KWAZULU-NATAL PROVINCE
EDUCATION
REPUBLIC OF SOUTH AFRICA

CURRICULUM GRADE 10-12 DIRECTORATE

NCS (CAPS)

LEARNER SUPPORT DOCUMENT

GRADE 12

LIFE SCIENCES

SPRING CLASSES

2025

PREAMBLE

This document has been prepared as support material for 2025 Grade 12 Life Sciences.

This document takes the following into account:

1. Focus on **core concepts and content** per topic as well as the relevant Life Sciences skills.
2. Activity based Revision sessions and constant feedback on assessments/activities given.
3. **Scaffolding of concepts** according to **cognitive/difficulty levels** and a differentiated approach to cater for learners with different abilities.
4. Addressing the **Common errors & misconceptions** in each topic.
5. Providing multiple opportunities for learners to master concepts through multiple exposure using different source stimuli.
6. A focus on **scientific investigations** and **biological terminology** for each topic.
7. Consolidating and supplementing topics through the use of previous examination question papers.

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Topic: Plant response to the Environment

DIAGNOSTIC ANALYSIS

Common errors and misconceptions	Possible solutions
• Learners fail to differentiate the effect of high concentration of auxins in the stem and in the root.	• Emphasis should be placed on the fact that a high concentration in the stem promotes growth, while inhibiting growth in the roots. • More activities on this aspect should be given.
• Learners seem to lack information on other functions of auxins besides role in phototropism and geotropism.	• Teachers should focus on all the functions of auxins in plants and not only phototropism and geotropism. • Teachers should also explain role of auxins as herbicides and also the effect of cutting of the tips of plants.
• Learners fail to understand the effect of apparatus/ materials used in investigation, such as agar and clinostat (effect of rotating and stationary clinostat)	• Wherever possible, the investigations involving plant responses to the environment should be done. If not, then learners must be exposed to the practical design of these experiments through worksheets, notes, slides and past examination papers.
• Learners fail to apply the role of abscisic acids and gibberellins in agriculture	• Teachers should explain the use of abscisic acids and gibberellins in agriculture and expose learners to a variety of questions on these aspects

Activity 1

Give the correct **biological term** for each of the following descriptions.

No.	Description	Biological Term
1.1	Growth or bending reaction by plants in response to light stimuli.	
1.2	A plant hormone that promotes apical dominance.	
1.3	The plant hormone that causes leaves to fall off trees in Autumn.	
1.4	Chemical used by farmers to kill weeds.	
1.5	Promotes sprouting of buds.	
1.6	Inhibition of the growth of lateral buds by auxins present in apical buds.	
1.7	A movement of part of a plant in response to gravity.	
1.8	Plant growth responses to external stimuli.	
1.9	Sharp structures found in plants for protection from herbivores.	
1.10	The plant hormone that stimulates the germination of seeds.	
		10x1 **(10)**

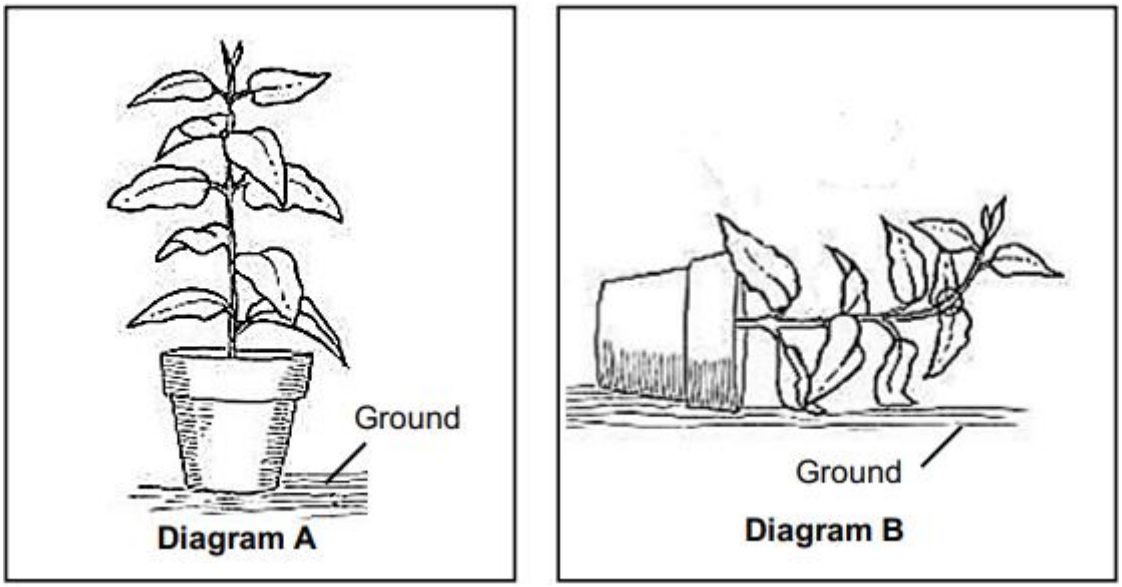
Activity 2

Indicate whether each of the descriptions in COLUMN I applies 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 (2.1 to 2.3) in the ANSWER BOOK.

	COLUMN I	COLUMN II
2.1	A plant hormone that stimulates the germination of seeds	A: Abscisic Acid B: Gibberellins
2.2	A defence mechanism that protects plants against herbivores	A: Thorns B: Chemicals
2.3	A plant hormone that inhibits the germination of seeds	A: Gibberellins B: Abscisic acid
2.4	Plant hormone that helps plant seeds to survive unfavorable conditions, e.g. droughts	A: Gibberellins B: Abscisic acid

Activity 3

3 Diagram **A** shows an upright pot plant. Diagram **B** shows the same pot plant one week after falling over. The plant was exposed to uniform light from all directions before and after falling over.



3.1 Which type of tropism is illustrated in **Diagram B**? (1)

3.2 Explain why the stem of the plant bent upwards, as illustrated in **Diagram B**. (4)

3.3 Explain the advantage that the upward bending of the stem could have for the plant. (2)

3.4 State how the roots in **Diagram B** would react. (1)

(8)

Activity 4

4. Read the extract below.

> Auxins control different aspects of growth and development in plants. They are known to influence the growth of stems and they also stimulate the development of new roots on stem cuttings in plant propagation.
>
> During plant propagation, a stem of a plant is cut and is then placed in water containing small quantities of artificial auxins. The auxins stimulate root development in the cuttings.

Auxins control different aspects of growth and development in plants. They are known to influence the growth of stems and they also stimulate the development of new roots on stem cuttings in plant propagation.

During plant propagation, a stem of a plant is cut and is then placed in water containing small quantities of artificial auxins. The auxins stimulate root development in the cuttings.

4.1 Name TWO places in plants where auxins are produced. (2)

4.2 State TWO ways in which auxins cause an increase in the length of stems. (2)

4.3 Name ONE other plant hormone that causes an increase in the length of stems. (1)

4.4 Explain how auxins can be used in plant propagation to the advantage of nature conservation. (2)

(7)

Activity 5

5. An investigation was conducted to determine the effect of different concentrations of gibberellins on the average percentage and rate of seed Germination in Penstemon digitalis (a garden plant).
The following procedure was followed:
• Thirty seeds of P. digitalis were used.
• The seeds were divided into three groups of ten (groups A, B and C).
• The seeds in each group were soaked in different concentrations of gibberellins for 24 hours, as shown in the table below:

GROUP	CONCENTRATION OF GIBBERELLINS (mg/ℓ)
A	0
B	500
C	1 000

• The seed mixtures were then filtered and rinsed under cold, distilled water for 2 minutes.
• The three groups of seeds were then placed in a dark growth chamber at a temperature of 21, 3 °C.
• Each day for 10 days, the groups of seeds were given the same amount of water.

The seeds were observed each day. They were considered to have germinated as soon as the shoots and roots first appeared.

The average percentage and rate of seed germination was calculated for each day.

5.1 Identify the TWO dependent variables in the investigation above. (2)
5.2 State THREE factors not related to gibberellins that were kept constant in this investigation. (3)
5.3 State ONE factor that should have been kept constant with regard to the gibberellins during the investigation. (1)
5.4 Explain the advantage of including many seeds in each group of seeds. (2)
5.5 Explain why the seeds were left to germinate in a dark growth chamber. (2)
(10)

Activity 6

6. A learner investigated the effects of two plant growth substances, gibberellins and auxins, on apical dominance. The apical buds of nine pea plants of the same species, age and height were removed. These plants were then divided equally into three groups. In each group the cut surface of the remaining shoot (growing stem) of the pea plants was treated in one of the following ways:

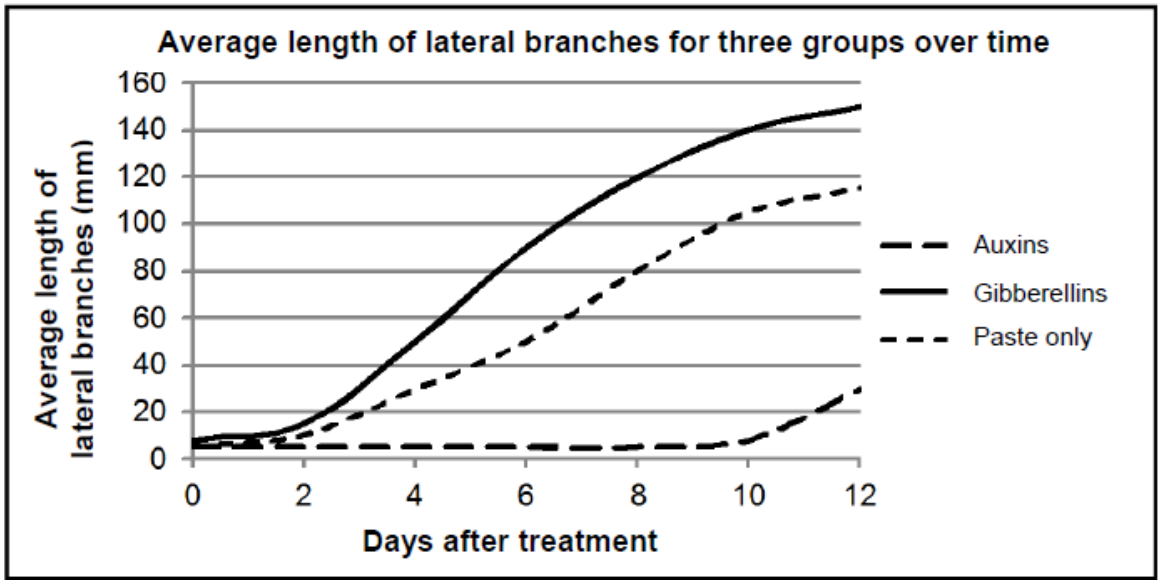
Group 1: Coated with a paste containing gibberellins of the same concentration

Group 2: Coated with a paste containing auxins of the same concentration

Group 3: Coated with a paste only (containing no plant growth hormones)

The hormones diffuse into the plant until no more hormones remain in the paste. The treated plants were all grown under the same conditions in the laboratory. The length of the lateral branches of each plant was measured after every two days for a period of 12 days. Measurements were taken at the same time for all treated plants and the average for each group was calculated.

