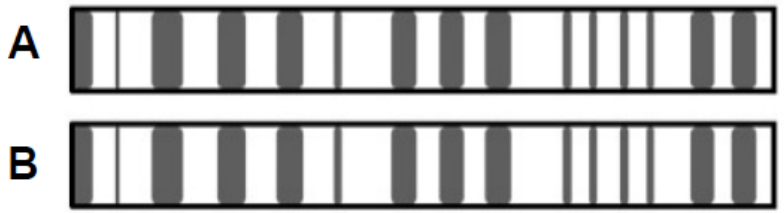
Extract from The Answer Series Grade 12 Life Sciences Part 2 p. 8

Return to home

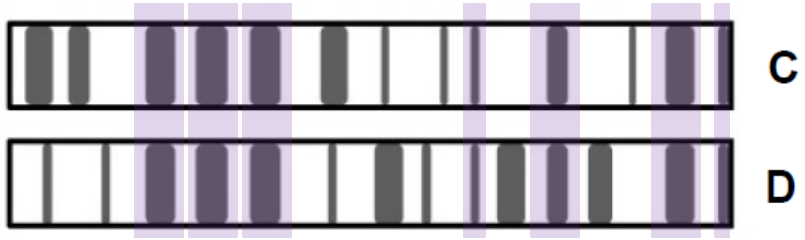
1

Identical twins share the exact same DNA and therefore their **DNA profiles match exactly**, i.e. all the bands on their DNA profiles match in thickness and position.

Non-identical twins share the same parents, but **not** the **exact same DNA**. They are siblings and the banded patterns of their DNA profiles only coincide at certain base pairs, i.e. only some of the bands on their DNA profiles match in thickness and position.



Identical twins A and B



Non-identical twins C and D

GENETICS QUESTIONS – General format hints and tips

Extract from 2021 Diagnostic Report p. 163

The following steps are generally useful on how to interpret a pedigree diagram:

- ✓ **Read** the **stem** of the question carefully to identify the inherited trait.
- ✓ **Check** if information is given on which trait is **dominant** or **recessive**.
- ✓ Identify if the trait is sex-linked.
  - Use the letters **X** and **Y** in the genotype *only if the trait is sex-linked*.
  - Only the **X** has a superscript and not the **Y**.
- ✓ Check if there is a key and use it for the **proper description** of the **phenotype**.
- ✓ Write in the **phenotype** of all the individuals **as given in** the **key**/question.
- ✓ Fill in the **genotypes**.
  - All individuals with the dominant phenotype will be homozygous dominant (e.g. AA) or heterozygous (e.g. Aa).
  - All individuals with the recessive phenotype will be homozygous recessive (e.g. aa).
- ✓ An individual with two recessive alleles will have obtained one from each parent.
- ✓ **Work backwards** and fill in one recessive allele for each parent.
- ✓ This will exclude one genotype for individuals with the dominant phenotype.

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NOTE

*Check out our videos on how to analyse pedigree diagrams for different types of inheritance **here**.*

