Western Cape Government

Western Cape Education Department
Directorate: Curriculum FET

LIFE SCIENCES

REVISION BOOKLET

2022 TERMS 3 and 4

Grade 10

This revision program is designed to assist you in revising the critical content and skills that you have covered during the 3rd erms. The purpose is to prepare you to understand the key concepts and to provide you with an opportunity to establish the required standard and the application of the knowledge necessary to succeed in the examination.

The revision program covers the following topics:

- Biosphere to ecosystems
- Biodiversity and classification
- History of life on earth

Table of Contents

TERM 3 AND 4 CONTENT

1. BIOSPHERE TO ECOSYSTEMS

1.1 The biosphere

The **biosphere** is that part of the earth where living organisms occur. The biosphere is the global sum of all ecosystems. The biosphere consists of the:

- **Atmosphere** – the layer of air that surrounds the earth and that consists of a mixture of gases e.g. nitrogen, oxygen and carbon dioxide.
- **Lithosphere** – refers to the outermost surface of the earth, the earth's crust i.e. the soil and rocks.
- **Hydrosphere** – is the combined mass of water found on, under and above the surface of the earth. The hydrosphere is made up of oceans, seas, lakes, rivers and springs. The water in these bodies can be freshwater or saltwater.

1.2 Biomes

- The biosphere is divided into several biomes.
- A **biome** is a particular physical environment that usually extends over a large geographical area.
- Biomes are regions with similar climate and geography which support a particular group of plants and animals.

- Biomes can be **terrestrial** (land) and **aquatic** (water).
- The following terrestrial biomes are found in South Africa: fynbos, forest, grasslands, savannah, thicket, Nama Karoo, succulent Karoo and desert. *(Note: You should know how the climate, soils and vegetation influence the organisms found in each of these biomes as well as the location of the different biomes in South Africa)*
- Aquatic biomes are divided into two main groups depending on the amount of salt present in the water: freshwater and marine (saltwater) biomes.

1.3 Environment

- The **environment** is the physical conditions, such as soil, water, air, temperature etc. and the biological conditions under which an organism lives.

1.4 Ecosystems

- An **ecosystem** is a particular area e.g. a pond, a forest etc. consisting of all different living organisms (**biotic** components) which interact with each other and their non-living environment (**abiotic** components).

1.5 Abiotic factors

The abiotic factors include the following:

- Physiographic factors – aspect, slope and altitude
- Edaphic (soil) factors – pH, humus content, texture, water retention capacity and air content
- Light – day length and seasonal changes
- Temperature – effect of day/night and seasons
- Water – water cycle and the importance of wetlands
- Atmospheric gases
- Wind

1.5.1 Physiographic factors

Aspect	Slope	Altitude
• Aspect refers to the position of an area in relation to the sun • In South Africa north-facing slopes receive more sunlight than south-facing slopes • North-facing slopes are warmer and drier • South -facing slopes are cooler and wetter and shade plants e.g. ferns grow well in such areas	• Slope is the gradient or steepness of a particular surface of the Earth • The slope of a mountain determines the rate of water run-off • The run-off of water on a steep slope is faster and soil erosion will occur more frequently • The soil on a steep slope is usually shallow and infertile and few plants and animals will be present	• Altitude is the height of the land above sea level. • Areas high above sea level experience extreme weather conditions e.g. low temperatures, less rainfall, strong winds and snow • Plants and animals that are found high above sea level will differ from those closer to sea level

1.5.2 Edaphic (soil) factors

Soil texture	Soil air	Water - retention capacity	Humus content	pH
● There are 3 types of soil i.e. clay, loam and sand ● Clay consists of small soil particles, loam has slightly bigger particles and sandy soil has large particles	● Spaces between soil particles are filled with air and water ● Sandy soil has bigger spaces between soil particles and is well aerated. ● Clay soil is poorly aerated	● Sandy soil has a low water-retention capacity because of the large spaces between soil particles ● Clay soil has a high water-retention capacity ● Loam has a medium water-retention capacity and is the most suitable soil for plant growth	● Humus is decayed plant and animal matter ● Humus increases soil fertility and water-retention capacity ● Soil with humus is normally dark in colour	● Some plants e.g. proteas grow better in acidic soil (low pH) ● Succulent plants grow better in alkaline soil (high pH) ● Most plants grow well in soil with a neutral pH (pH of 7)

1.5.3 Light

- Plants need light for photosynthesis
- The effect of day length on the growth of a plant is called **photoperiodism.**
- Short-day plants only flower when the day length is shorter than 12 hours
- Long -day plants need a day length of more than 12 hours
- Neutral plants are plants that are not affected by day length
- Some animals e.g. moths and bats are **nocturnal** (active at night).

1.5.4 Temperature

- The temperature that plants and animals are exposed to varies between day and night and between summer and winter e.g. ectothermic animals (fish, amphibians, reptiles) become inactive during cold winter temperatures, deciduous trees lose their leaves in autumn to limit photosynthesis and growth.