The results of the investigation are shown in the graph below



6.1 State ONE function of the gibberellins that led to the results obtained in the investigation. (1)

6.2 Calculate the difference in the average length of the lateral branches between the plants treated with gibberellins and the plants treated with the paste only on the 8th day after the treatment. Show ALL working. (3)

6.3 State TWO ways in which the reliability of the investigation could be increased. (2)

6.4 Use the results to explain the effect of auxins on the growth of the lateral branches. (4)

(10)

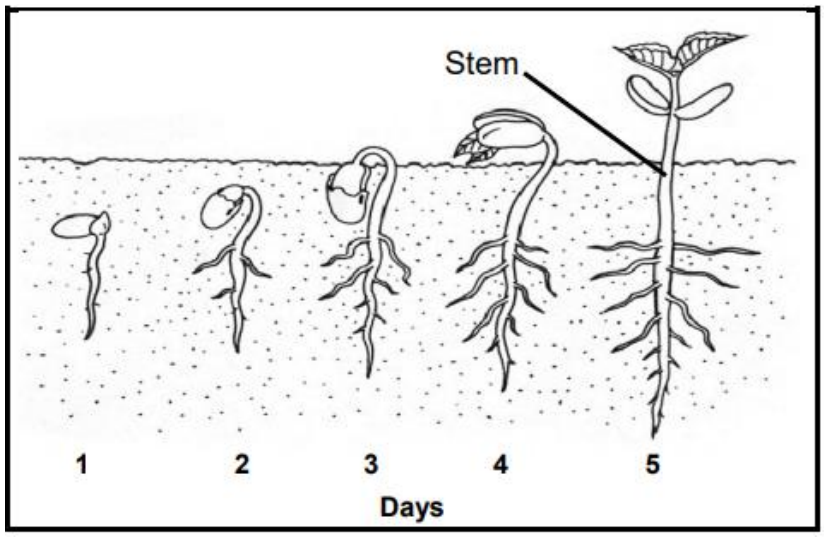
Activity 7

7 An investigation was conducted to determine the relationship between seed germination and the amount of abscisic acid found in the seed. The procedure was as follows:

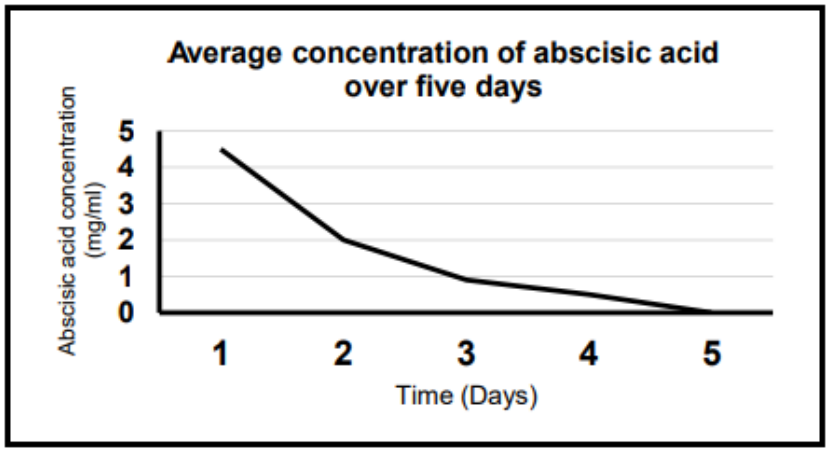
- 10 seeds were placed on damp cotton wool on a tray
- The tray was placed in a dark cupboard
- The abscisic acid concentration in the seeds was measured in the laboratory every day

for five days.

The diagram below shows one of the seeds that germinated.



The graph below shows the average concentration of abscisic acid in the 10 seeds.



7.1 Identify the:

(a) Independent variable. (1)

(b) Dependent variable. (1)

7.2 State the function of abscisic acid (1)

7.3 Describe the trend of the hormone concentration as shown in the graph. (2)

7.4 Explain the effect of the trend described in **QUESTION 7.3** on the seed germination (2)

7.5 State TWO ways to increase the validity of this investigation. (2)

7.6 Explain the plant growth response shown by the stem of the seedling on days 4 to 5. (4)

(13)

Activity 8

8. The table below shows the concentration of abscisic acid and gibberellins in germinating seeds over 10 days.

TIME (DAYS)	HORMONE CONCENTRATION IN GERMINATING SEEDS (ARBITRARY UNITS)	
	ABSCISIC ACID	GIBBERELLINS
0	20	0
2	8	1
4	4	4
6	3	7
8	2	10
10	1	12

[Adapted from *Biology Cambridge,* 2013]

8.1 Draw a line graph to show the changes in the concentration of abscisic acid over the period of the investigation. (6)

8.2 State what happened to the concentration of each of the following hormones over the period of the investigation:

(a) Abscisic acid (1)

(b) Gibberellins (1)

8.3 Explain the growth response of a plant when the stem is exposed to light coming from one side only. (4)

(12)

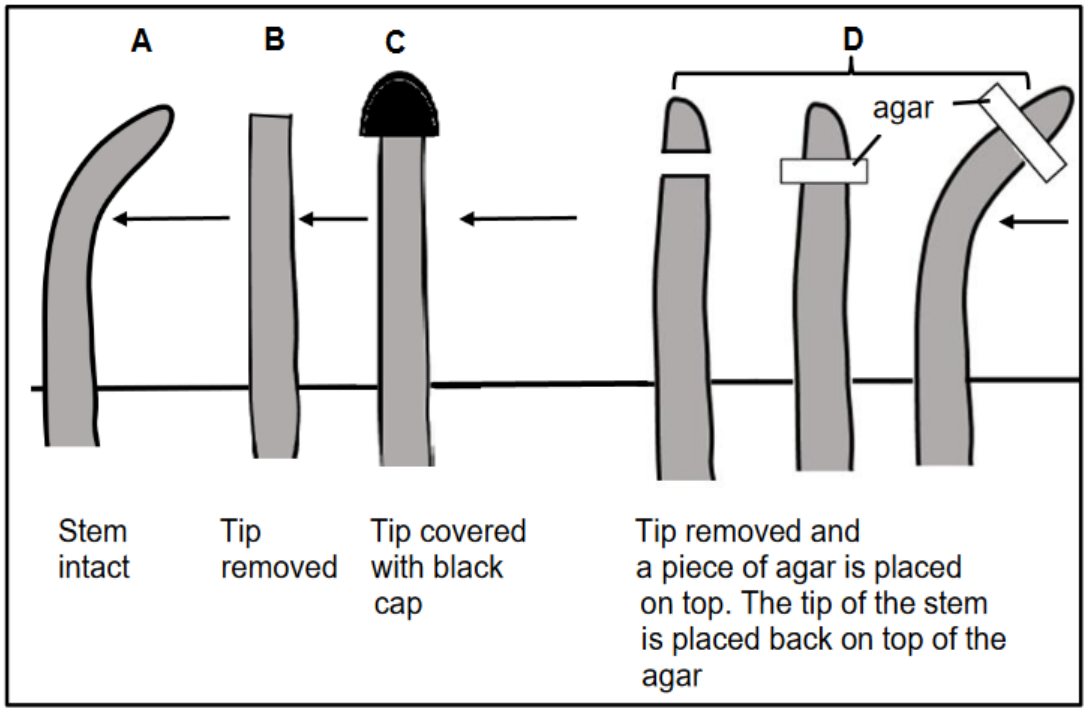
Activity 9

9. Phototropism was investigated in young stems.

A group of stem tips were exposed to a unilateral light. The stem tips were treated differently.

Stem A's tip was intact, stem B's tip was removed, and stem C's tip was covered with a black cap. In diagram D the tip was removed, and agar (jelly-like substance) was placed between the tip and the stem.

The diagrams below show the different treatments and results. The arrows indicate the position of a unilateral light source.



9.1 Name the plant hormone that causes the growth movements illustrated in the diagrams. (1)

9.2 Define phototropism. (2)

9.3 Explain why stem D grows towards the light source. (6)

9.4 Explain the result of the experiment with stem C. (3)

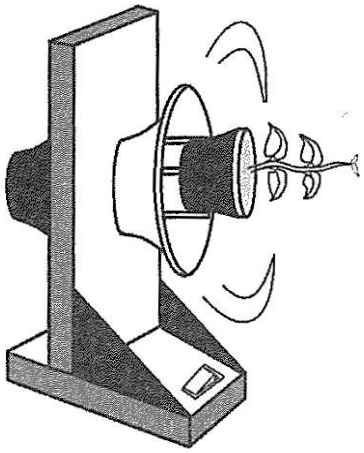
(12)

Activity 10

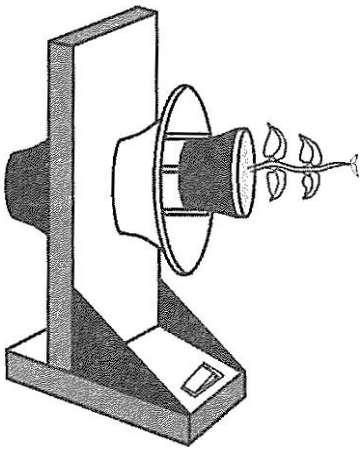
10. An investigation was done to determine the effect of gravity on the direction of growth of the stem.
The procedure was as follows:

- Two plants of the same species, height and age were selected
- Plants were exposed to the same environmental conditions (water, nutrients and type of soil)
- Both plants were attached to a clinostat.
- They were then exposed to light from all directions.

The experiments were setup as shown in the diagram below.



Rotating clinostat
DIAGRAM I



Stationary clinostat
DIAGRAM II

10.1 Suggest ONE reason why it is important for the stem of the plant to grow towards the light. (1)

10.2 What is the term given to the growth movement of a part of a plant in response to gravity? (1)

10.3 State the purpose of rotating the clinostat in DIAGRAM 1 during the investigation. (1)

10.4 Explain the results that will be obtained after 2 weeks in DIAGRAM 11. (5)

10.5 If the growth tip of the stem in DIAGRAM I was removed at the start of the investigation, explain the results that will be obtained after 2 weeks. (4)

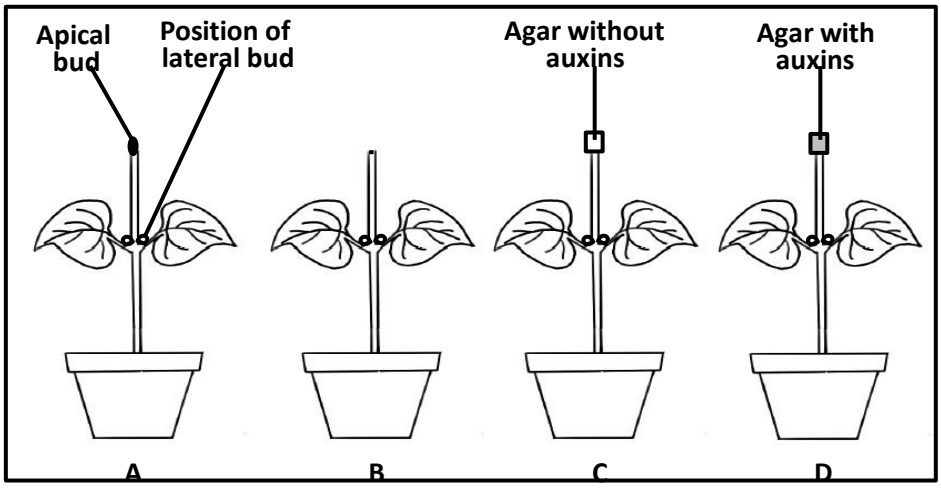
(12)

Activity 11

11. An investigation was done to determine the effect of auxins on the growth of lateral branches. (The elongation of lateral buds results in the growth of lateral branches.)

The procedure was as follows:

- Four potted plants (A, B, C and D) of the same species were used.
- Plant A was left untreated.
- The apical bud of plant B was removed.
- The apical bud of plant C was removed and replaced with agar jelly (a jelly-like substance through which other substances can diffuse).
- The apical bud of plant **D** was removed and replaced with agar jelly containing auxins.
- The plants were exposed to the same environmental conditions.
- The length of the lateral buds of each plant was measured at the beginning of the investigation and again after three weeks.
- The diagram below shows the setup of the investigation at the beginning



The results are shown in the table below.

Plant	Length of the lateral buds (mm)	
	At the beginning	After three weeks
A	7,0	7,3
B	6,9	10,4
C	7,2	10,3
D	7,1	7,2

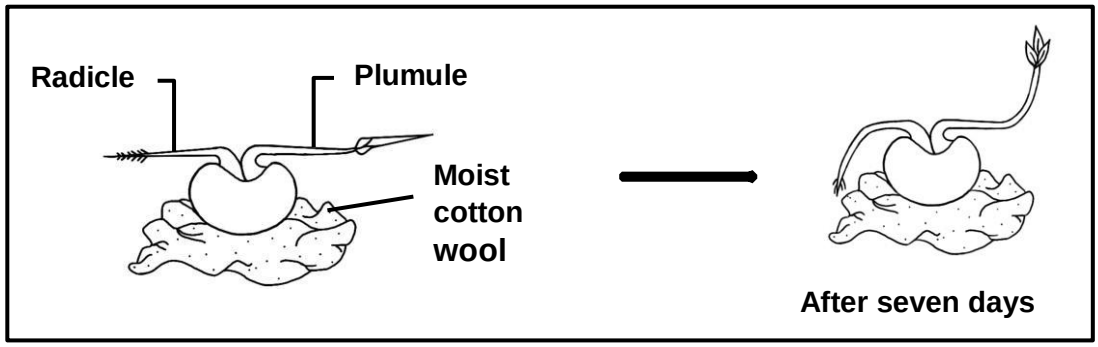
11.1 For this investigation, state the:
(a) Independent variable (1)
(b) Dependent variable (1)
11.2 Explain why all the plants were exposed to the same environmental conditions (2)
11.3 Explain why agar without auxins was used in plant **C**. (3)
11.4 State a conclusion for this investigation. (2)
(9)

Activity 12

12. An experiment was set up to investigate a plant growth response to a stimulus.

A seedling has a radicle (young root) and a plumule (young stem).

