

LIFE SCIENCES
EVOLUTION
GRADE 12
CONTENT MANUAL MARKING GUIDELINES
TEACHER AND LEARNER TERM 2 AND 3

THEORIES OF EVOLUTION

HUMAN EVOLUTION

ACTIVITY 1.1 (EC, SEP,2023)

1.1 The theory of evolution is based on many lines of evidence.

1.1.1 Define biological evolution.

Biological evolution refers to the change in the characteristics ✓ of a species over time. ✓ (2)

1.1.2 Why is the Theory of Evolution regarded as a scientific theory?

Theory of Evolution is regarded as a scientific theory since various hypotheses relating to evolution ✓ have been tested and verified over time ✓. (2)

1.1.3 Tabulate ONE difference between a theory and a hypothesis. (3)

<i>HYPOTHESIS</i>	<i>THEORY</i>
Hypothesis is a possible prediction or explanation of phenomena after observation. ✓	Theory is a scientific explanation of events which is supported by same results obtained via research, investigations and studies by many scientists. ✓
Based on guess or speculation and on limited data ✓	It is supported by a lot of evidence ✓
Hypothesis can be either accepted or rejected ✓	Theories are reliable and the basic ideas persist in science ✓

ANY 3

Table 1

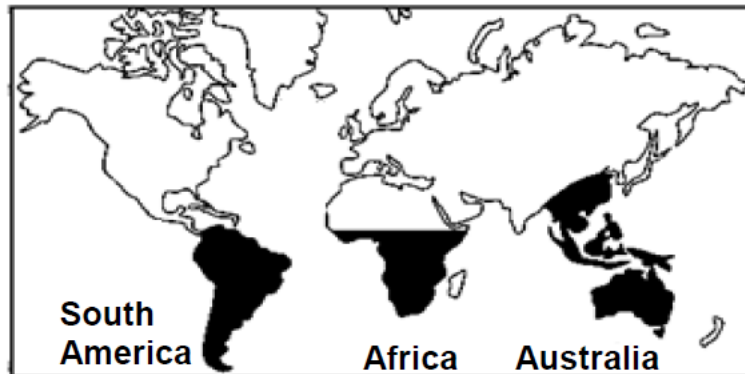
1.14 Name TWO sources where scientists find evidence for evolution.

- Fossil record ✓
- Biogeography ✓
- Modification by descent ✓
- Genetics ✓

Any 2 (2)

ACTIVITY 1.2 (May-June, DBE,2023)

- 1.2 Shrubs of the family Proteaceae (e.g. Waratahs and proteas) can be found in Australia, South America, Indo-China and parts of Africa as shown on the map below



It is hypothesised that all continents were once one large continent called Pangaea and that they separated due to continental drift.

This is evidence that the family Proteaceae ...

D ✓✓

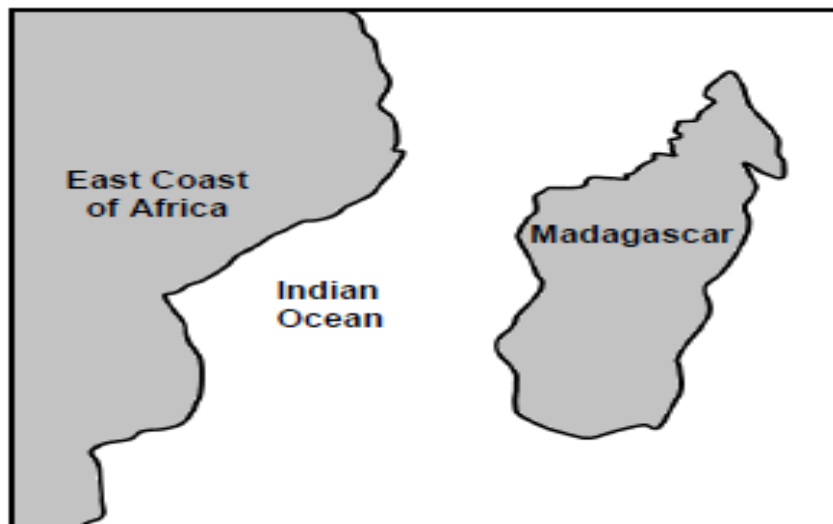
(2)

ACTIVITY 1.3 (DBE/November 2020(2))

- 1.3 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 coast of Africa as shown in the diagram below.



- 1.3.1 Explain how continental drift could have affected the distribution of the common ancestor.

- There was once one large continent ✓ and
- the common ancestor existed throughout this continent ✓

- When Madagascar separated ✓
 - the common ancestor was found in both ✓ regions
- (4)

ACTIVITY 2

2.1 Define the following terms:

2.1.1 Population

- A group of organisms of the **same species** ✓ that live together in a **defined area** ✓ at a **given time** and **interbreeding** ✓ can take place.
- (3)

Species

- A group of organisms that have **similar characteristics** ✓ and can **interbreed** ✓ to produce **fertile offspring** ✓
- (3)

2.2 Scientists believe that variation in populations can lead to the formation of new species.

2.2.1 List FOUR sources of variation in populations.

- Random assortment ✓/segregation/recombination
 - of chromosomes during meiosis in the formation of gametes
 - Crossing over ✓
 - Chance/random fertilisation of gametes ✓/sexual reproduction
 - Mutation ✓
 - Outbreeding ✓/Gene flow
- OR Meiosis ✓
- (4)

2.3 Describe how the following contributes to genotypic variation within a species:

2.3.1 Meiosis (6)

- crossing over ✓ takes place
- leading to an exchange of genetic material ✓/recombination occur
- between homologous chromosomes
- random arrangement ✓ of chromosomes/independent assortment
- along the equator ✓
- allow different combinations of chromosomes to move into each daughter cell ✓
- thus leading to variation in the gametes ✓ produced

2.3.2 Sexual reproduction (4)

- Large number of gametes produced ✓
- Gametes are different because they are produced by
- meiosis ✓
- random fusion of gametes ✓
- therefore the offspring ✓ produced
- will be genetically different ✓