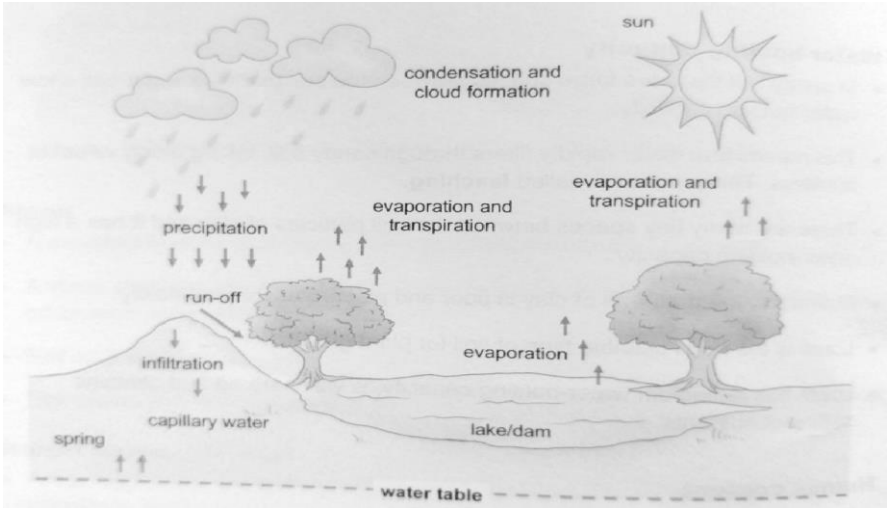
1.5.5 Water

- Water is one of the most important factors in any ecosystem.

Hydrophytes	Mesophytes	Xerophytes
● Plants that grow in water e.g. water lilies	● Plants that grow in areas with moderate water supply e.g. fruit trees, wheat etc.	● Plants that grow in extremely dry conditions e.g. aloe

1.5.5.1 Water cycle

- The water cycle is the cyclic movement of water between the earth and the atmosphere.
- Water moves from the atmosphere to the earth in the form of rain, snow, fog, hail and dew. This is called **precipitation.**
- A part of the water that reaches the earth is absorbed by the upper layers of soil to form **hygroscopic** and **capillary** water.
- Some of the water filters through the upper layers of the soil to the water table. This process during which water is absorbed by the soil is known as **infiltration.**
- Some of the water runs off above the ground and forms streams and rivers that flow into lakes and oceans.
- Water reaches the atmosphere by **evaporation** from large water masses and from the soil.
- Plants **transpire** and lose water to the atmosphere in the form of water vapour.
- Large amounts of water vapour **condense** and form clouds.



1.5.5.2 Importance of wetlands

- Wetlands include a wide range of inland and coastal habitats e.g. lagoons and estuaries that are linked by rivers and streams. Examples of wetlands are springs, swamps, riverbanks etc.
- Wetlands provide a regular water supply, and the water is filtered naturally by vegetation.
- Wetlands play an important role in maintaining biodiversity as it supports a variety of plant and animal life.

1.5.6 Atmospheric gases:

The air around us consists of a mixture of gases:

- Nitrogen – 78%
- Oxygen – 21%
- Carbon dioxide – 0,04%
- Other gases – 0,96%

1.5.7 Wind

- Wind (moving air) increases the processes of evaporation and transpiration.

1.6 Biotic factors

The biotic component includes all living organisms (plants and animals) in an ecosystem.

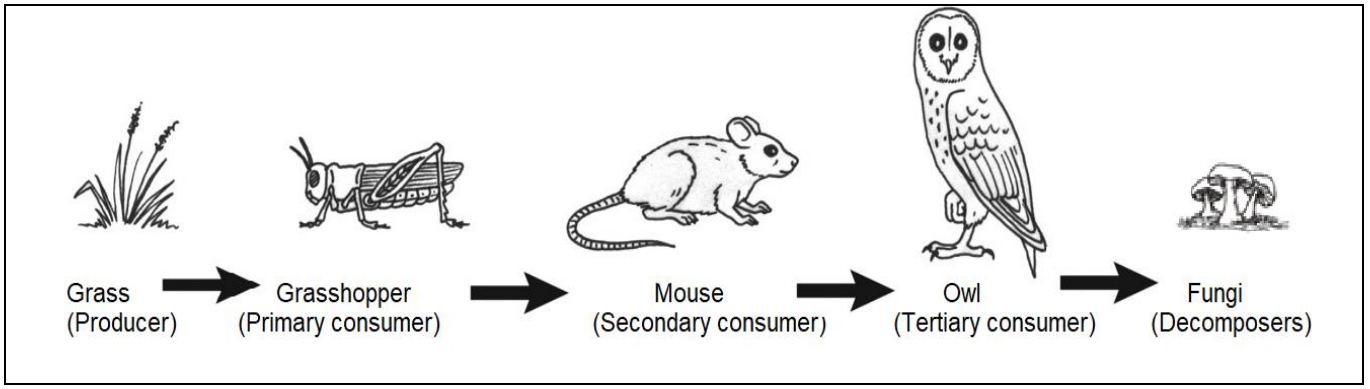
Producers	Consumers	Decomposers
● **Green plants** are called producers because they contain chlorophyll and can produce their own organic food through photosynthesis. ● Producers are **autotrophic** organisms	● **Animals** are consumers because they cannot produce their own organic food but they use the food produced from the plants. ● Consumers are referred to as **heterotrophic** organisms. ● **Primary consumers** e.g. sheep, rabbits, locusts etc. feed directly on the producers (plants). Primary consumers are also called **herbivores**. ● **Secondary consumers** e.g. lions, owls, dogs, humans etc. feed on the primary consumers and include carnivores and omnivores. ● **Carnivores** e.g. lions, owls etc. feed on animal matter.	● Decomposers e.g. **saprophytic** bacteria and fungi feed on dead organic matter. ● They break down organic compounds into simple inorganic compounds that are released back into the environment. ● Decomposers are also **heterotrophic** organisms.