This seedling was placed horizontally in a dark place and a growth response was observed after seven days, as shown in the diagram below.



12.1 Name the:
(a) Growth response observed after seven days (1)
(b) Plant hormone responsible for the growth response named in QUESTION 12.1 (a) (1)
12.2 Explain the growth response observed in the root of the seedling. (5)
12.3 Explain how a control set-up will be different from the above set-up (2)
(9)

TOPIC: GENERAL EVOLUTION

DIAGNOSTIC ANALYSIS

Common Errors and misconceptions	Possible Solutions
• Most candidates lacked the ability to apply the process of artificial selection for the given scenario. They were generic in their responses and many confused this process with genetic engineering. • A number of candidates did not know how to calculate 'by how many times'; many calculated the percentage increase while some calculated the difference. • Many of the candidates could not differentiate between the process of artificial selection and genetic engineering.	✓ Biotechnology involves the manipulation of genes of an organism, especially genetic engineering, when a 'gene is taken from one organism and inserted in another organism'. ✓ Artificial selection e.g. when a 'donkey is interbred with a horse' ✓ The difference in these processes is that artificial selection involves interbreeding of whole organisms, whilst genetic engineering involves a single gene inserted in an organism.
• There were some common errors and misconceptions which caused some candidates to lose marks in describing natural selection. These candidates: o Referred to variation in species/organisms. Natural selection occurs in a population. o Wrote 'desirable characteristic' instead of 'favourable characteristic'. o Stated that organisms 'that could not adapt' instead of 'that were not adapted'. o Indicated that these organisms 'became extinct' instead of 'died out'. o Stated that organisms 'produce' instead of 'reproduce'. o Indicated 'ALL the individuals in the next generation' instead of 'There will be a greater proportion of individuals.'	✓ Teachers must support learners to learn the sequence of steps describing *natural selection* or *speciation* found in the *2021 Examination Guidelines*. ✓ Learners should also be able to apply this generic process to the source material provided. Special care needs to be taken to tailor their answers to the context of the question given.
• Scientific investigations remain a challenge for candidates. Many candidates lost marks because they: o Incorrectly identified the variables while some wrote the 'effect of' for an independent variable. Whilst some candidates are swopping the independent and dependent variable.	✓

○ Failed to write the factors as outlined in the procedure. They stated 'same species of lizards' instead of 'similar species of lizards' and 'were kept in the same environment' instead of 'were kept in an environment similar to their habitats'. ○ Gave generic responses such as 'same measuring tool'. ○ Wrote the whole sentence in the procedure and did not identify the exact variable in that sentence ○ Wrote a generic response or incorrectly stated 'the *investigation* was done 5 times' instead of 'the *measurements* were done 5 times.' Some candidates stated that 'calculating an average' increased the reliability. ○ Did not write the relationship between the two variables to show the variable that influenced the other. Some wrote terms like 'directly proportional': In Life Sciences they are required to be explicit in the nature of the relationship between the variables. In some cases, the candidates did not include all aspects (height of the head, bite force). ○ Failed to articulate the degree of comparison between 3 species for the data given. They used 'stronger' instead of 'strongest'.	

Activity 1

Give the correct **biological term** for each of the following descriptions.

	DESCRIPTION	**TERM**
1.1	Organisms that are able to interbreed and produce fertile offspring	
1.2	A type of variation where there is a range of phenotype for the same characteristics	
1.3	Present day distribution of living organisms	
1.4	The selection of desirable characteristics by humans	
1.5	The process whereby new species are formed	
1.6	The type of variation in a population with no intermediate phenotype	
1.7	An evolution consisting of long periods of little/no change alternating with short periods of rapid change	
1.8	The permanent disappearance of species from earth	
1.9	An explanation for something that has been observed in nature and which can be supported by facts, laws and tested hypothesis	
1.10	Organisms with similar characteristics, able to interbreed randomly and produce fertile offspring	
1.11	The process that enables organisms with desirable characteristics to survive and reproduce in a particular environment	
1.13	The type of evidence for human evolution that includes tool-making	
1.14	Change of living organisms over successive generation through genetic variation and natural selection	
	(14 x 1)	**(14)**

Activity 2

Indicate whether each of the descriptions in COLUMN I applies 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.

	Column I	**Column II**
2.1	A group of similar organisms that occurs in a particular place at a particular time with the ability to interbreed	A: Population B: Species
2.2	The manipulation of biological processes to satisfy human needs	A: Biogeography B: Biotechnology
2.3	Mechanisms of reproductive isolation	A: Species-specific courtship behaviour B: Breeding at different times of the year
2.4	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
2.5	The scientist who proposed the law of use and disuse	A Darwin B Lamarck
	(5 X 2)	**(10)**

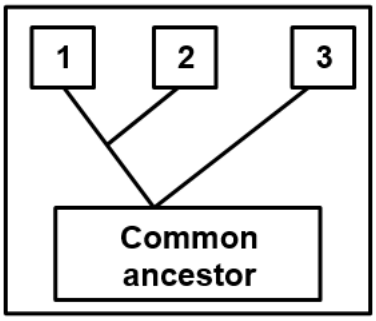
Activity 3

3. Scientists compare the number of differences in the amino acid sequence to see how closely related species are. Fewer differences in the amino acid sequence mean the species are more closely related.

Cytochrome C is a protein that occurs in many species. The amino acid sequence of this protein differs between species.

The table below shows the number of differences in the amino acid sequences of three species, **A**, **B** and **C.**

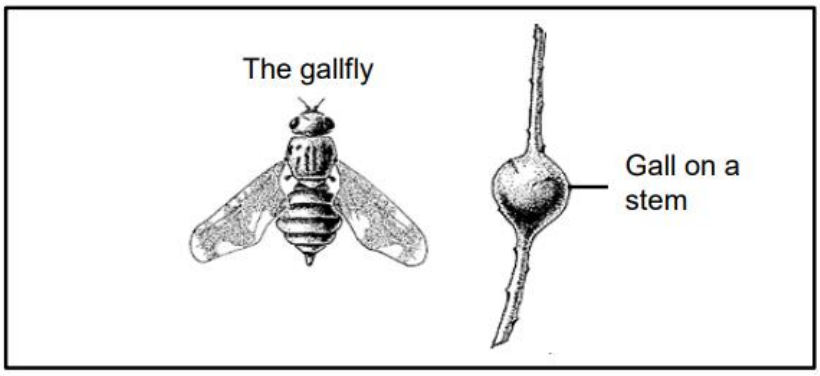
	SPECIES B	**SPECIES C**
SPECIES A	**11**	**3**
SPECIES B		**10**

	3.1	What type of evidence for evolution is being used in this table?	(1)
	3.2	Give the LETTER of the species, **A**, **B** and **C**, that should appear at positions 1, 2 and 3 in the diagram below.  	(3)
			(4)

Activity 4

Female gallflies lay eggs on the stems of plants. The eggs hatch to form larvae that secrete a substance into the plant tissue. The secretions cause the plant cells to grow and form ball-like structures, called galls, which are high in nutrients. Predatory birds feed on the larvae called galls.
The size of the galls produced actually depends on genetic variation in the gallfly.

The diagram bellow shows the gallfly and a gall on a plant stem.



Scientists wanted to investigate whether the size of the galls had an effect on the percentage of the gallfly killed by predatory birds.

The table below shows the results of their investigation.

Gall size (mm)	Gallfly larvae killed by predatory birds (%)
10	1
15	0
20	1
25	2
30	10

4.	4.1	State the: (a) independent variable (b) dependent variable	 (1) (1)
	4.2	Give ONE advantage of the gall to the gallfly larvae.	(1)
	4.3	State why the size of the galls produced is an example of continuous variation	(1)
	4.4	Explain how the percentage of gallfly larvae killed by predatory birds is influenced by the size of the gall.	(3)
	4.5	Draw a line graph to represent the information in the table.	(6)
			(13)

Activity 5

5. The fat content of cow's milk may vary between 2,6% and 5%. A farmer has found that there is a high demand for low-fat milk (milk with a content of 3% or less). He determined the fat content in the milk produced by the cows on his farm.

The results of his survey are given in the table below.

FAT CONTENT (%)	NUMBER OF COWS
2,6 – 3,0	11
3,1 – 3,5	66
3,6 – 4,0	93
4,1 – 4,5	61
4,6 – 5,0	15

5.1	State the type of variation that occurs in the cows, based on the evidence in the table.	(1)
5.2	Give a reason for your answer to **QUESTION 5.1**	(1)
5.3	Calculate the percentage of the farmer's cows that produce low-fat milk. Show All your working.	(3)
5.4	Draw a histogram to represent the results of the survey.	**(6)**
		(11)

Activity 6

6.	6.1	Describe the process of natural selection.	(7)
	6.2	Tabulate THREE differences between Lamarckism and Darwinism	(7)
			(14)

Activity 7

7.	Lamarck based his theory of evolution on two principles, ideas or 'laws'.		
	7.1	Name and describe TWO principles that Lamarck used to explain how evolution took place	(6)
	7.2	Give TWO reasons why Lamarck's theory is NOT accepted.	(4)
			(10)

Activity 8

8.	Explain why modern-day Spider monkeys all have long tails whereas ancestors of Spider monkeys had much shorter tails using:		
	8.1	Lamarck's theory	(6)
	8.2	Darwin's theory	(8)
			(14)

Activity 9

<table>
<tr><td>9.</td><td colspan="3">Read the extract below:

MUTATION IN GENE ALLOWS TIBETANSTO SURVIVE AT HIGH ALTITUDE

It is possible to cope with the low oxygen content at high altitudes

One way is for the body to produce more red blood cells in response to an increase in altitude.

Another way of coping has developed in Tibetans as a result of a gene mutation that they inherited from their ancestors. The mutant gene helps them to use the low amount of oxygen present more efficiently. The mutant gene was found in 87% if the Tibetan population but only in 9% of the Han population that live at a lower altitude the Tibetans.

A gene mutation caused variation between the Tibetan population and the Han population..</td></tr>
<tr><td></td><td>9.1</td><td>Name THREE other sources of variation in a human population.</td><td>(3)</td></tr>
<tr><td></td><td>9.2</td><td>Give evidence in the extract which suggests that the survival of people living at high altitudes could be:

(a) due to a genetically inherited trait.
(b) caused by an environmental factor.</td><td>

(1)
(1)</td></tr>
<tr><td></td><td>9.3</td><td>Explain the advantages of producing more red blood cells.</td><td>(2)</td></tr>
<tr><td></td><td>9.4</td><td>Describe how Lamarck would have explained the survival of Tibetans at high altitudes</td><td>(6)</td></tr>
<tr><td></td><td></td><td></td><td>(13)</td></tr>
</table>

Activity 10

10.	A population of lizards on an island, Island **A,** were well suited to feed mainly on insects. Scientists moved five adult pairs of this lizard species to a neighbouring island, Island **B**. Here they reproduced and a new population formed. Island **B** has a large supply of plants with tough fibrous leaves and fewer insects. Exposure to this new environment may have caused the lizards to undergo evolution. Thirty-six years later, scientists returned to Island **B** to conduct further investigations on the lizard population there. They observed that the jaw size of the lizards had increased. Scientists also analysed the stomach content of the lizards and found that it was mainly plant-based. They also confirmed that the two populations still belong to the same species.