ACTIVITY 3

3.1 Mutations result in genetic variation.

3.1.1 Give THREE other sources of genetic variation in a species. (3)

- Crossing over ✓
 - Random arrangement of chromosomes ✓
 - Independent/random assortment of chromosomes
- } OR Meiosis ✓
- Random fertilisation ✓
 - Random mating ✓

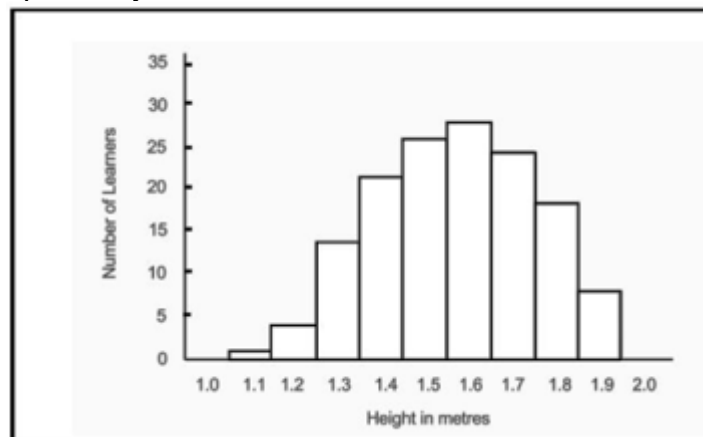
3.1.2 Differentiate between continuous variation and discontinuous variation.

- Continuous variation occurs when there is a range of Phenotypes for the same characteristic ✓/has intermediate forms,
- whereas discontinuous variation occurs when phenotypes fit into separate or distinct categories ✓/with no intermediate forms

(2)

3.2

The graph below shows the variation of heights of a group of 18-year-old students.



3.2.1 Identify the type of graph represented.

(1)

- Histogram ✓

3.2.2 Explain why this type of graph mentioned in QUESTION 3.2.1 is most suitable for plotting data on continuous variation.

- shows a variation with a range of measurements ✓ that are linked /connected ✓

(2)

3.2.3 What is the most common height?

- 1.6 m ✓

(1)

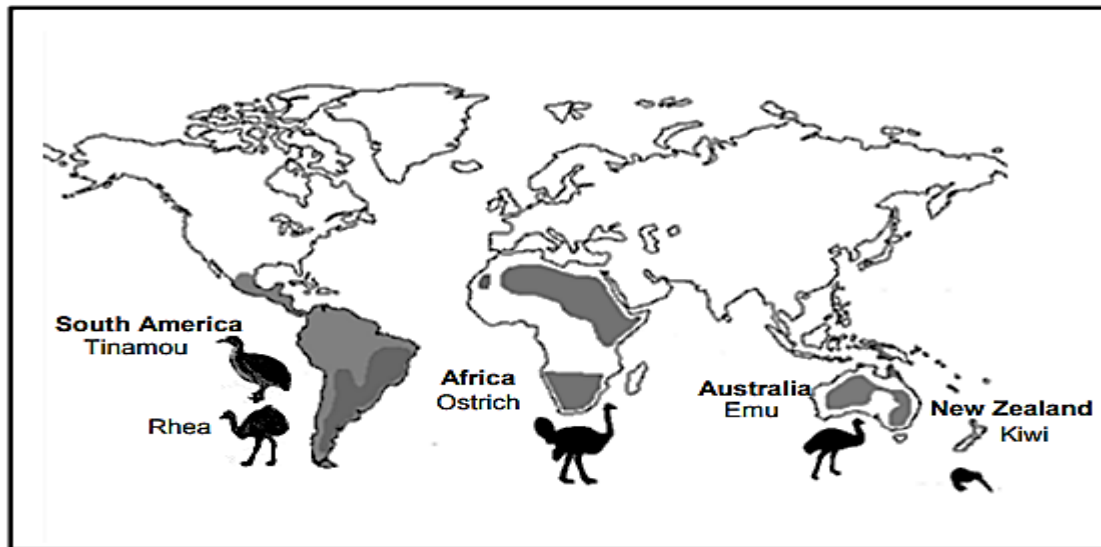
3.2.3 How many people in the group were shorter than 1.3 metres?

- 5 ✓

(1)

ACTIVITY 3

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



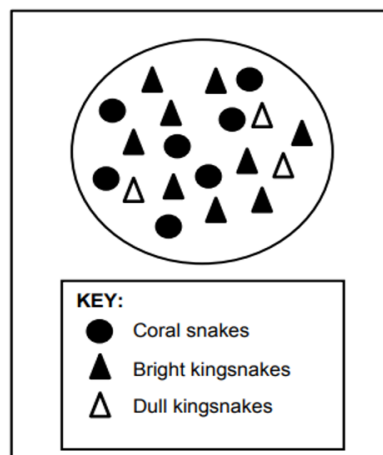
Scientists hypothesise that these species of flightless birds arose from a single common ancestor that was able to fly.

3.1.1 Describe how Lamarck would have explained the evolution of flightless birds.

- As the wings were used less ✓
- they became reduced in size ✓/less developed
- and could not be used for flying ✓
- This acquired characteristic was passed on to the offspring ✓ (6)

6.1 ACTIVITY 4

There are two variations in the colour of kingsnakes. Some have a bright colourful pattern, and others have a dull pattern. Kingsnakes are non poisonous to their predators. Coral snakes also have a bright colour pattern but are poisonous to their predators. This is a defence mechanism as predators avoid them. Scientists observed that where kingsnakes shared the same habitat with coral snakes, there were more kingsnakes that had bright colourful patterns. The diagram below represents the distribution of the snakes.



4.1.1. Explain how the bright colour pattern of coral snakes influences their survival.

- The bright colour pattern is associated with being poisonous ✓
- thus reducing predation ✓ and
- improving the chances of survival ✓

(3)

4.1.2. Use Darwin's theory of evolution through natural selection to explain why there are more brightly coloured kingsnakes in this habitat.