Continue learning

GENETICS QUESTIONS – General format hints and tips

Extract from 2021 Diagnostic Report p. 163

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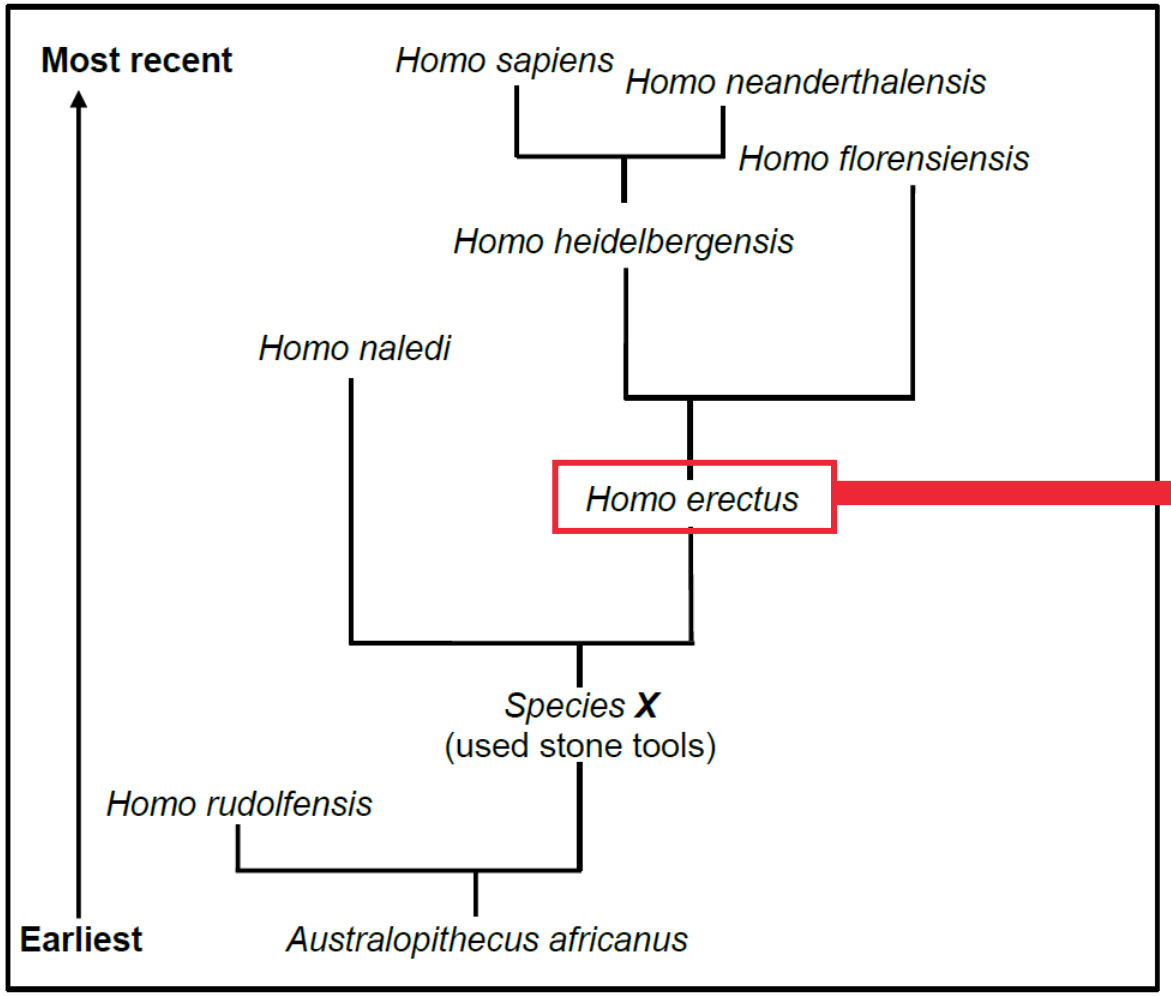
When asked to explain inheritance of alleles in an individual/s learners must apply the following steps:

- ✓ Give the **phenotype** of the individual(s).
- ✓ State the **genotype** of the individual(s).
- ✓ State **which allele is inherited** from each parent or which allele is passed on from each parent to the offspring.

Note the notations of the different types of genetic crosses:

Type of inheritance	Brief description of the mode of inheritance
Complete dominance	One allele masks the expression of the other allele; e.g. B is dominant over b.
Incomplete dominance	Neither of the alleles is dominant over each other. An intermediate phenotype is obtained when both alleles are present.
Co-dominance	Both alleles are equally dominant and both are expressed in the phenotype, e.g. I^A and I^B.
Sex-linked	The allele causing the disorder is found on the X chromosome, e.g. X^HX^h & X^HY.
Dihybrid cross	Two characteristics are investigated and therefore there will be four letters in the individual's genotype, e.g. RRYy (two for each characteristic). Gametes will have two different letters, e.g. Ry.

SPECIES, GENUS AND GENERA – Writing scientific names



An organism's name consists of <u>two parts</u>:

Homo *erectus*

genus name — **species** name

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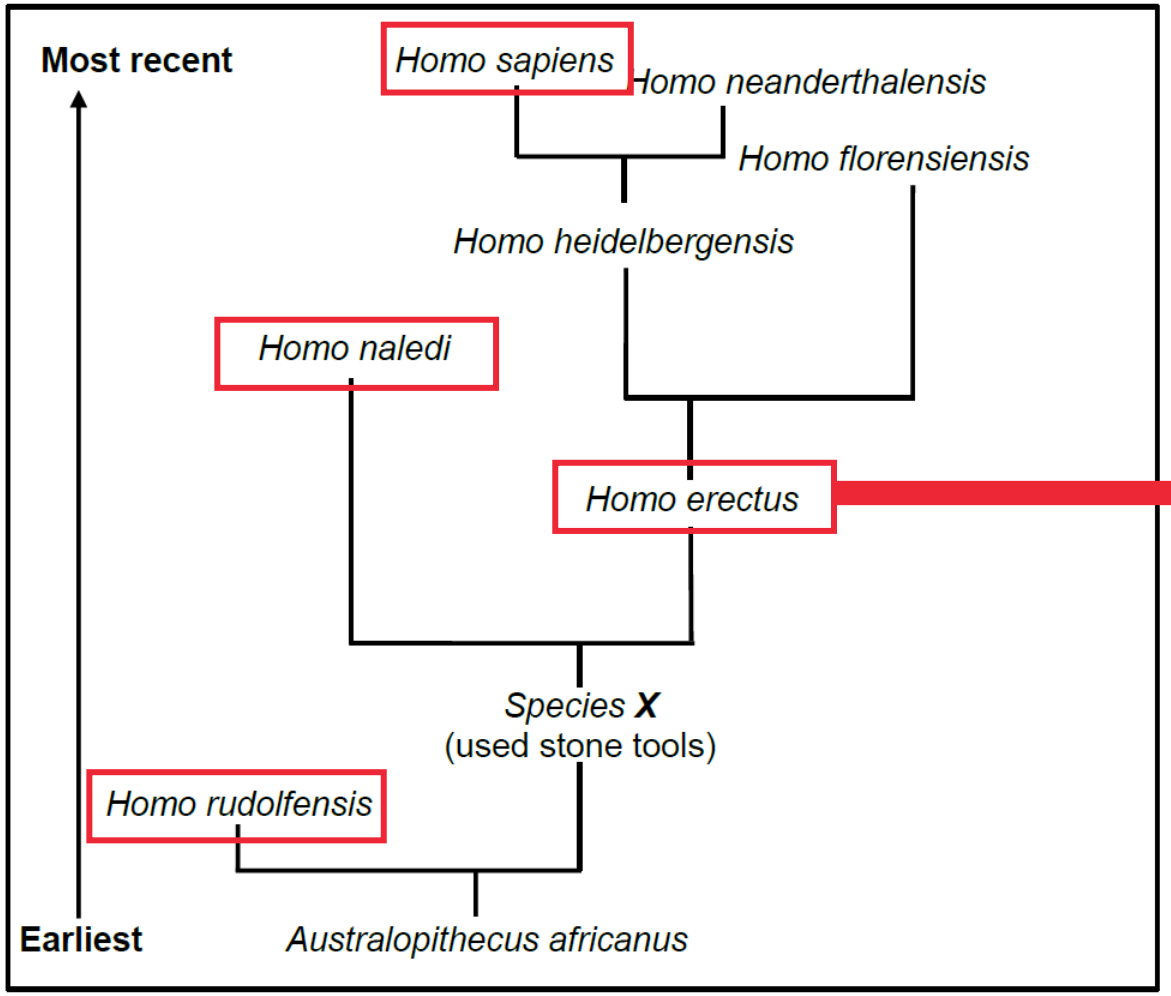
SPECIES, GENUS AND GENERA – Writing scientific names



Many species can belong to the <u>same genus</u>, e.g.:

Homo	erectus
Homo	naledi
Homo	rudolfensis
Homo	sapiens

same **genus**

different **species**

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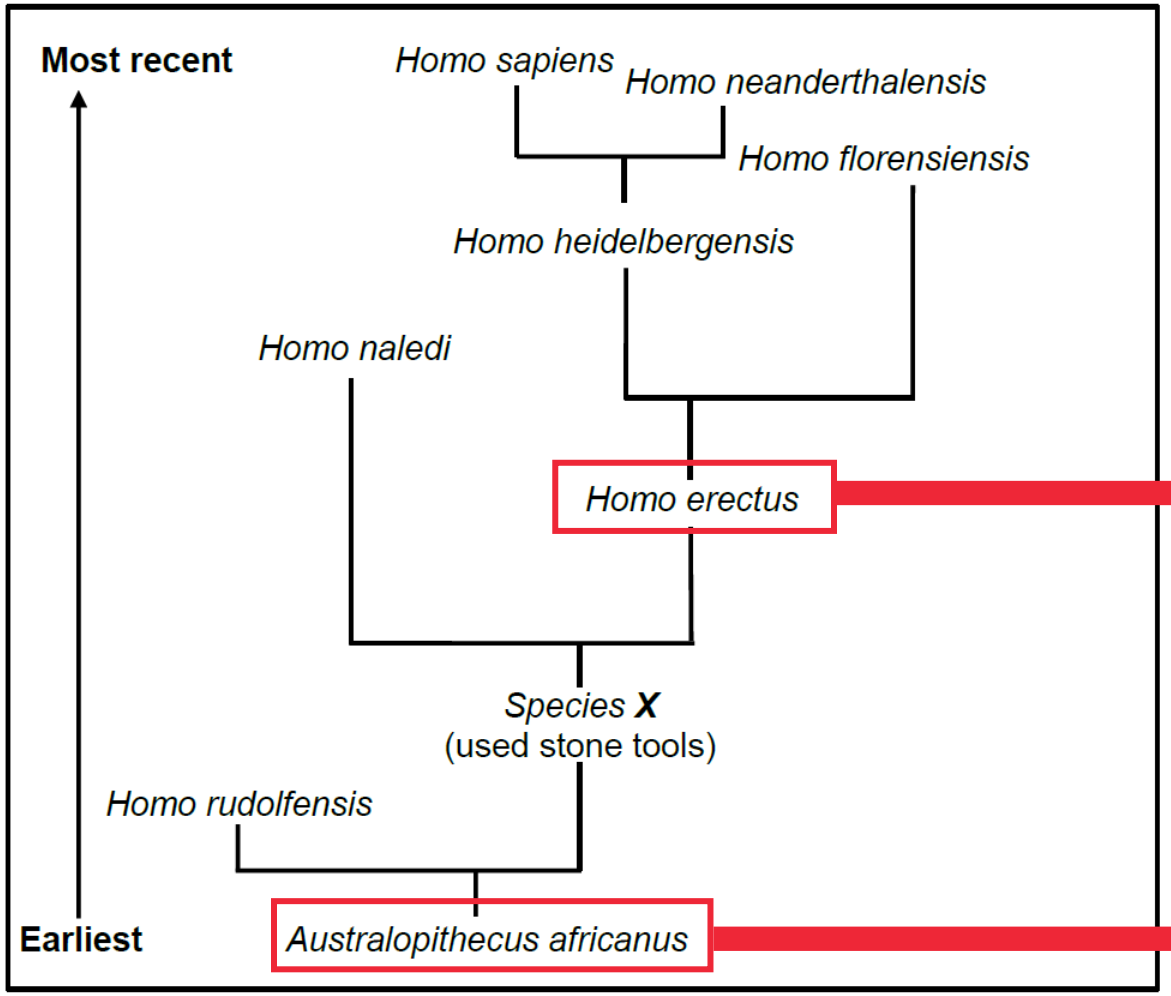
SPECIES, GENUS AND GENERA – Writing scientific names



There are two different genera visible on this phylogenetic tree:

Homo erectus

different **genera**

Australopithecus africanus

NOTE

Genus = singular

Genera = plural

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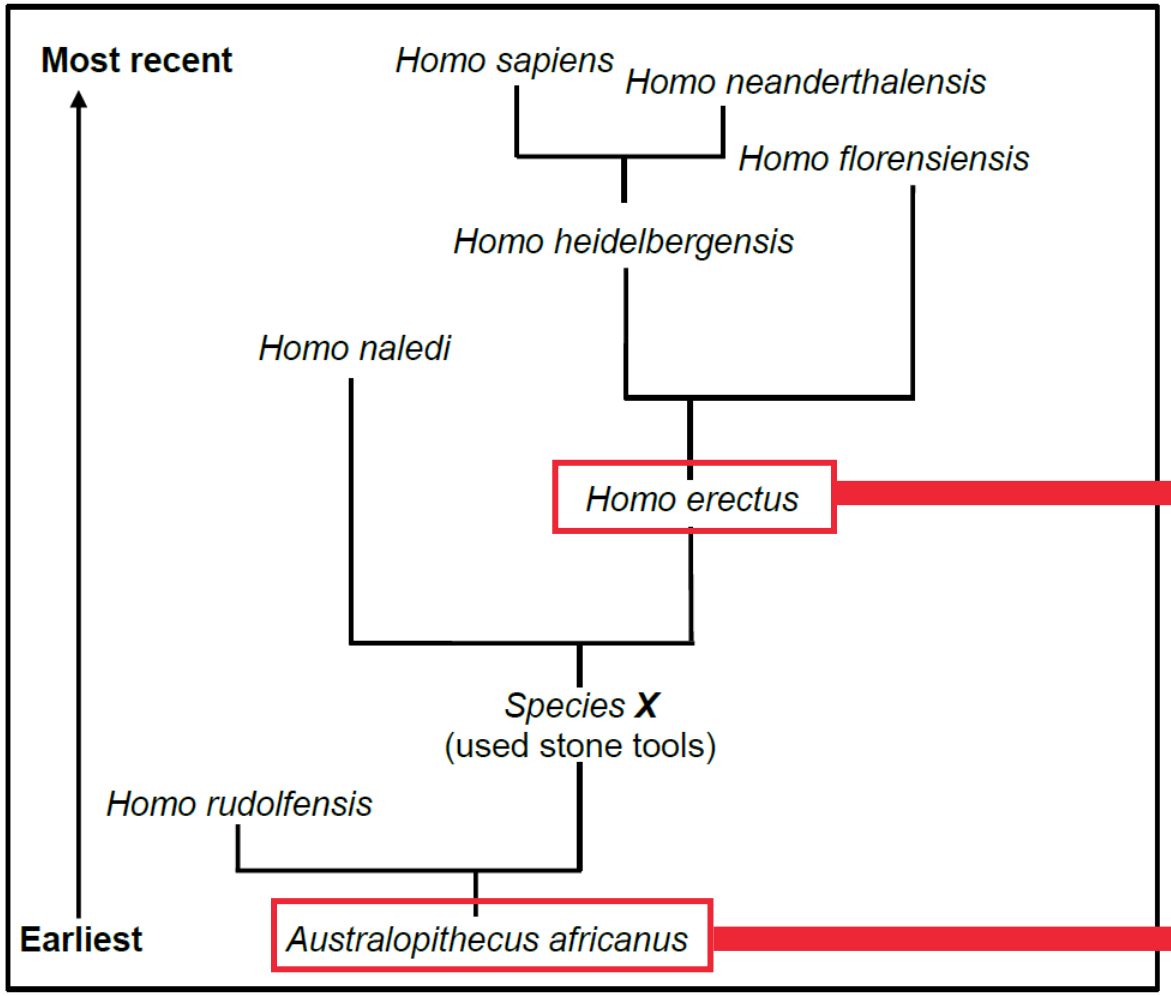
SPECIES, GENUS AND GENERA – Writing scientific names



Sometimes the genus name is abbreviated to its first letter :