	10.1	Describe how the scientists could confirm that there was a change in jaw size between the lizards of Island **A** and the lizards of Island **B**.	(3)
	10.2	Explain how the larger jaws of the lizards on Island **B** would be structurally suited to eat tough fibrous leaves.	(3)
	10.3	How did the scientists determine that the two populations of lizards on both islands still belong to the same species?	(2)
	10.4	Explain the possible effect that the evolution of the lizards has on biodiversity.	(2)
	10.5	Use Darwin's theory of natural selection to explain the evolution of lizards with larger jaws.	(7)
			(17)

Activity 11

11. 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

	11.1	Which ancestor of whales most likely lived both in water and on land?	(1)
	11.2	Give ONE reason for your answer to QUESTION 11.1.	(2)
	11.3	Explain why *Ambulocetus* and *Dorudon* may be considered as transitional species in the evolution of whales.	(2)
	11.4	Explain, according to Lamarck, why modern-day whales do not have legs.	(3)
			(8)

Activity 12

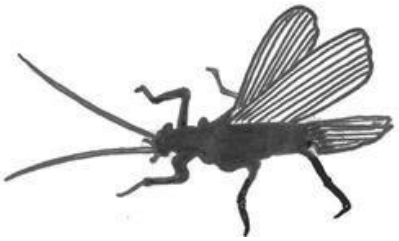
12.	Read the extract below. The red-bellied black snake (*Pseudechis porphyriachus*) and the green tree snake (*Denderelaphis punctualatus*) are predators that sometimes feed on can toads (*Bufo mannus*) that contain a toxin that may kill them. The snakes consume the loads by swallowing them whole. A decrease in the average jaw size has been observed over a period of 70 years. Some scientists believe that this may be an example of punctuated equilibrium. With this change it was also noted that the snakes could no longer swallow the large cane toads. This has resulted in an increase in the survival of the snakes		
	12.1	Define *punctuated equilibrium*.	(3)
	12.2	What characteristic of the toad species protects it from predation?	(1)
	12.3	Explain how the change in jaw size helped the snakes to survive.	(3)
	12.4	How would the Lamarck have explained the development of small jaw size in the snakes?	(4)
			(11)

Activity 13

Insects on islands without trees are likely to be wingless because flying is dangerous for them in an area with strong winds.

A certain island was once covered with tall trees. Over the years, there has been deforestation in some areas of the island. On this island, insects called stoneflies, have undergone natural selection. Some have wings and some do not have wings, depending on the area where they are found.

The diagram below shows stoneflies with and without wings.



Stonefly with wings

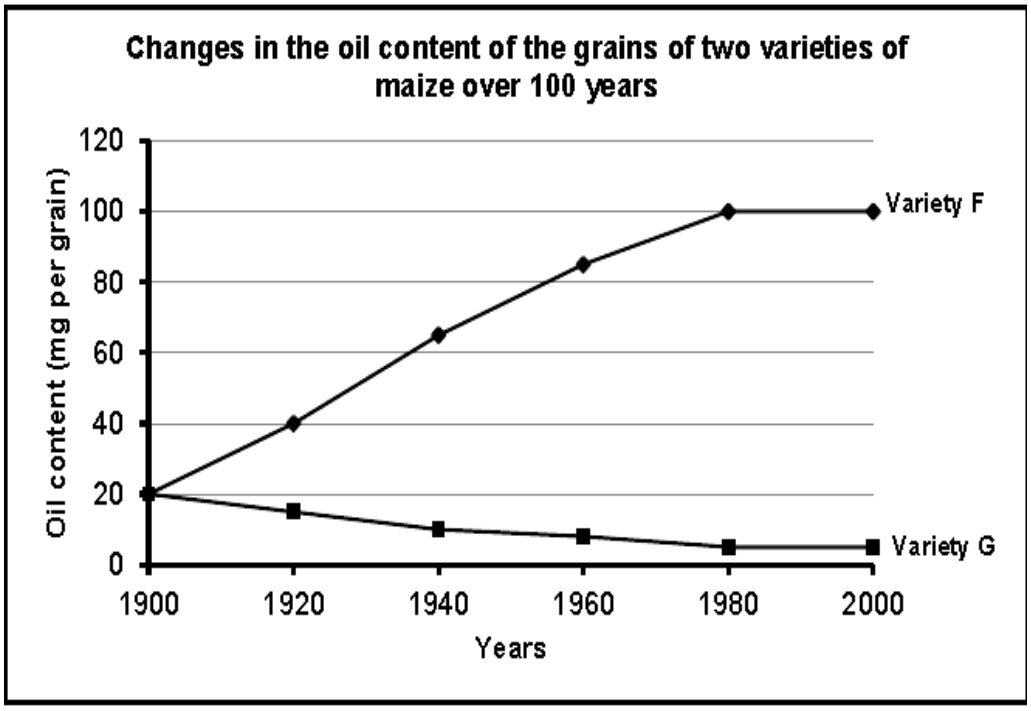
Stonefly without wings

Scientists wanted to determine the relationship between the presence of tall trees and the wings on the stoneflies.

- They selected six locations, of which three had tall trees and three were without trees.
- Using a specialised net, they collected thousands of stoneflies in each location.
- The samples were labelled according to the area of collection.
- These samples were all collected in the morning during summer.
- The number of stoneflies with wings and without wings at each location was counted and recorded.

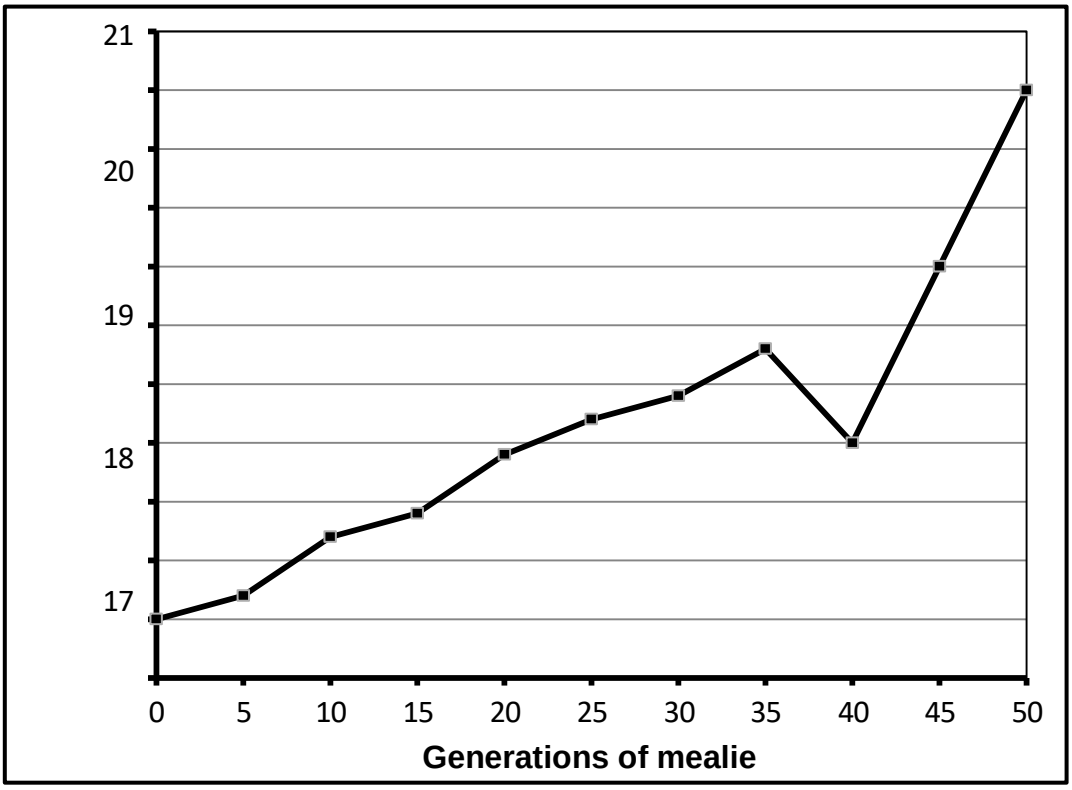
13.	13.1	Identify the: (a) Independent variable (b) Dependent variable	 (1) (1)
	13.2	State TWO factors that were kept constant during the investigation.	(2)
	13.3	State TWO ways in which the reliability of this investigation was ensured.	(2)
	13.4	Explain why it would be expected that more stoneflies will have no wings in the areas without trees.	(4)
	13.5	Describe how Lamarck would have explained the evolution of stoneflies without wings in the areas without trees.	(5) **(15)**

Activity 14

14.	Artificial selection programme has produced two varieties of maize. One has grains with a high oil content (Variety F) and the other has grains with a low oil content (variety G) The graph below shows the changes in the oil content of the grains of the two varieties over 100 years of artificial selection.  		
	14.1	In which year did the two maize varieties have the same oil content?	(1)
	14.2	Calculate the percentage increase in the oil content of Variety F over the 100-year period. Show ALL working.	(3)
	14.3	Tabulate TWO differences between natural selection and artificial selection.	(5) **(9)**

Activity 15

The graph below shows the results of artificial selection for protein content in mealie plants over 50 generations.



15.	15.1	Describe how this farmer did artificial selection of the mealie plant.	(3)
	15.2	What was the average percentage of the protein content in the mealie grains (kernels) at the 15th generation?	(1)
	15.3	By how many times did the average percentage of the protein content in the mealie grains (kernels) increase between the 40th and 50th generation? Show ALL working.	(2)
	15.4	Describe ONE way in which the process of artificial selection is different from genetic engineering.	(2) **(8)**

Activity 16

16. Dogs have been selected and bred over many years to produce approximately 340 different dog breeds. They have been bred for certain characteristics desirable to humans. An analysis of 736 base pairs of the cytochrome-b gene showed that grey wolves are the only direct ancestor to present-day dog breeds. All dog breeds belong to the species Canis familiaris. The table below shows some dog breeds and their desirable characteristics.

Grey wolf	Dog breeds	Characteristics
	 Poodle	Intelligent
	 Pug	Loving, affectionate and playful
	 Saint Bernard	Outgoing and adventurous
	 Rhodesian ridgeback	Strong, athletic and fast

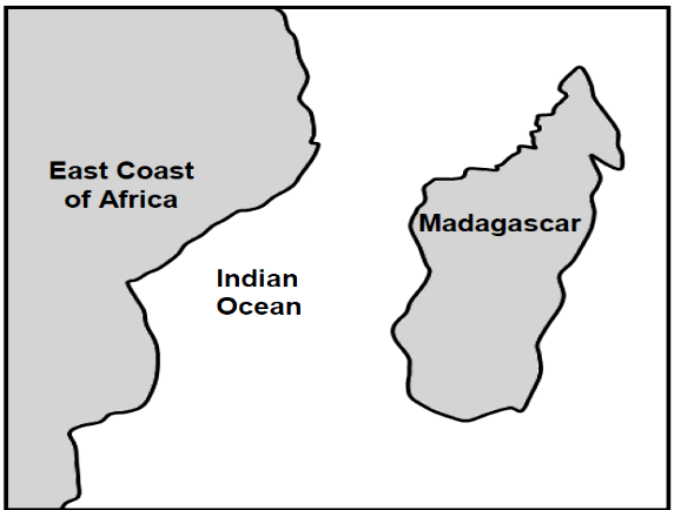
(3)

16.1	Name the process whereby the different breeds of dogs were produced.	(1)
16.2	Describe how humans carried out the process named in QUESTION	(3)
16.3	Explain how it can be confirmed that all these dog breeds belong to the same species.	(2)
16.4	Explain which of the dog breeds shown would best be used for hunting.	(2)
16.5	Explain how present-day dog breeds may be disadvantaged in relation to their common ancestor.	(3) **(11)**

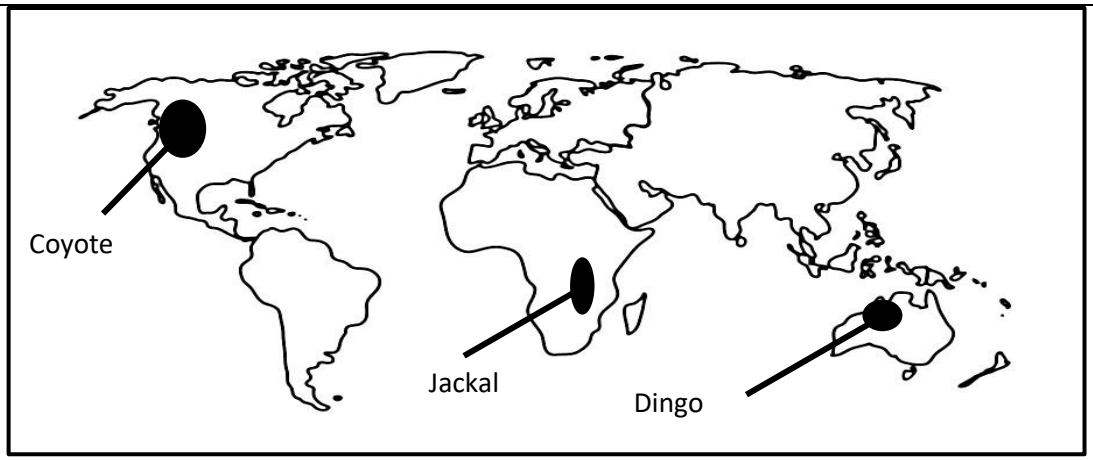
Activity 17

Describe the process of speciation through geographic isolation.	(7)

Activity 18

18.	Pottos and lemurs are small mammals. Scientists believe that pottos and lemurs share a common ancestor that existed in Africa. Presently pottos only occur in Africa while lemurs are only found in Madagascar. Madagascar is an island off the East of Africa as shown in the diagram below.		
			