- There is variation in the colour of kingsnakes ✓
- Some are bright in colour ✓ /resemble the coral snakes and
- the others are dull in colour
- Those with dull colours are killed ✓ by predators
- Those with bright colours are not eaten ✓
- so they survive ✓ and reproduce,
- passing on the allele for bright colour to the next generation ✓

(6)

ACTIVITY 5

Darwin and Lamarck were both scientists who tried to understand evolution.

Lamarck's theory of evolution was based around how organisms (e.g. animals, plants) change during their lifetime and then pass these changes onto their offspring.

For example, Lamarck believes that the giraffe had a long neck because its neck grew longer during its lifetime, as it stretched to reach leaves in high-up trees, meaning that each generation of giraffe had a longer neck than previous generations.

Darwin's theory, known as **natural selection**, believed that organisms possessed **variation** and these variations led to some being more likely to **survive** and **reproduce** than others. In terms of the giraffe, Darwin's theory would state that longer necked giraffes were more likely to survive, because they could eat leaves from taller trees, and therefore more long-necked giraffes will be born, which eventually caused all giraffes to have longer necks.

5.1. Give:

a) The term that describes Lamarck's ideas.

(1)

- Lamarckism ✓

b) The term that describes Darwin's idea of Natural selection.

(1)

- Darwinism ✓

c) The name of the Scientist that is associated with the theory of punctuated equilibrium.

(1)

- Eldredge and Gould ✓

5.2. Tabulate the difference between Lamarck's theory of evolutions and Darwin's theory of evolution

(2)

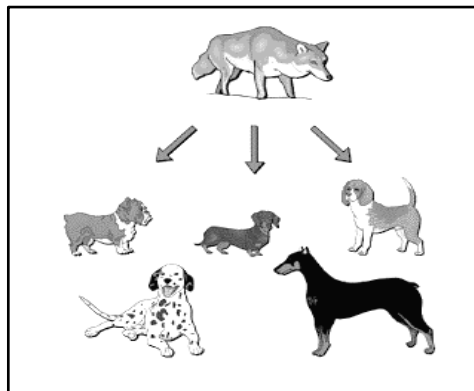
Lamarck's	Darwin's
Variation of offspring brought about by individuals in the population changing ✓	Offspring inherit variation ✓
Individuals want to change ✓	Environmental factors working randomly ✓
Change because of adaptation to environment ✓	Natural selection – best suited to the environment to survive ✓
Individuals in the population change ✓	The population as a whole changes ✓
Changes brought about by adaptation to the environment are inherited from parent to offspring ✓	Characteristics are passed on from generation to generation to enable individuals to survive in the environment ✓

ACTIVITY 6

6.1. Distinguish between punctuated equilibrium and gradualism. (2)

- Punctuated means a sudden change that takes place in a species (punctuated) and then this new change last for a long period of time (equilibrium).

6.3. The first dog evolved from a population of wolves. Although wolves look very similar to some breeds of domestic dogs, wolves and domestic cannot interbreed.



All types of domestic dogs are capable of interbreeding to produce puppies which will eventually be capable of interbreeding with any other domestic dog.

6.3.1. Explain why all breeds of domestic dogs belong to the same species.

- If any of those dogs are physically mate, they will produce a fertile offspring. ✓

(2)

6.3.2. Domestic dogs are bred to show specific characteristics with respect to their health, personality, and appearance. Explain why this is consider as artificial selections.

(2)

- Humans chose characteristics that they like and bred dogs with those phenotypes and genotypes ✓ to create dogs that suit their needs, e.g. hunters, companions, helpers. ✓

6.3.3. Describe how artificial selection led to different breeds of domestic dogs

- Humans chose characteristics that they like and bred dogs with
- those phenotypes and genotypes ✓ to create dogs that suit
- their needs, e.g. hunters, companions, helpers. ✓ The different
- breeds are bred for the different needs and therefore selected
- characteristics. ✓

(3)

ACTIVITY 7

7.1

When the Grand Canyon was formed, the population of the ancestral species of squirrels living in the area were split into two sub-populations. Over a period two species developed.



Kaibab squirrel

Abert's squirrel

One species is the Kaibab squirrel which has black fur and fluffy tail. The other is the Abert's squirrel which has grey fur and a bushy tail.

Members of these two species have a similar size, shape, and diet, but they are no longer in contact with each other and have become so different during their separation that they are now separate species.

[Adapted for <http://biologydictionary.net/allopatric-speciation>]

7.1.1. Define a population.

- A group of organisms of the **same species** ✓ that lives together in a **defined area** ✓ at a **given time** and **interbreeding** ✓ can take place.

(2)

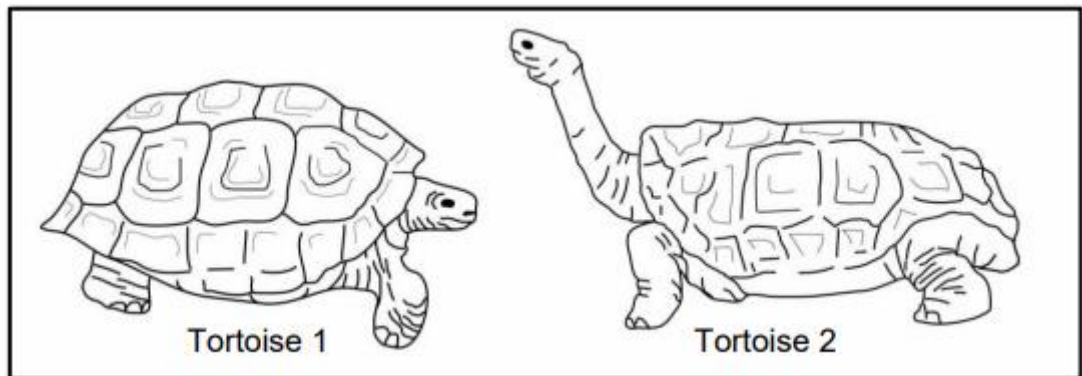
7.1.2. Describe how speciation of the **GRAND CANYON** squirrels took place.