H. erectus

abbreviated **genera**

A. africanus

NOTE

Genus = singular

Genera = plural

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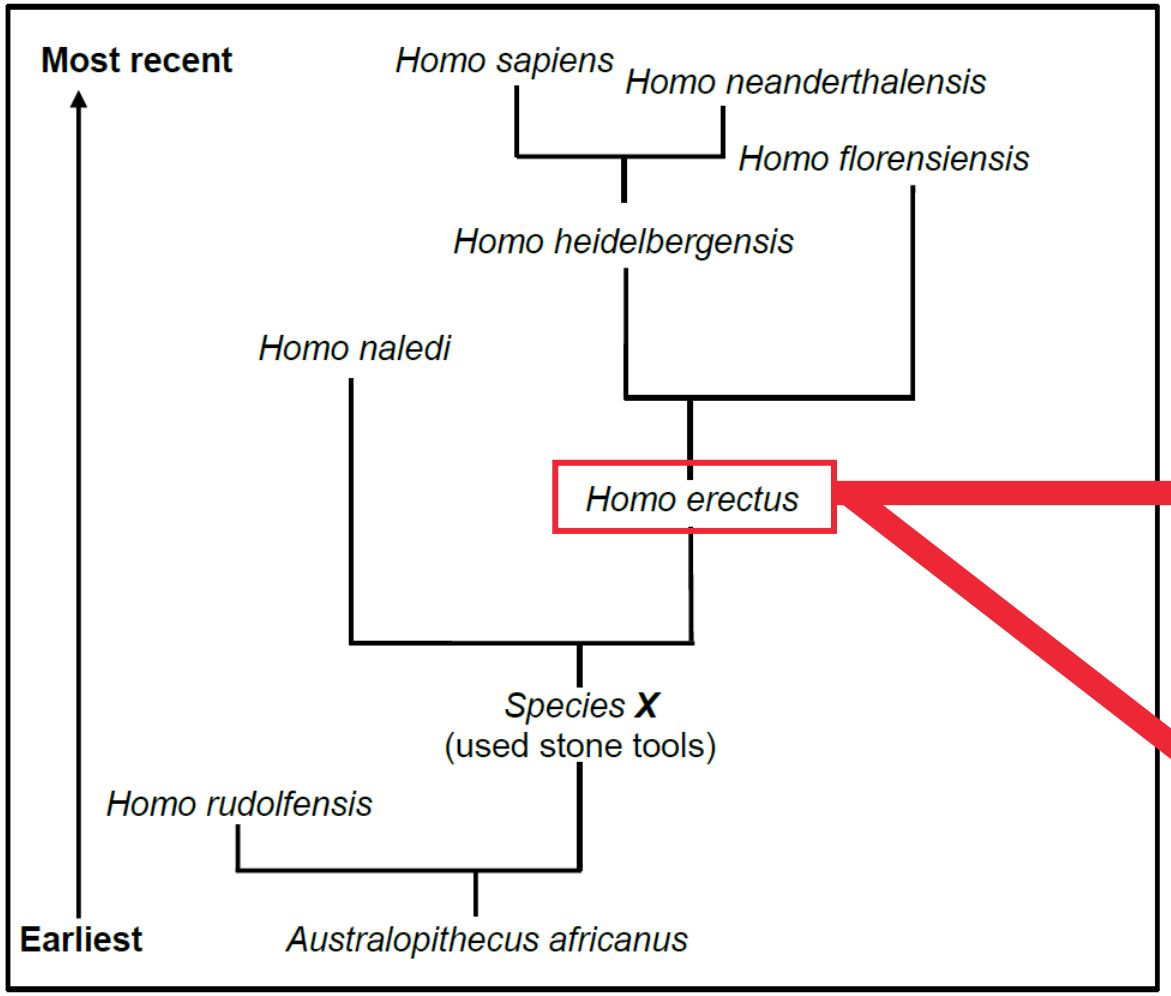
SPECIES, GENUS AND GENERA – Writing scientific names



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When typed, a scientific name must be in italics:

Homo erectus

When written, a scientific name must be underlined – both parts separately:

Homo erectus

NOTE

Always write the full two-part scientific name of an organism in exams.

THE ANSWER SERIES Your Key to Exam Success

TRANSITIONAL FOSSILS

SPECIES	EXISTENCE ON EARTH	CHARACTERISTICS
Pakicetus 	50 mya	Quadrupedal carnivore
Ambulocetus 	48 mya	Flipper-like large feet and tail for swimming
Dorudon 	40 mya	Large flippers in front and very small hind limbs
***Balaena* (Blue whale)** 	Present day	Non-functioning pelvis and large flippers in front

Return to home

- ✓ A transitional fossil displays the **intermediate phenotype**.
- ✓ It shares characteristics with a **predecessor** (which comes before it) and/or a **descendant** (which comes after it).
- ✓ For example, *Ambulocetus* shares:
  - **feet** with its **predecessor** (*Pakicetus*)
  - **flipper-like feet** for swimming with its **descendents** (*Dorudon* and *Balaena*)

Continue learning

TRANSITIONAL FOSSILS

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Return to home

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- ✓ For example, *Dorudon* shares:
  - **feet** with its **predecessors** (*Pakicetus* and *Ambulocetus*)
  - **flipper-like feet** for swimming with its **descendent** (*Balaena*)

NATURAL SELECTION – Format of steps

Describe the evolution of resistance to antiretroviral medication in HIV.

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1. Describe the **variation** in the original population.
2. Describe a **selection pressure**. (Think 'Then something happens…')
3. Describe the **struggle for survival**.
4. State Darwin's **theory**.
5. Describe the **inheritance** of **traits**.
6. What happens **after** a long **time**?

1. In an HIV population there is variation in the resistance to antiretroviral drugs – some viruses are resistant to the drugs and other are not.
2. Antiretroviral medication/drugs is administered / missed.
3. HIV that is resistant to the ARVs will survive while those that are not resistant will die/not survive.
4. This is called Natural Selection.
5. Resistant HIV strains survive and produce more viruses that also carry the ARV-resistant trait.
6. Eventually there will be more ARV-resistant HIV in the population and treatment will be ineffective.