	18.1	Explain how continental drift could have affected the distribution of the common ancestor	(4)
	18.2	Describe the speciation of the pottos and lemurs to become different	(6) **(10)**

Activity 19

19.	The present-day distribution of three closely related species of the dog family, the coyote, jackal and dingo, is shown on the world map below.		
			
	19.1	What type of evidence for evolution is represented here?	(1)
	19.2	What is a *biological species*?	(3)
	19.3	Describe how these three species could have evolved from a common ancestor.	(7) **(11)**

Activity 20

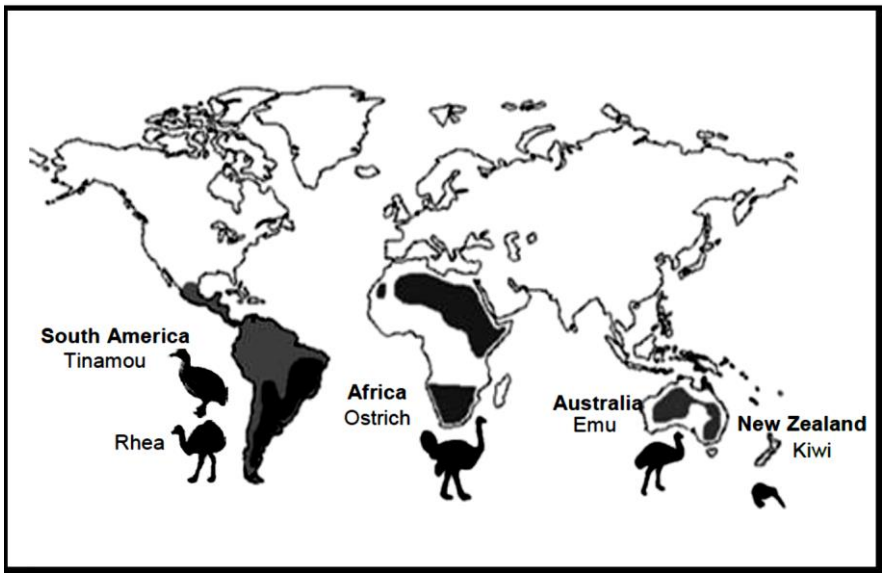
20.	Read the extract below.		
	Samango and vervet are two species of monkeys that occupy the same habitat. Researchers have recently discovered that a population of samango monkeys were able to interbreed with vervet monkeys to produce offspring. These offspring were infertile.		
	20.1	Define the term *population.*	(3)
	20.2	Give ONE reason why samango and vervet monkeys are considered to be two different species.	(1)
	20.3	List THREE mechanisms of reproductive isolation that are NOT mentioned above.	(3)
			(7)

Activity 21

21.	Read the passage below.		
	Datura flowers open in the evening and release a powerful fragrance which attracts hawk moths. The Datura produces a highly addictive nectar which ensures that the hawk moths stay longer inside the flower and only visit Datura flowers.		
	21.1	Explain TWO ways in which the Datura plants ensure that they are reproductively isolated.	(4)
	21.2	State TWO other mechanisms that would ensure reproductive isolation in plants.	(2)
			(6)

Activity 22

Flightless bird species that are currently distributed across different continents are shown in the picture below.



Scientists hypothesize that these species of flightless birds arose from a single common ancestor that was able to fly.

20.	22.1	Describe how Lamarck would have explained the evolution of flightless birds	(4)
	22.2	Name THREE reproductive isolation mechanisms that keep species separate.	(3)
			(7)

Activity 23

Use ONE example to describe the role of mutations in evolution in present times.	(8)

Activity 24

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 below.

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

24.	24.1	State the following for this investigation: (a) The dependent variable (b) The independent variable	 (1) (1)
	24.2	Based on the results, state ONE precaution for patients receiving antiretroviral treatment.	(1)
	24.3	State a conclusion for this investigation.	(2)
	24.4	Describe the evolution of resistance to antiretroviral medication in the HI virus.	(5)
			(10)

Activity 25

Weeds are problematic to farmers because they invade farm fields and outcompete crop plants for space. This reduces the crop yield.

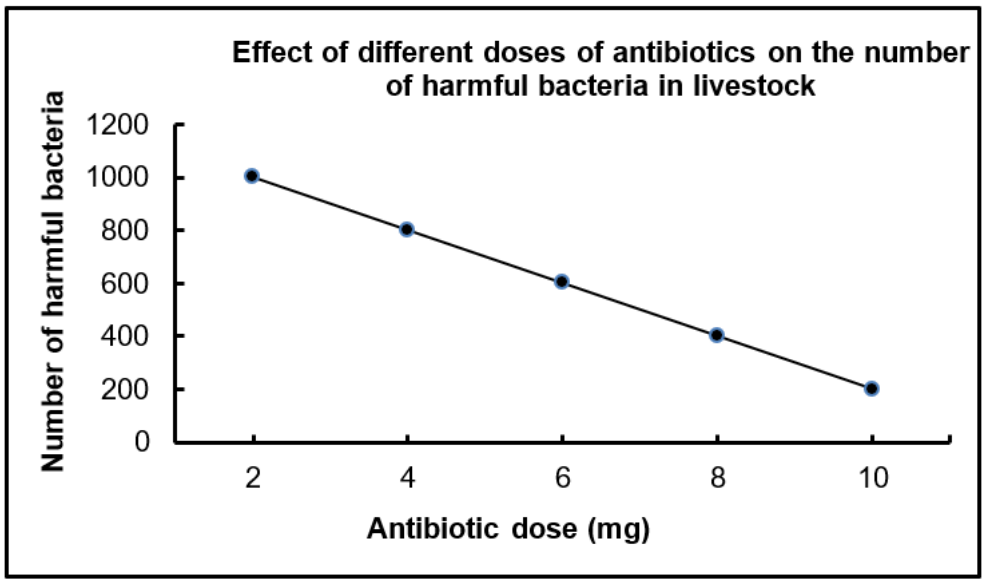
Farmers spray their fields with chemicals known as herbicides to kill the weeds. Some weeds however have evolved to be resistant to herbicides.

Scientists investigated the time it took for a species of weed to develop resistance to five types of herbicides. The results are shown in the table below:

TYPES OF HERBICIDE	TIME TAKEN FOR WEEDS TO DEVELOP RESISTANCE (YEARS)
2,4-D	9
Dalapon	9
Picloran	25
Dicloflop	7
Trifluralin	26

	25.1	Refer to the passage above and state how weeds act to reduce crop yield.	(1)
	25.2	Identify the: (a) Independent variable (b) Dependent variable	 (1) (1)
	25.3	Name the herbicide: (a) To which the weeds developed resistance the fastest (b) That remained effective for the longest period of time	 (1) (1)
	25.4	The scientists used the same weed species when investigating resistance to the different herbicides. (a) Describe how the scientists would have determined the resistance of the weeds to the herbicides. (b) Explain how the use of the same weed species improved the validity of the investigation.	 (2) (2)
	25.5	Draw a bar graph to show the time taken for the evolution of resistance to the herbicides.	(6)
			(15)

Activity 26

26.	Some farmers add low doses of antibiotics to the feed for cattle. The use of antibiotics in cattle feed could result in the evolution of antibiotic-resistant bacteria. The graph below shows the effect of different doses of antibiotics on the number of harmful bacteria in the cattle		
			
	26.1	Use evidence from the graph to explain why higher doses of antibiotics will benefit the farmer economically.	(4)
	26.2	Explain how the use of antibiotics in animal feed may result in the evolution of antibiotic resistant bacteria.	(6)
			(10)

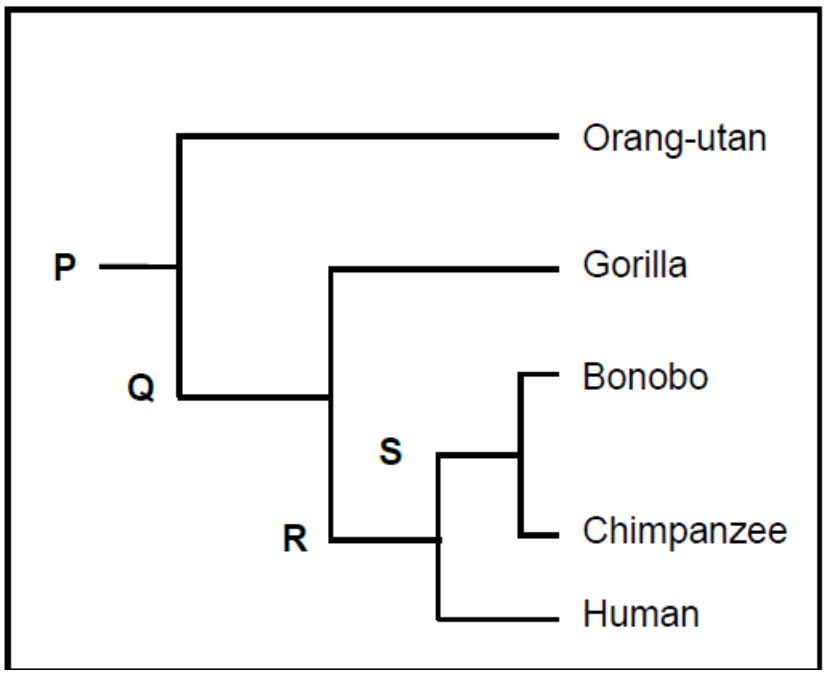
Topic:Human Evolution

Activity 1

Give the correct **biological term** for each of the following descriptions.