- If a population of a single species Squirrel family/ original population of the dog's ancestor lived on a large continent
- They become separated by a **GRAND CANYON**
- The population splits into two
- There is now no gene flow between the two populations, Kaibab squirrels and Abert's squirrels
- Since each population may be exposed to different environmental conditions
- natural selection occurs independently in each of the Two populations
- such that the individuals of the two populations become very different from each other

- genotypically and phenotypically
 - Even if the three populations were to mix again
 - they will not be able to interbreed
 - The two populations are now different species, Kaibab squirrels and Abert's squirrels
- (5)

ACTIVITY 8

- 8.1. Darwin discovered two different species of tortoises on two different islands in the Galapagos. One had a domed shell and short neck, the other had an elongated shell and a longer neck. The two islands had very different vegetation. One of the islands (island X) was rather barren, dry and arid. It had no grass but rather short tree-like cactus plants. On the other island (island Y), there were no cactus plants but it had a good supply of water and grass grew freely. The diagram below shows the two main???



- 8.1.1. Which tortoise would be found on island Y
- Tortoise 2
- (2)
- 8.1.2. Describe how the two tortoise species become different
- The ancestral tortoise population was separated by a geographic barrier (the ocean) as they were found on the mainland and an islands
 - There was no gene flow between the populations
 - Each population was exposed to different climatic conditions and different vegetation types, so that natural selection occurs independently in both populations
 - The individuals in the populations become very different to each other
 - both in their genes (genotypically) and their appearance (phenotypically)
 - Even if the populations were to mix again, they will not be able to reproduce with one another since they are now two different species.
- (6)
- 8.1.3. List FOUR sources of variation that could have led to the variation in the tortoise population
- crossing over during Prophase I of meiosis
 - the random arrangement of maternal and paternal chromosomes

- random fertilisation of egg cells
- random mating

(4)

8.1.4. Explain the role of natural selection on **island X** where more of tortoise 2 are found.



- During continental drift two different islands formed ✓/Geological
- barrier
- The population will split up into two groups ✓
- Each island has a different environment ✓/vegetation
- Each group of tortoises undergoes natural selection independently ✓
- The tortoises with longer necks (Tortoise 2) survived on island X ✓
- because they could feed on the cactus plants
- The tortoises with shorter necks (Tortoise 1) survived on island Y ✓
- because they could feed on grass ✓
- Each group may become genotypically ✓and phenotypically
- Different ✓which might prevent them from interbreeding✓
- They become reproductively isolated leading to the formation of a new
- Species ✓ through allopatric speciation ✓

(6)

ACTIVITY 9

9.1. Identify the reproductive isolation mechanisms that is illustrated in the diagrams below.

(5)

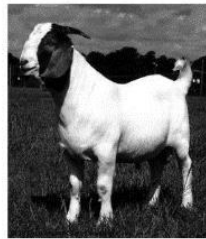
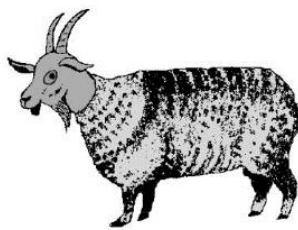
 <p>Insects have very specific copulatory organs.</p>	
	

May



Species 1

Species 2



Sheep and goat hybrid dies before birth



ACTIVITY 10

10.1.1. What is meant by the term reproductive isolation?

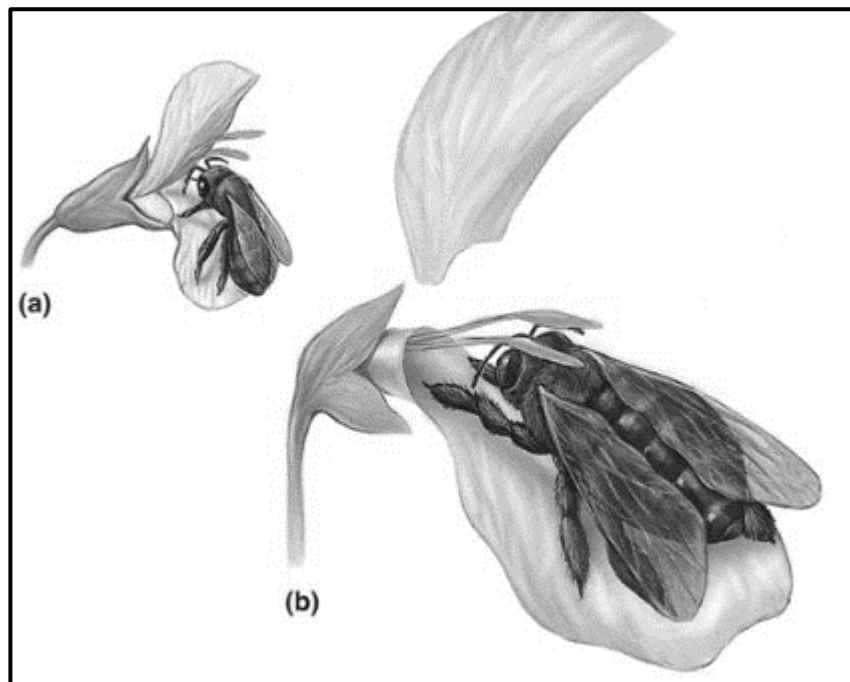
- Reproductive isolation is the mechanism that prevents two species from mating with
- one another and making fertile hybrids, even when not separated by a geographic barrier ✓.

(1)

10.1.2. Describe species - specific courtship behaviour.

- Some animals have very specific courtship behaviours that do not attract individuals of other species, even if they are closely related species.

(2)



Differences in flowers structure in black and white sage select for different pollinating bees. Big bees do not fit on black sage petals.