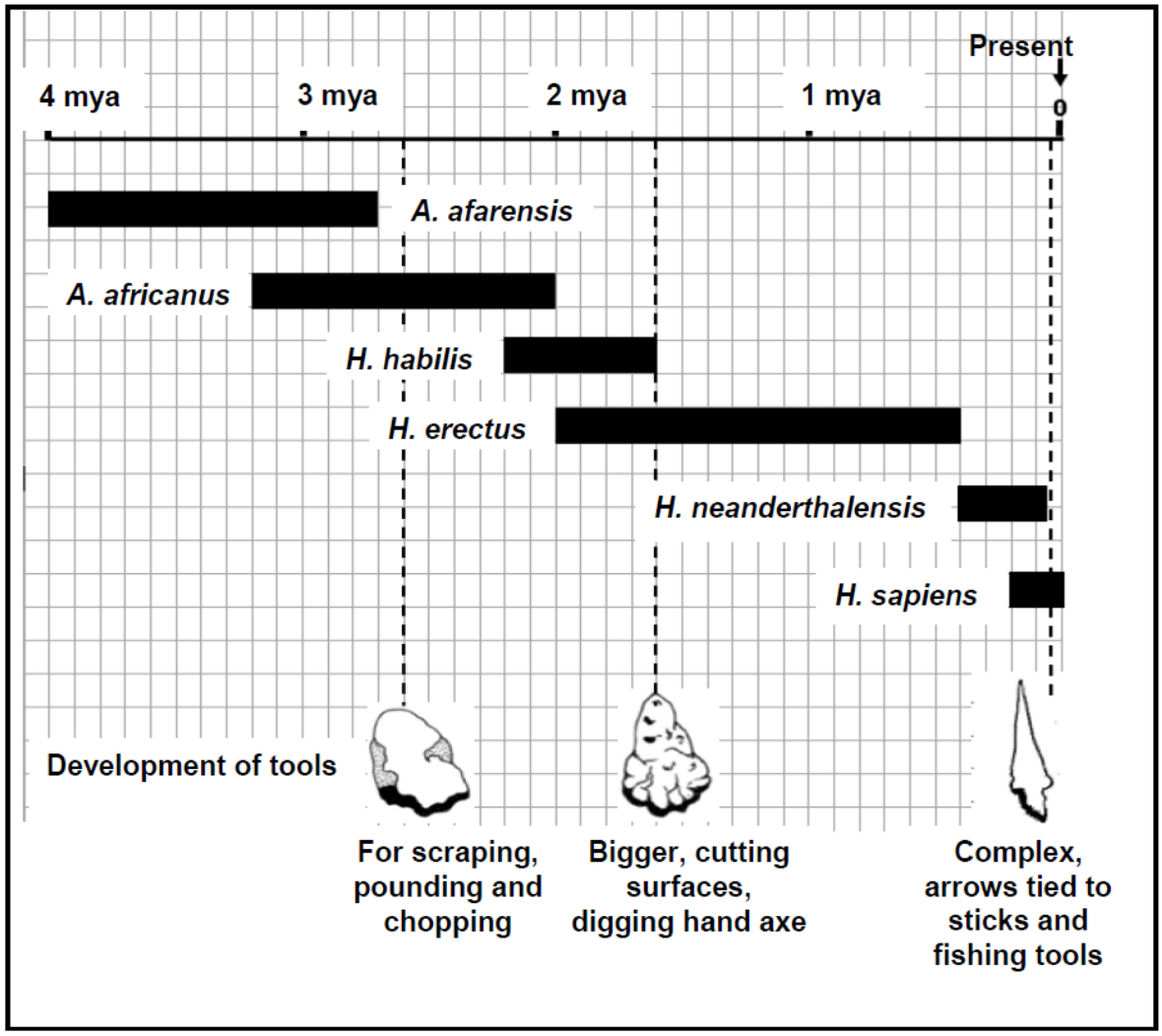
No.	Description	Biological Term
1.1	A diagrammatic representation showing possible evolutionary relationships between different species	
1.2	Similar structures that perform different functions in different organisms	
1.3	Remains of life forms preserved in rocks, ice and dried sap trees	
1.4	The opening in the base of the skull through which the spinal cord passes	
1.5	An upright posture and walking only on two legs	
1.6	Family to which humans belong	
1.7	The type of evidence for human evolution that includes toolmaking	
1.8	Genus to which Little Foot and Mrs Ples belongs	
1.9	The type of vision shared by apes and humans that allows for depth perception	
1.10	The act of walking on all four limbs	
1.11	Having a protruding jaw	
1.12	Large, pointed teeth in African apes that are used for tearing food	
		12 X1 **(12)**

Activity 2

2.1	The diagram below represents the evolution of the family Hominidae 		
	2.1	Name the type of diagram represented above.	(1)
	2.2	Give the LETTER of the organism which:	
		(a) Is the common ancestor of all hominids	(1)
		(b) Share the most recent common ancestor with the gorilla	(1)
	2.3	Name TWO organisms that:	
		(a) Have S as a common ancestor	(2)
		(b) Are quadrupedal	(2)
	2.4	Describe THREE anatomical features of the skeleton of a quadrupedal hominid.	(3)
			(10)

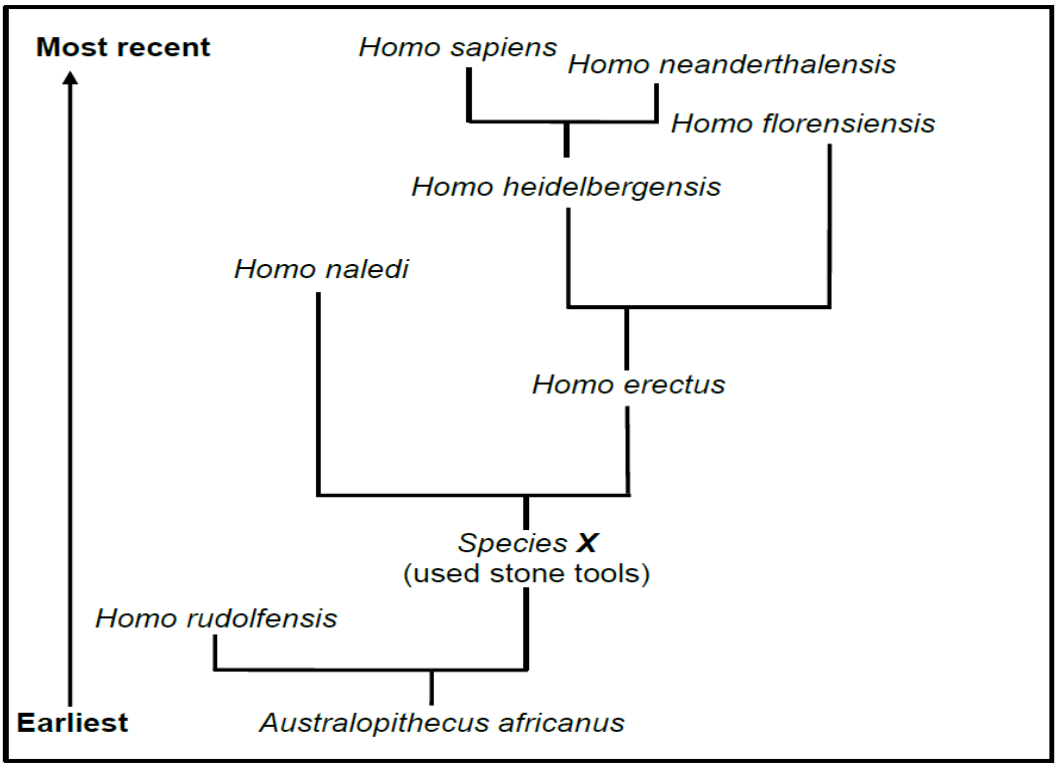
Activity 3

3.	The diagram below shows a timeline of different hominid species and the development tools.		



	3.1	Which species in the diagram above existed/ survived for the longest period?	(1)
	3.2	Calculate the period (million years) in which the A.afarensis and A.africanus coexisted.Show ALL working.	(2)
	3.3	Name the species that was also known as the handyman.	(1)
	3.4	State TWO uses of the tool that was developed 2,6mya	(2)
	3.5	Identify TWO species that used the most complex tools.	(2)
	3.6	Explain how the changes in brain size over time relates to the development of tools.	(3)
			(11)

Activity 4

4	The diagram below represents one model of the evolution of some hominids.		
			
	4.1	Identify the type of diagram shown.	(1)
	4.2	How many genera are represented by the diagram?	(1)
	4.3	Name the species: (a) Represented by **X** on the diagram (b) That shares a common ancestor with *Homo erectus*	 (1) (1)
	4.4	Which species of the genus *Homo* is the only one in existence today?	(1)
	4.5	Name TWO forms of evidence that would have been used to support the information in the diagram.	(2)
	4.6	The average cranial capacity of *Homo sapiens* is 1 500 cm3 compared to 520 cm3 in *Australopithecus africanus*. Explain the significance of the difference in cranial capacity.	(3)
	4.7	Explain how the fossils of *Australopithecus africanus*, *Species **X*** and *Homo erectus* are used to support the 'Out of Africa' hypothesis.	(4)
			(14)

Activity 5

5	There are anatomical differences between African apes and humans. There are also characteristics that they share.		
	5.1	Name ONE characteristics of the hand that African apes share with humans.	(1)
	5.2	Tabulate THREE differences between the skulls of African apes and humans.	(7)
	5.3	Give TWO characteristics of the pelvis of a bipedal organism.	(2)
			(10)

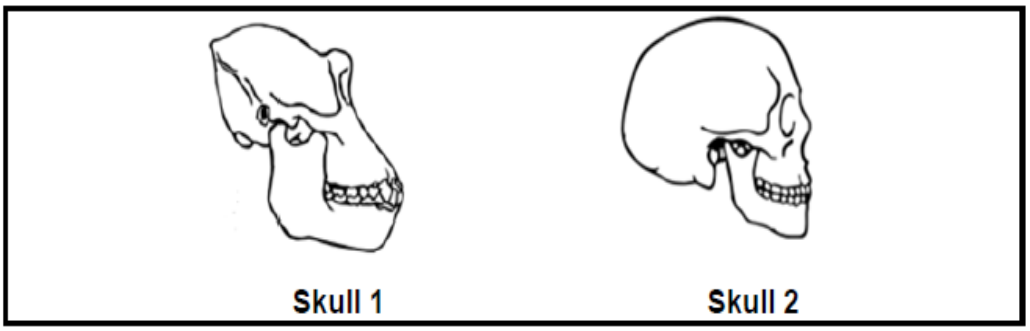
Activity 6

6.	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.		
	6.1	Why do scientists look for similarities between humans and African apes?	(1)
	6.2	Explain the importance of the positioning of the thumbs for humans and African apes.	(2)
	6.3	State ONE difference between the teeth of humans and African apes.	(2)
			(5)

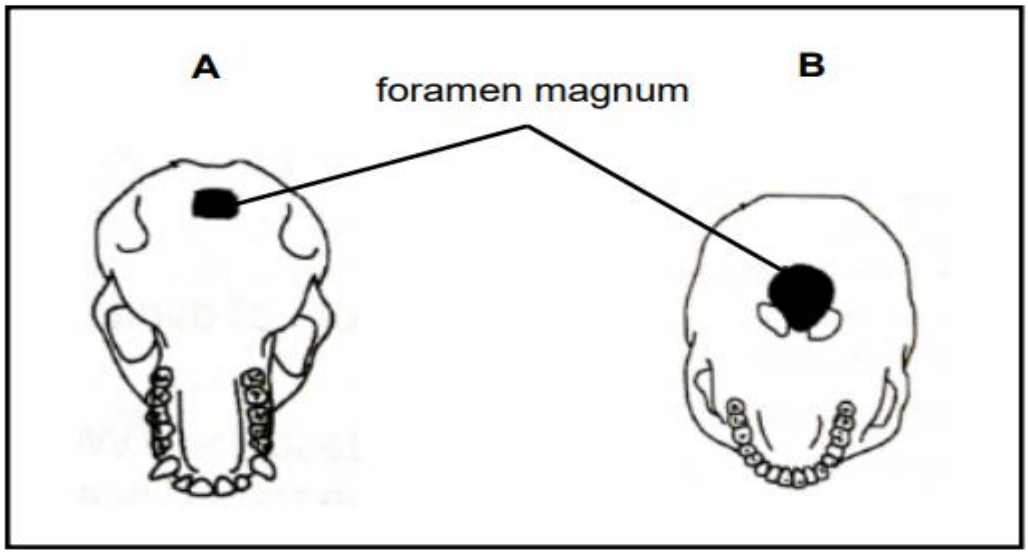
Activity 7

7.	Humans are bipedal organisms.		
	7.1	Define bipedalism?	(2)
	7.2	Explain how each of the following skeletal structures have contributed to bipedalism in humans: (a) Foramen magnum (b) Pelvic girdle (c) spine	 (2) (2) (2)
			(8)

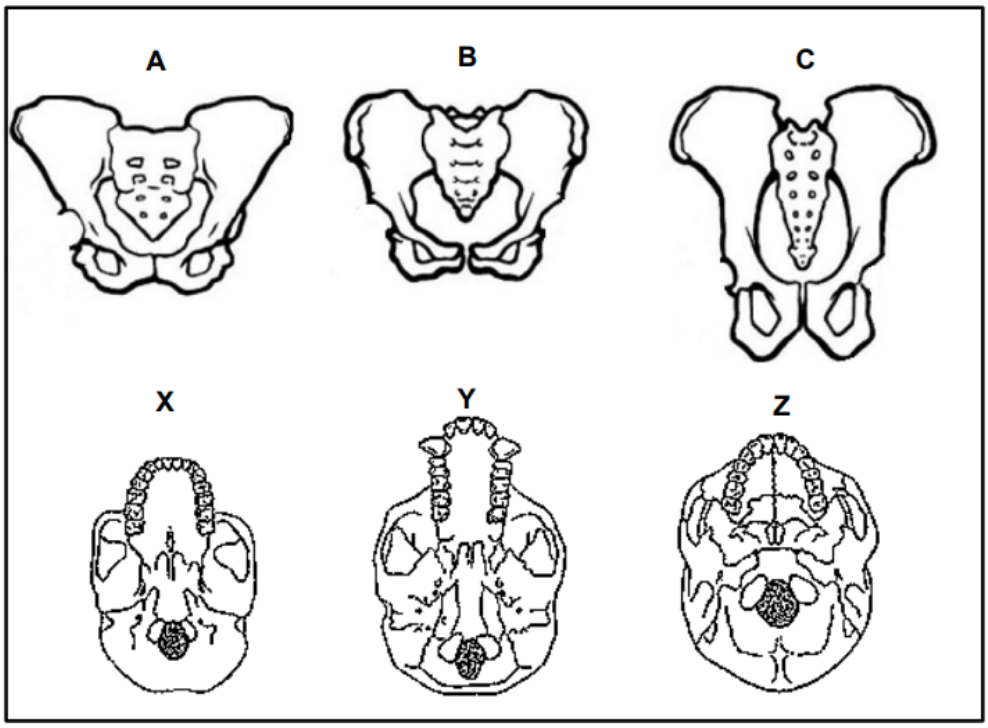
Activity 8

8.	The diagrams below show the skulls of two species of primates 		
	8.1	Tabulate THREE observable differences between skull **1** and skull **2** that show trends in human evolution.	(7)
	8.2	Give FOUR characteristics of the upper limbs that humans share with other primates.	(4)
	8.3	Explain how an increase in cranial volume is related to intelligence.	(3)
			(14)

Activity 9

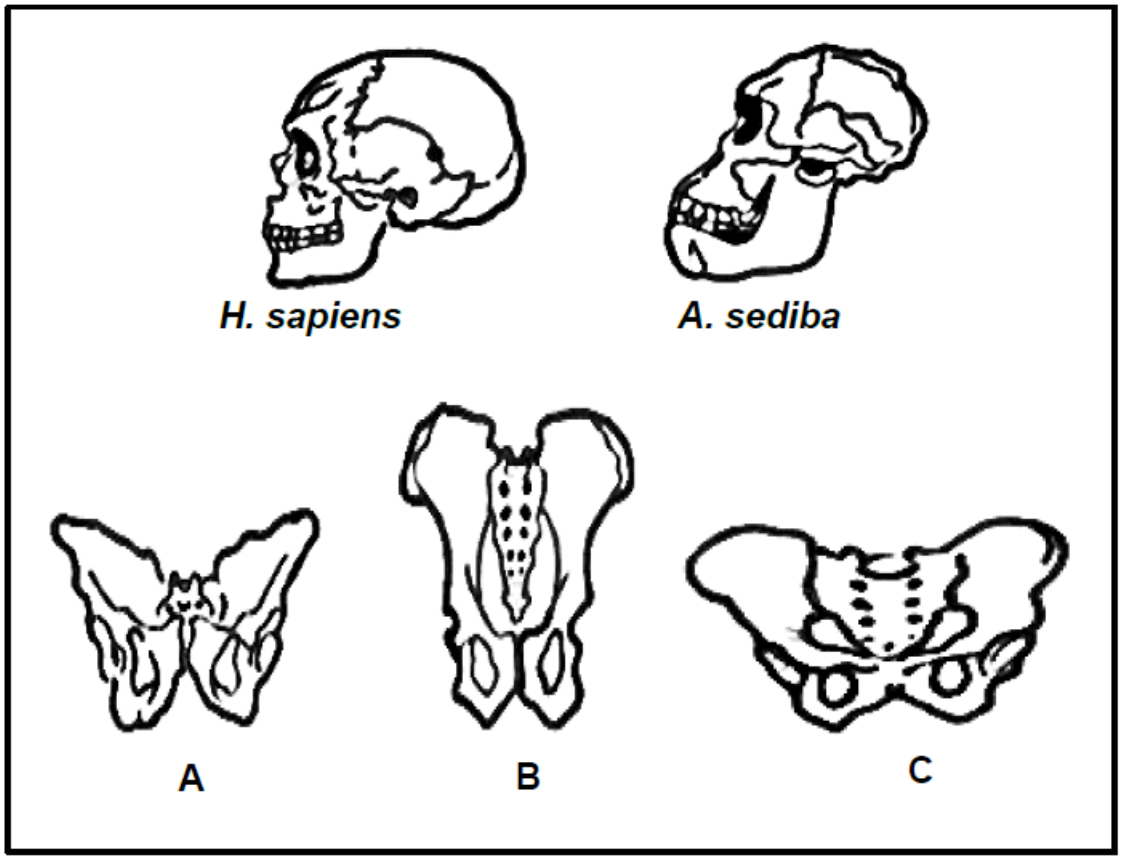
9.	Diagram A and B show the ventral (bottom) view of the skulls of two organisms. The diagrams are NOT drawn to scale. 		
	9.1	Which diagram represents the skull of a bipedal organism?	(1)
	9.2	Give ONE visible reason for your answer to **QUESTION 9.1.**	(2)
	9.3	Tabulate TWO visible differences between the upper jaws in the diagrams **A** and **B** that represents trends in human evolution.	(5)
	9.4	Explain the significance of the shape of the spine that is associated with the skull in diagram **B.**	(2)
			(10)

Activity 10

10.	The diagram below represents the pelvic structure and the ventral view of the skulls of three organisms. The diagrams are drawn to scale.  		
	10.1	Write down the LETTER(S) in the diagram(s) that represent the: (a) Skulls of bipedal organisms (b) Pelvic structure of a quadrupedal organism.	 (2) (1)
	10.2	Give a reason for your answer to **QUESTION 10.1(b).**	(2)
	10.3	Describe ONE other structural difference between a bipedal and a quadrupedal organism.	(3)
			(8)

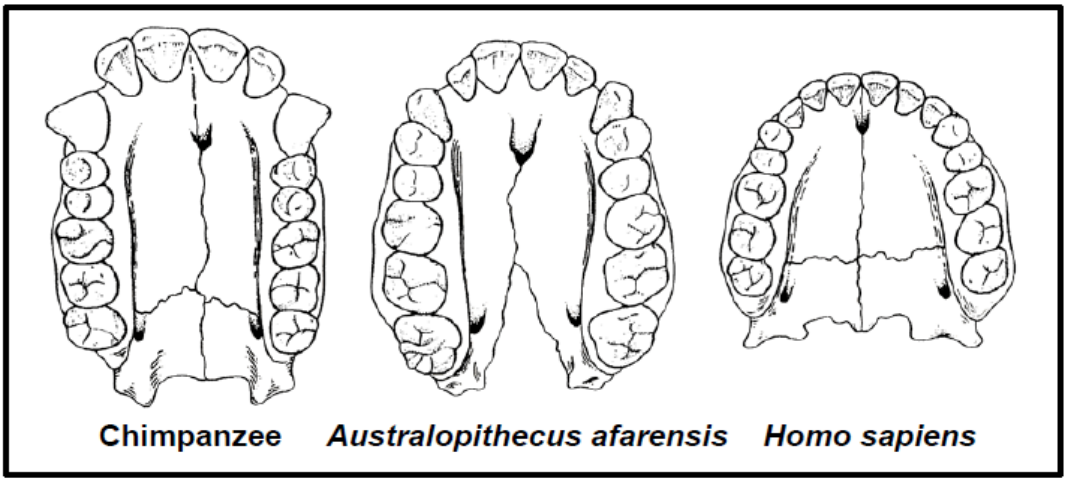
Question 11

11. The diagrams below show the skulls and pelvises of different hominids.



	11.1	State the genus name of A. sediba.	(1)
	11.2	Describe the shape of the spine of H.sapiens.	(1)
	11.3	A.sediba is thought to be a transitional species. State what is meant by a transitional species.	(2)
	11.4	Give the LETTER of the pelvis that would be representative of A.sediba.	(1)
	11.5	Explain your answer to QUESTION 12.5	(2)
	11.6	Explain the significance of the change in prognathism from A. sediba to H.sapiens.	(5)
			(12)

Activity 12

12.	The diagrams below show the upper jaws of some fossils. These diagrams are draw to scale  Chimpanzee *Australopithecus afarensis* *Homo sapiens*		
	12.1	Describe ONE visible difference between the jaw of a chimpanzee and that of *Homo sapiens* which show trends in human evolution.	(2)
	12.2	Based on the differences in dentition, what conclusion can be made about the change in diet from *Australopithecus afarensis* to *Homo sapiens*?	(2)
	12.3	*Australopithecus* may be described as a transitional species between the chimpanzee *and Homo sapiens.* (a) Define a transitional species. (b) Use ONE visible feature of the jaw to explain why *A. afarensis* may be described as a transitional species.	(1) (2)
			(7)

Activity 13

13.	13.1	Describe the structural changes that characterize the evolution of modern humans from their ape-like ancestors in the following parts: (a) Foramen magnum (b) Cranium	 (2) (2)
	13.2	Explain the significance of the structural changes to the parts mentioned in **QUESTION 13.1** above.	(4)
			(8)

Activity 14

14. The table shows the evolution of cranial capacity in some species.

SPECIES	PERIOD OF EXISTENCE (MILLION YEARS AGO)	AVERAGE CRANIAL CAPACITY (CM^3)
Sahelanthropus	7,0-6,0	450
Australpoithecus afrecanus	3,0-2.0	480
Homo habilis erectus	2.2-1,6	650
Homo erectus	2.0-0.4	900
Homo neanderthalensis	0.4-0.04	1500
Homo sapies	0.2-0	1450

	14.1	Name: (a) Two hominid genera in the table above (b) Two fossils of *A. africanus* that were found in South Africa (c) The genus that appeared first on Earth as shown in the table	 (2) (2) (1)
	14.2	Which hominid had a cranial capacity closest to that of *Homo sapiens?*	(1)
	14.3	Give the smallest cranial capacity (in cm3) of a Homo species	(1)
	14.4	When did *Australopithecus africanus* become extinct?	(1)
	14.5	Fossils are used as evidence of hominid evolution. Name TWO other lines of evidence	 (2)
			(10)

Activity 15

15. The table below shows information on selected hominid fossils**.**

Common name of the fossil	Species	Fossil site	Scientists responsible for discovery
P	*Australopithecus sediba*	Malapa Cave in the Cradle of Humankind	**Q**
Taung Child	**R**	Sterkfontein Caves	**S**

	15.1	Name fossil **P.**	(1)
	15.2	Identify the species at **R**.	(1)
	15.3	Give the name of the scientist at: (a) **Q** (b) **S**	 (1) (1)
			(4)

Activity 16

16.			
	16.1	State the 'Out of Africa' hypothesis	(2)
	16.2	Name the family to which modern humans belong.	(1)
	16.3	What genetic evidence is used to support the 'Out of Africa' hypothesis?	(1)
	16.4	Describe how fossil evidence is used to support the 'Out of Africa' hypothesis.	(4)

BIOLOGICAL TERMS
PAPER 1

LOGICAL TERMS: PAPER 1

Give the correct biological term for the following descriptions.

Description	Biological term
1. The period of development of an embryo in the uterus between fertilisation and birth.	
2. Disease characterised by a lack of insulin production.	
3. Tube that connects the pharynx and the middle ear.	
4. A stage in the development of humans in which the embryo consists of a layer of cells surrounding a cavity.	
5. The structure at the tip of a sperm cell containing enzymes and which makes contact with the egg cell during fertilisation.	
6. The gland in the male reproductive system of humans that produces an alkaline fluid to counteract the acid environment of the vagina.	
7. The duct leading from the testis to the urethra in human males.	
8. The process by which the ovum is formed through meiosis in the ovary.	
9. The membranes which protect the central nervous system.	
10. A plant growth hormone that stimulates seed germination.	
11. The nervous system which consists of cranial and spinal nerves.	
12. A branch of the autonomic nervous system that decreases the heartbeat back to normal.	
13. The outermost extra-embryonic membrane surrounding the embryo.	

14. The hormone that regulates the salt concentration in the human body.	
15. The blood vessel in the umbilical cord that carries blood rich in oxygen and nutrients.	
16. The hormone inhibited by an increased level of thyroxin.	
17. The structure in the ear that equalises the pressure on either side of the eardrum.	
18. The watery fluid that supports the cornea and the front chamber of the eye.	
19. The hormone produced by the Graafian follicle.	
20. The hormone responsible for the formation of the corpus luteum.	
21. The receptors in the ear that detect changes in the direction and speed of any movement of the body.	
22. The type of fertilisation associated with viviparous reproduction.	
23. The series of changes that take place in the shape of the lens and the eyeball in response to the distance of an object from the eye.	
24. The part of the brain that controls the heart rate.	
25. The maintenance of a constant internal environment in the body within certain limits.	
26. The plant hormone that promotes seed dormancy.	
27. A hormone that stimulates the maturation of sperm.	
28. The type of development in birds in which the young is capable of moving around on its own soon after hatching.	
29. A Disorder which results in the myelin sheath of the neurons being damaged.	
30. A liquid between the cornea and the lens in the human eye.	
31. The formation of ova by meiosis.	