10.2.1 Identify the reproductive isolation mechanism that is illustrated in the diagram above.

- Adaptation to different pollinators ✓

(1)

10.2.2. Explain what the significance of this isolation mechanism is.

(2)

10.2.3. Explain the development of infertile offspring between two species.

(3)

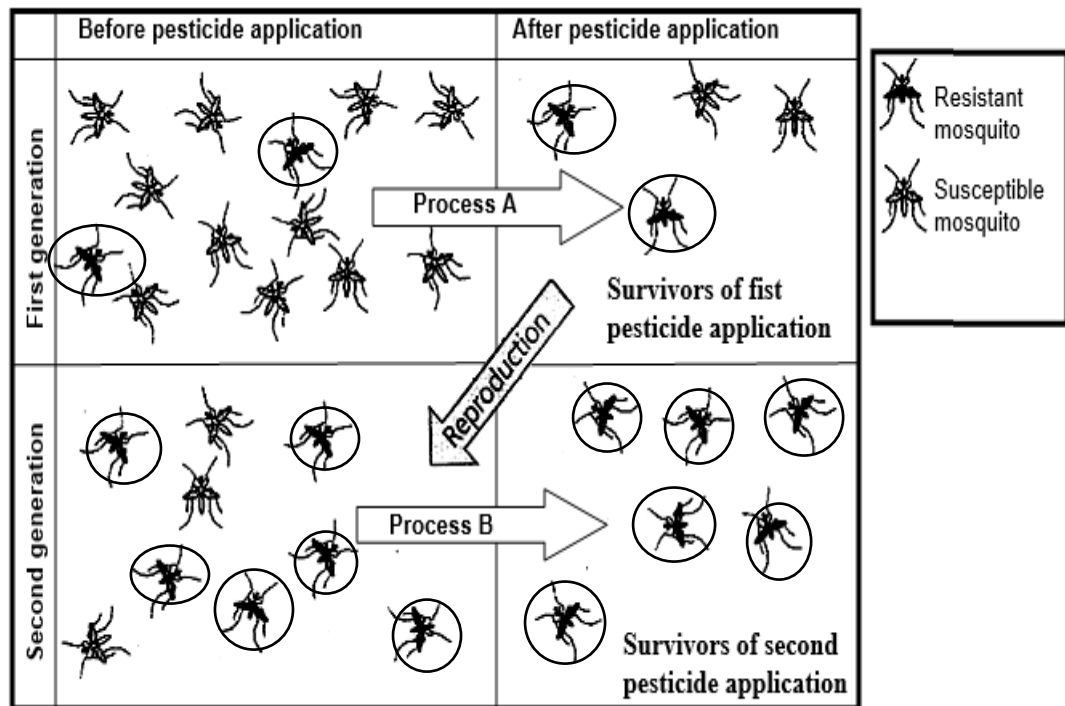
10.2.4 Give an example of infertile offspring between two species.

- Horse + Donkey = Mule

(2)

ACTIVITY 11

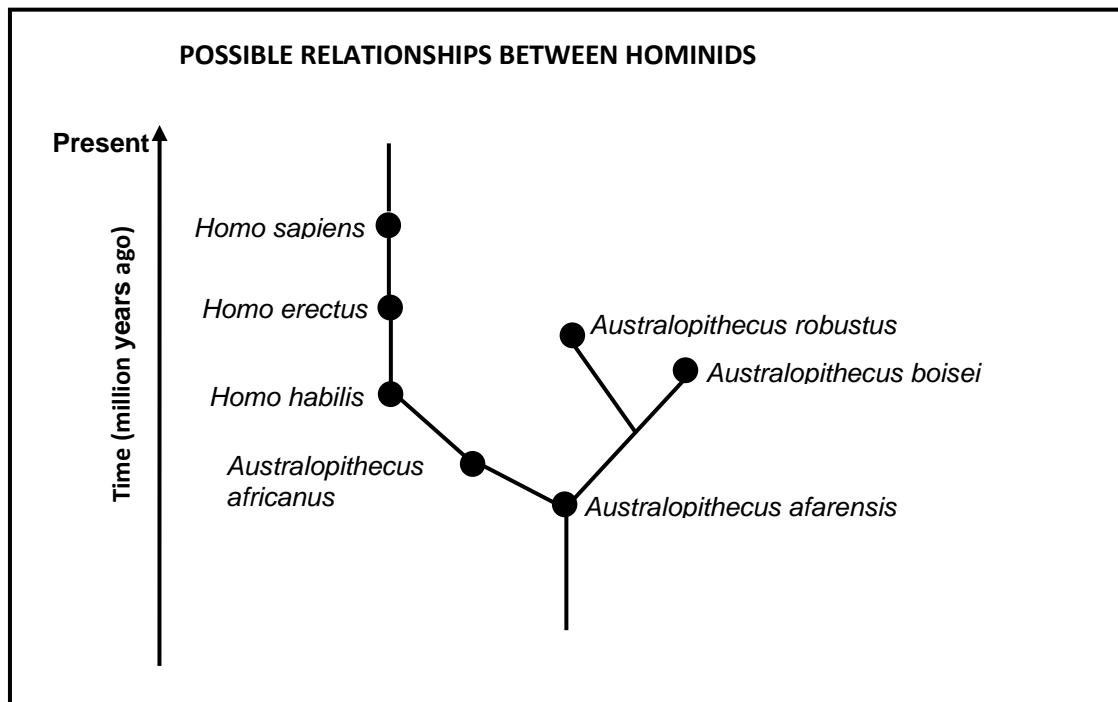
- 11 The introduction of DDT represents a change in the environment of the mosquito. Study the diagram and answer the questions (1)



- 11.1.1. Give a suitable heading for the diagram above. (2)
 - Evolution in present time ✓
- 11.1.2. What process is represented by: (1)
 a) A resistance to DDT by mosquito ✓ (1)
 b) B Natural selection ✓ (1)
- 11.1.3 Describe the composition of the first generation. (2)
- 11.1.4 Explain how these two dark mosquitoes evolved in the first generation. (3)
 - The mosquitoes had become resistant to DDT and those which could not resist DDT did not survive.
- 11.1.5 Describe the composition of the survivors of the second pesticide application. (2)
 - DDT also killed birds and fish that naturally prey on mosquitoes and therefore, there were no longer any natural predators. ✓
 - This gave rise to an increase in the mosquito populations ✓

ACTIVITY 12

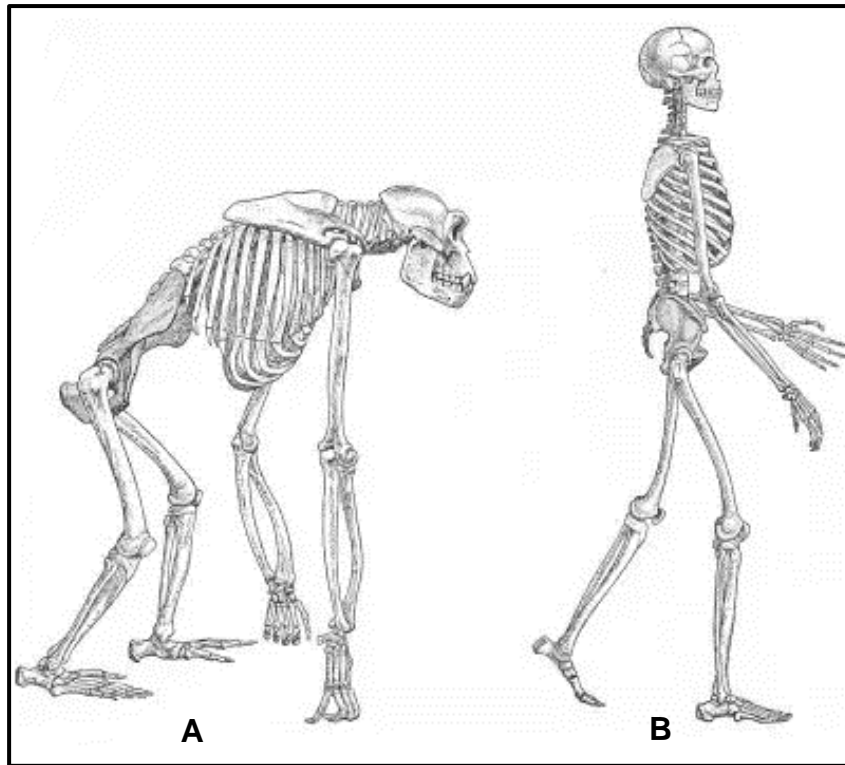
- 12 The diagram below shows possible relationships between members of Hominids.



- 12.1.1 What is the name given to this diagram? (1)
 - **phylogenetic tree ✓**
- 12.1.2 How many of each of the following are represented in the diagram? (2)
 a) **two genera *Australopithecus*, *Homo* ✓**
 b) **and seven species ✓**
- 12.1.3 Explain why *A. robustus* and *A. boisei* are more closely related than *A. boisei* and *A. afarensis*. (2)
 - ***A. robustus* and *A. boisei* ✓ share a more recent common ancestor ✓**
- 12.1.4 Which hominid is the common ancestor of all the hominids in this diagram? (1)
 - ***Homo habilis* ✓**
- 12.1.5 Give the: (5)
 a) Family to which all humans belong to (1)
 ***Homo* ✓**
 b) Genera to which all humans belong to (1)
 ***Sapiens* ✓**
 c) Name of the ancestor of *Homo sapiens* (1)
 ***Homo habilis* ✓**

ACTIVITY 13

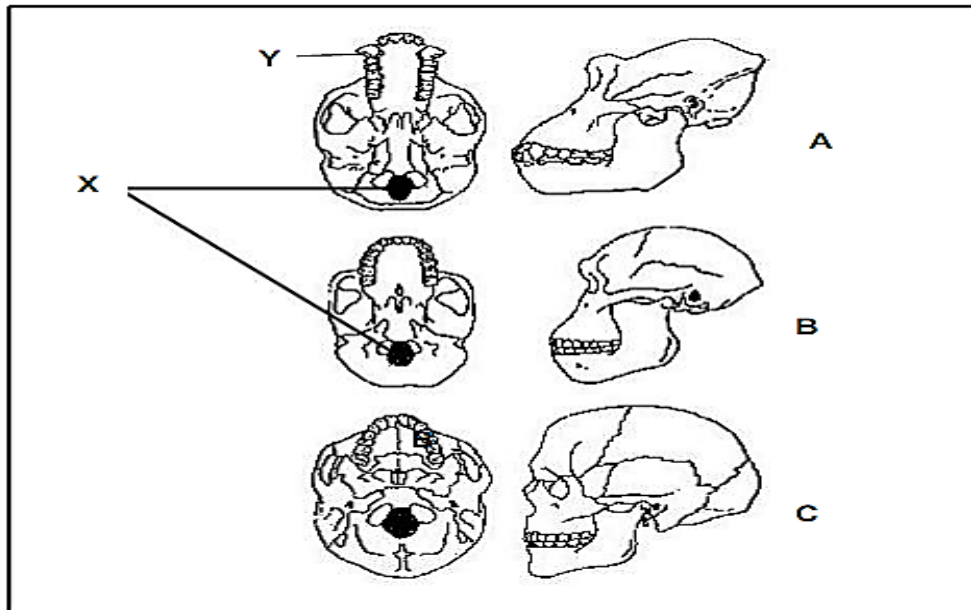
13 Skeletons of an African ape and a human



- 13.1.1. Organism **A** and **B** belong to the same order and family.
Give the name of the order and family
- **Homonids ✓** (1)
- 13.1.2. Give FOUR similarities they share regarding their **upper limbs**.
- **Arms rotate freely at the shoulder joint ✓**
- **Long upper arms ✓**
- **Arms rotate freely around the elbow joint ✓**
- **Opposable thumbs ✓**
- **Bare fingertips ✓**
- **Nails instead of claws ✓** (4)
- 13.1.4. Which organism:
a) Belongs to the hominin group
B ✓ (1)
b) Is quadrupedal
A ✓ (1)
c) Belongs to Mammalia
Both A and B ✓ (1)
- 13.1.5. What is the different function of the opposable thumbs of organism **A** and **B**?
- **A –**
- **B - enabling the hand to grip an object ✓** (2)