32. A long, coiled tube in human males that lies at the top of the testes, which stores sperm.	
33. A hormone that promotes the absorption of water in the kidneys.	
34. A type of reproduction in humans where the foetus develops inside the uterus.	
35. Structures found only in animal cells that form the spindle during cell division.	
36. The movement of part of a plant in response to gravity.	
37. The stage in humans when sexual maturity is reached in males and females.	
38. A change in the internal or external environment that will be detected by a receptor and converted into an impulse.	
39. Small tubes placed in the tympanic membrane to drain liquid from the middle ear.	
40. Part of the human ear that directs sound waves into the auditory canal.	
41. A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum outside the body of the female.	
42. The growth of part of a plant in response to light.	
43. The condition of the blood vessels in the skin in humans when the environmental temperature is low.	
44. The sensory receptors found in the semi-circular canals.	
45. A layer inside the eye that absorbs light, thus reducing reflection.	
46. The part of the brain that receives nerve impulses from the semi-circular canals.	
47. The innermost layer of the eye where a light stimulus is converted into a nerve impulse.	
48. The phase in the cell cycle when DNA replication occurs.	

49. The part of the peripheral nervous system that controls involuntary actions.	
50. A plant hormone that causes leaves to fall off trees in autumn.	
51. The division of the cytoplasm through the constriction of the cell membrane at the end of cell division.	
52. The structure in the amniotic egg that stores wastes.	
53. The inner lining of the uterus where implantation of the embryo occurs.	
54. Part of the female reproductive system where fertilisation occurs.	
55. The diploid cell formed by the process of fertilisation.	
56. A fluid that protects the human embryo against injuries and large scale temperature changes.	
57. A disorder of the nervous system that is characterised by the breakdown of the myelin sheath of neurons.	
58. A hormone produced by the hypophysis that stimulates milk production in human females.	
59. A blood vessel in the umbilical cord that transports nutrients to the foetus.	
60. A part of the neuron that conducts impulses towards the cell body.	
61. A disease that results from the body's inability to produce insulin.	
62. The part of the sperm cell that contains enzymes to digest the membrane of the ovum	
63. The hormone that prepares the human body for an emergency situation.	
64. A hormone that stimulates the maturation of sperm and puberty in males.	
65. The tube in the male reproductive system that connects the epididymis with the urethra	

66. The hormone which regulates the salt balance in humans	
67. The hormone that stimulates the mammary glands to secrete milk	
68. The division of the cytoplasm through the constriction of the cell membrane at the end of cell division.	
69. The plant hormone that stimulates the germination of seeds.	
70. A type of fertilisation in which the nucleus of a sperm fuses with the nucleus of an ovum outside the body of the female.	
71. The point where two chromatids overlap during prophase I	
72. A hormone which regulates the salt balance in the human body.	
73. The maintenance of a constant internal environment in the human body within certain limits.	
74. A type of egg where the embryo develops inside a fluid-filled sac which is surrounded by a shell.	
75. A hormone that stimulates the development of the corpus luteum.	
76. A disorder of the eye caused by the curvature of the lens or cornea being uneven, resulting in distorted images.	
77. The nerve that carries impulses from the retina to the brain.	
78. Collective name for the membranes that protect the brain and spinal cord.	
79. The part of the female reproductive system where fertilisation takes place.	
80. The part of the ear that converts pressure waves into nerve impulses.	
81. A hollow ball of cells formed from the zygote	

82. The hormone responsible for osmoregulation	
83. The vesicle which contains enzymes found in the head of the sperm cell	
84. The hormone that stimulates milk production for breastfeeding in humans	
85. The part of the nervous system made up of cranial and spinal nerves.	
86. The part of the male reproductive system that secretes testosterone.	
87. A disorder of the brain that is characterised by memory loss and confusion.	
88. The system in the body that regulates processes by secreting hormones directly into the blood.	
89. The production of male gametes through meiosis.	
90. The hormone that stimulates the production of milk in a mother after the birth of a baby.	
91. Sharp structures found in plants for protection from herbivores.	
92. A plant growth response to an external stimulus 93. The type of egg produced by reptiles that has extra-embryonic membranes.	
94. The type of development in birds where the hatchlings' eyes are open and their bodies are covered with down feathers.	
95. The part of the brain that receives impulses from the maculae.	
96. The dark pigmented layer of the eye.	
97. The structure that connects the left and right hemispheres of the brain.	
98. The part of the brain that controls body temperature.	

99. The gas in the blood which, when increased, causes an increase in the breathing rate.	
100. Plant growth responses to external stimuli.	
101. A substance containing plant hormones used to kill unwanted plants.	
102. The structures formed by the centrioles during cell division.	
103. Receptors that provide information about the position of the head.	
104. A hormone that regulates the water balance in the body.	
105. The part of the brain that regulates breathing.	
106. The process of maintaining a constant internal environment in the human body.	
107. The membrane that together with the endometrium, forms the placenta.	
108. The structure in the head of a sperm containing digestive enzymes.	

BIOLOGICAL TERMS
PAPER 2

LOGICAL TERMS: PAPER 2

Give the correct biological term for the following descriptions.

Description	**Biological term**

1. An allele that does not influence the phenotype when found in the heterozygous condition.	
2. The position of a gene on a chromosome.	
3. The physical and functional expression of a gene.	
4. Chromosomes that are not responsible for sex determination.	
5. The process of finding a desirable gene, isolating it and then moving it into the cells of another organisms.	
6. The two parts of a chromosome held together by a centromere.	
7. A section of a DNA molecule that codes for a specific characteristic.	
8. The production of genetically identical copy of an organism using biotechnology.	
9. The deliberate breeding of organisms for desirable characteristics selected by humans.	
10. The explanation that species experience long periods without physical change, followed by short periods of rapid physical change.	
11. The phase of meiosis during which homologous chromosomes separate and start moving towards opposite poles.	
12. The defect in cell division that leads to Down syndrome.	
13. The structure that is made up of two chromatids joined by a centromere.	
14. An explanation for something that has been observed in nature and which can be supported by facts, laws and tested hypotheses.	
15. Similar structures on different organisms that suggest they have a common ancestor.	
16. The complete set of chromosomes in the cell of an organism.	

17. A bar code pattern formed from DNA.	
19. The bonds formed between amino acids.	
20. A representation of the number, shape and arrangement of all the chromosomes in the nucleus of a somatic cell.	
21. Openings in the nuclear membrane that allow mRNA to leave the nucleus.	
22. A tentative explanation of a phenomenon that can be tested.	
23. The distribution of species in different parts of the world.	
24. Chromosomes that carry the same set of genes.	
25. Two or more alternative forms of a gene at the same locus.	
26. The structure responsible for pulling chromosomes to the poles of an animal cell during cell division.	
27. A phase in the cell cycle that occurs before cell division.	
28. A diagrammatic representation showing possible evolutionary relationships among different species.	
29. The type of vision shared by apes and humans that allows for depth perception.	
30. A genetic cross involving two characteristics.	
31. A genetic disorder characterised by the absence of a blood-clotting factor.	
32. The present –day distribution of organisms.	
33. A nucleic acid that carries amino acids to the ribosome for protein synthesis.	
34. The natural shape of a DNA molecule.	
35. A section of DNA that codes for a specific protein.	
36. Evolution with long periods of no change followed by short periods of rapid change.	

37. The sex chromosomes of an organism.	
38. Descent with modification over time.	
39. A group of organisms of the same species in a specific habitat.	
40. The family to which humans belong.	
41. A human disorder caused by a non-disjunction of chromosome pair 21.	
42. The stage of protein synthesis during which mRNA forms from DNA.	
43. The type of variation in a population with no intermediate phenotypes.	
44. The type of inheritance where the dominant allele masks the expression of the recessive allele in the heterozygous state.	
45. The variety of life forms that exist on Earth.	
46. The opening in the skull through which the spinal cord enters.	
47. A testable statement that can be rejected or accepted.	
48. Total disappearance of a species from Earth.	
49. A segment of a chromosome that codes for a particular characteristic.	
50. The ability to walk on two limbs.	
51. The organelle in the cytoplasm which is the site of protein synthesis.	
52. The name of the bond that forms between amino acids in a protein molecule.	
53. The process by which a DNA molecule makes identical copies of itself.	
54. The name of the process when homologous chromosome pairs fail to separate during meiosis.	

55. The permanent disappearance of a species from earth.	
56. A testable statement that may be rejected or accepted.	
57. The type of nucleic acid that carries a specific amino acid.	
58. The selection and breeding of organisms with desirable characteristics by humans.	
59. An allele that is not shown/expressed in the phenotype when found in the heterozygous condition.	
60. A sudden change in the sequence/order of nitrogenous bases of a nucleic acid.	
61. Explanation of an observation that is supported by facts, models and laws.	
62. The breeding of organisms over many generations in order to achieve a desirable phenotype.	
63. The type of sugar found in a RNA molecule.	
64. Type of evolution involving long periods of time when species do not change and short periods of rapid change. 65. The hypothesis which supports migration of human ancestors from the point of origin.	
66. The mineralised remains of organisms that have lived in the past.	
67. The position of a gene on a chromosome.	
68. The genus of the fossil “Little Foot”	
69. A diagram showing the inheritance of genetic disorders over many generations.	
70. The bond that forms between amino acids.	
71. The phase in the cell cycle during which DNA replication occurs.	
72. The first *Homo* species to use tools	
73. Undifferentiated cells that develop into any type of cell.	

74. A breeding process used for the domestication of plants and animals.	
75. Nitrogenous base found only in RNA molecules.	
76. The use of biological processes, organisms or systems to improve the quality of human life.	
77. Type of variation within a population in which there is a range of intermediate phenotypes.	
78. An upright posture and walking only on two legs.	
79. A sugar molecule found in a nucleotide of DNA.	
80. Genetic disorder resulting in the abnormal clotting of blood.	
81. Study of fossils.	
82. Present-day distribution of living organisms across the continents.	
83. Family to which humans belong.	
84. The type of RNA containing anticodons.	
85. The process during which genetically identical organisms are formed using biotechnology.	
86. Undifferentiated animal cells that can form any type of tissue.	
87. Type of inheritance where none of the two alleles is dominant over the other and an intermediate phenotype is produced.	
88. The breeding of organisms by humans to achieve a desirable phenotype.	
89. The point of crossing over between two adjacent chromosomes.	
90. The organelle in a cell where translation occurs.	
91. The variety of living organisms on Earth.	

92. A diagrammatic representation of possible evolutionary relationships amongst species.	
93. The splitting of the cytoplasm during cell division.	
94. The process whereby DNA makes an exact copy of itself.	
95. A type of variation where there is a range of phenotypes for the same characteristic.	
96. The present-day distribution of living organisms.	
97. The failure of chromosome pairs to separate during meiosis.	
98. Similar structures in different species that show modification by descent.	
99. An individual having two non-identical alleles for a characteristic.	
100. A testable statement that may be accepted or rejected.	
101. The bonds between nitrogenous bases in a DNA molecule.	
102. All the genes that make up an organism.	
103. The type of evidence for human evolution that includes tool-making.	
104. The process whereby new species are formed.	
105. An inherited disorder where blood fails to clot properly.	
106. The opening at the base of the skull through which the spinal cord passes.	
107. Two or more alternative forms of a gene at the same locus.	
108. The type of variation in a population with no intermediate phenotypes.	
109. Chromosomes involved in sex determination.	

110. Type of inheritance where both alleles are expressed equally in the phenotype.	
111. The analysis of DNA samples to identify individuals that may be related.	
112. The sugar found in RNA	
113. The structure in an animal cell that forms spindle fibres.	
114. Undifferentiated animal cells that can give rise to specialised cell types.	
115. The division of the cytoplasm after a cell nucleus has divided.	
116. A diagram representing possible evolutionary relationships between species.	