ACTIVITY 14

14.1 Fossilised skulls of three different species of primates.



14.1.1. Give the label for **X** and **Y**.

X - Foramen magnum

Y - Canine

(1)

14.1.2. Which skull belongs to:

a) **A**

b) **B**

c) **C**

(3)

14.1.3. Explain how the change in the skull from **B** to **C** could indicate change in intelligence.

- **There is an increase**
- **in the cranium size from organism B to organism C**
- **This will allow it to house a larger brain/cerebrum which**
- **suggests greater intelligence**

(4)

14.1.4 Tabulate FIVE visible differences between the skulls of **A** and **C**

Skull B	Skull C
Brow ridges pronounced✓	Brow ridges are not as pronounced✓
More protruding jaws✓/larger jaws	Less protruding jaws✓/ smaller jaws

(6)

ACTIVITY 15

15 The extract below is about human evolution.

In 2004 scientists in Indonesia discovered the first fossil of the species *Homo floresiensis* along with stone tools and animal remains. The fossil was made up of a nearly complete skull and skeleton, including hand and foot bones and a pelvis.

Dating of the tools suggests that *H. floresiensis* may have lived from as early as 95 000 years ago until about 12 000 years ago.

Researchers closely analysed three wrist bones and found that they more closely resembled those of apes than modern humans. This finding implied that *H. floresiensis* was indeed a separate species from modern humans.

They had skulls that resembled early *Homo* species. This included a flat forehead and a short, flat face; however, their teeth and jaws more closely resembled *Australopithecus*.

The scans of the skull suggested that the brain volume of *H. floresiensis* was about 426 cm³; around one-third the size of the modern human brain which has an average volume of about 1 300 cm³. The findings suggested that *H. erectus* may be the ancestor of *H. floresiensis*, as *H. erectus* had brains about 860 cm³ in size or, alternatively, it may have evolved from *H. habilis*, whose brains were about 600 cm³ in size.

- 15.1.1 Name the TWO lines of evidence for human evolution that is referred to in the extract above (2)
- Fossil/ 'the first fossil'
 - Cultural/ 'stone tools'/'animal remains'
- 15.1.2 How long did *Homo floresiensis* exist on Earth? (1)
- 83 000 years
- 15.1.3 Name ONE *Homo* ancestor mentioned in the extract. (1)
- *Australopithecus*
- 15.1.4 Describe ONE feature of the skull that can be used as evidence for bipedalism. (2)
- The jaw was more prognathous/protruding and larger than in humans
 - The jaw was more rectangular
 - The palate shape was less rounded/U-shaped/rectangular
 - The canines were larger
 - Large spaces/diastema between the teeth
- 15.1.5 State TWO similarities between the hands of African apes and modern humans. (2)
- A more forward position
 - of the foramen magnum

- 15.1.6 State THREE features of the jaw of *H. floresiensis* that might have led scientists to believe that it resembled that of *Australopithecus*, rather than of a *Homo* species
- Opposable thumbs
 - Bare fingertips
 - Nails instead of claws
 - Pentadactyl hand
- (3)

- 15.1.7 Draw a table to show the brain volumes of the different *Homo* species, using information from the extract.

HOMO SPECIES✓	BRAIN VOLUME✓(cm ³)
<i>H. floresiensis</i>	426
<i>H. habilis</i>	600
<i>H. erectus</i>	860
<i>H. sapiens/modern humans</i>	1300

(4)

- 15.2. Scientists use fossils as evidence for human evolution. The brain volume of some extinct primates has been estimated from their fossils and have been compared to the brain volumes of living primates

PRIMATE	PERIOD OF EXISTENCE (million years ago)	AVERAGE BRAIN VOLUME (cm ³)
<i>Ardipithecus ramidus</i>	5,8 to 4,4	400
<i>Australopithecus afarensis</i>	4 to 2,7	450
<i>Australopithecus africanus</i>	3 to 2	450
<i>Homo habilis</i>	2,2 to 1,6	750
<i>Homo erectus</i>	2 to 0,4	1 000
<i>Homo neanderthalensis</i>	0,3 to 0,23	1 500
<i>Homo sapiens</i>	0,2 to present	1 400
Modern apes	0,2 to present	500

- 15.2.1. What type of evidence of human evolution is given in the table
- Fossil evidence ✓
- (1)

- 15.2.2 Give the

- a) Family to which all these fossils belong to
 - *Ardipithecus ramidus* ✓

(1)
- b) First primate that become extinct
 - *Ardipithecus ramidus* ✓

(1)
- c) Genus of erectus
 - *Homo* ✓

(1)

- 15.2.3 Name FOUR fossils of *Australopithecus* that are found in Africa only.
- *Ardipithecus* ✓
 - *Australopithecus* ✓
- (4)

- *Homo habilis* ✓
- *Homo erectus* and *Homo sapiens* ✓ found in Africa, while the younger fossils were found in other parts of the world)

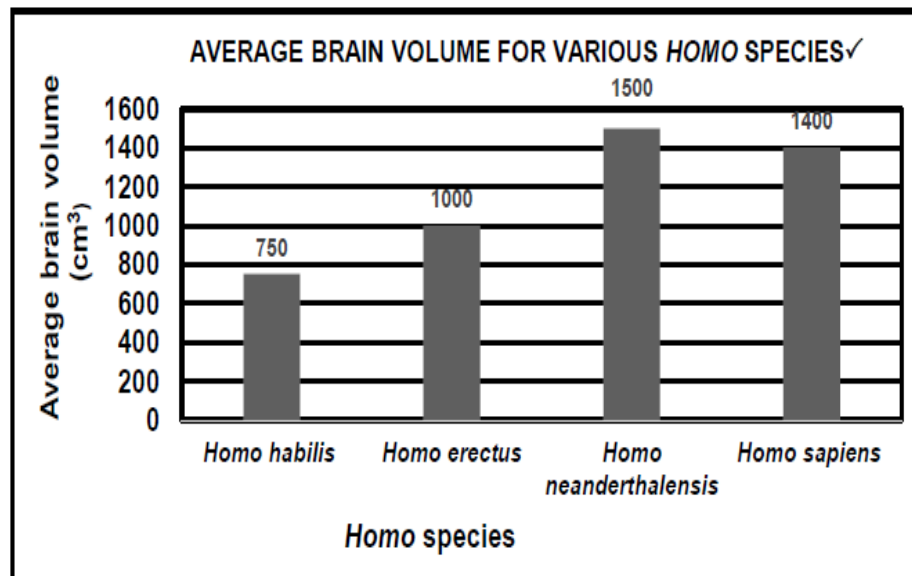
15.2.4 The brain of an organism is not preserved as a fossil.
How do scientists determine the brain volume of extinct primates?

- They would measure the volume ✓
 - of the cranium of the fossil ✓
- (2)

15.2.5 Give evidence in the table that suggests that:

- Homo habilis* and *Homo erectus* may have existed at the same time
 - There is an overlap in their period of existence/they both existed between 2 and 1,6 mya ✓
 - Ardipithecus* was the most primitive of all the primate genera
 - It has the smallest brain volume ✓
 - It appeared first/is the oldest ✓
- (1)
- (1)

15.2.6 Draw a bar graph to show the average brain volume of EACH of the species of the genus *Homo*.



15.2.7 Explain how genetic evidence as a line of evidence contributes to human evolution.

- mtDNA of the sperm cell does not fuse with mtDNA of the egg cell ✓
 - mtDNA is therefore handed down from **mother to child** ✓
 - By following mutations in mtDNA, we can trace our female line of descent. ✓
 - Analysis of mitochondrial DNA leads to ancestral female who lived in East Africa about 150 000 years ago. ✓
- (4)

ACTIVITY 16

16 The image below is of Mrs. Ples



16.1.1 Give the

- a) Genus and species to which Mrs. Ples belong to (1)
 - *Australopithecus Africanus* ✓
- b) Site where Mrs. Ples was found (1)
 - Sterfontein ✓
- c) The scientist that found Mrs. Ples (1)
 - Robert Broom ✓

2 16.2.1. Complete the table

Organism	Fossil site	Discovered by
<i>Aridipithecus</i>	North-East Ethiopia ✓	Tim White ✓
<i>Australopithecus Sediba (Karabo)</i> ✓	Malapa Cave – in the cradle of humankind	Lee Berger
<i>Homo erectus</i> ✓	Indonesia and Swartkrans	Eugene Dubois
<i>Homo sapiens</i> ✓	Makapans gat in Limpopo; Border Cave in KZN	Tim White ✓
Lucy	Ethiopia, Kenya, Tanzania ✓	Donald Johanson
Taung; child ✓	Sterkfontein	R Dart

16.2.2. Give the name of the *Australopithecus afarensis* that was found in Kenya and Tanzania.

- Kenya (Lucy) ✓ (1)

16.2.3. Give the *Australopithecus africanus* that was discovered by

- a) Robert Broom
 - Mrs. Ples ✓
- b) R Dart
 - Taung ✓
- c) Lee Berger
 - Sediba (Karabo) ✓

d) Ron Clark

- Little foot ✓

ACTIVITY 17 – Scientific Investigation Question

Brine shrimp are small arthropods found in saltwater lakes. During favourable conditions female shrimps produce eggs that hatch into live young. However, when conditions are unfavourable, the shrimp produce cysts. Each cyst contains the embryo covered with a hard, protective covering. In this state the embryo stops growing and is said to be dormant. The embryo can remain in this dormant state for many years and the cyst will only hatch at the optimum salt concentration.

Scientists wanted to investigate which salt concentration resulted in the highest percentage of hatched cysts

They did the following:

- Prepared salt solutions of different concentrations: 0%, 0,5%, 1%, 1,5% and 2%
- Placed 30 ml of each solution into one of five beakers
- Took samples of brine shrimp cysts using a dropper
- Counted the number of cysts in each sample
- Recorded this as the initial number of cysts
- Placed the samples into each of the five beakers
- Left the beakers at room temperature for 48 hours
- Recorded the number of cysts that hatched in each beaker
- Calculated the percentage of cysts that hatched.
- The results are shown in the table below.

SALT CONCENTRATION (%)	NUMBER OF CYSTS USED AT THE START	NUMBER OF CYSTS THAT HATCHED	PERCENTAGE OF CYSTS THAT HATCHED
0	54	0	0
0,5	34	2	6
1	40	6	15
1,5	40	1	2,5
2	53	1	X

17.1. State TWO planning steps to consider before collecting the samples. (2)

- Obtain permission from the relevant authority ✓
- Plan when to do the investigation ✓
- Get all the equipment ✓
- Decide where to obtain shrimp cysts ✓
- Decide on the different concentrations of solution to use ✓
- Decide on how to record the data ✓
- Decide on where to do the investigation ✓

17.2 State the:

a) Salt concentration ✓

(b) Number of cysts that hatched ✓ / percentage of cysts hatched

(1)

17.3 Calculate the value of X in the table. Show ALL working.

(3)

$$\% \text{ Hatched} = \left[\frac{1}{53} \right] \times 100$$

$$= 1,9\% \text{ (accept range 1,88 to 2)}$$

17.4 State THREE factors that were kept constant in order to ensure the validity of this investigation.

(3)

- Temperature ✓
- The volume of solution ✓ used / 30ml solution was used
- Duration ✓ / the amount of time / left the beakers for 48 hours
- Cysts from the same type of shrimp ✓

17.5 Which salt concentration resulted in the highest percentage of hatched cysts?

(1)

- 1% ✓ salt solution