Producers	Consumers	Decomposers
	● **Omnivores** e.g. humans feed on both animal and plant matter. ● **Tertiary consumers** e.g. snakes feed on secondary consumers and are all carnivores.	

1.7 Energy flow

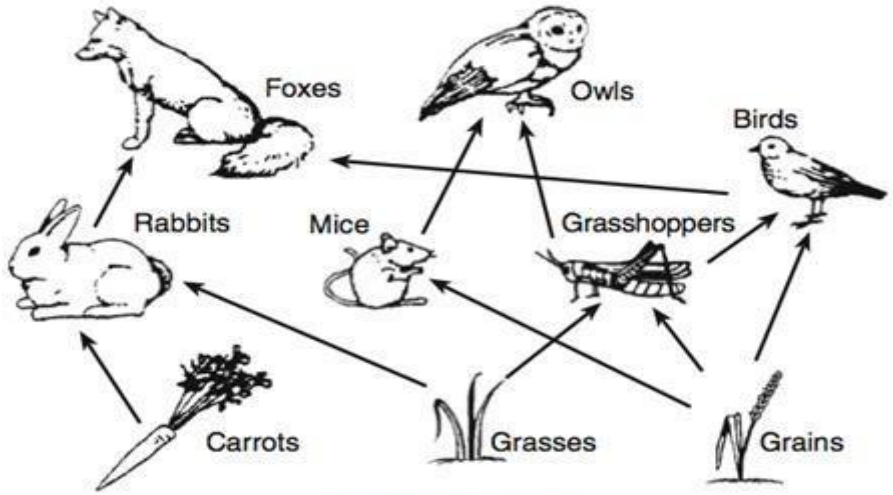
- Energy flows through an ecosystem in one direction.
- Radiant energy from the sun is converted into chemical potential energy during photosynthesis and carbohydrates are stored in green plants (producers).
- Primary consumers obtain their energy from the plants that they eat.
- Secondary consumers obtain their energy by eating the primary consumers.
- Tertiary consumers obtain energy by eating the secondary consumers.
- Producers and consumers are decomposed by bacteria and fungi and energy is released into the environment.
- The transfer of energy from the sun through the green plants and the various consumers is known as a **food chain.**

A food chain



- A food chain never occurs in isolation but is usually linked to other food chains to form a **food web**.
- A food web therefore consists of all the food chains in an ecosystem.

A food web



1.8 Trophic levels

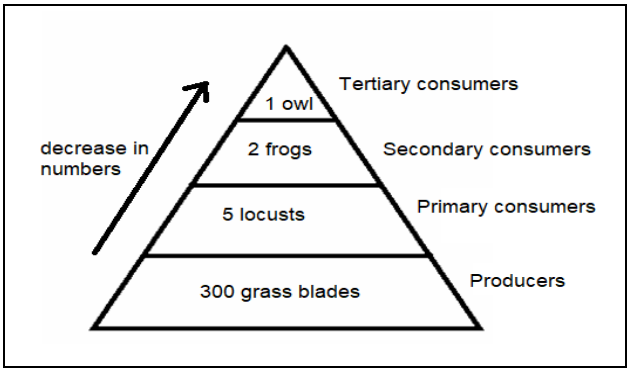
- Living organisms occur at different feeding levels in an ecosystem. These feeding levels are called **trophic levels**.
- **Producers** (green plants) produce their own food and form the first trophic level. They have the greatest amount of energy.
- **Primary consumers** (herbivores) form the second trophic level.
- **Secondary consumers** (carnivores) form the third trophic level.
- **Tertiary consumers** (carnivores that feed on other carnivores) form the fourth trophic level.
- **Omnivores** may be part of the second, third or fourth trophic levels depending on the food they eat.
- **Decomposers** may be part of any of the trophic levels.
- Energy is used by the organisms at each trophic level. These organisms use some of the energy for growth or some of the energy is lost as heat energy through respiration or some of the energy is lost in urine and faeces. This energy is therefore not available for the next trophic level.
- **Note:** Energy can be transferred from one organism to another, but energy cannot be created or destroyed. Energy is lost with the transfer of energy from one trophic level to another.

1.9 Food pyramids

- The different trophic levels are often represented as ecological pyramids.
- There are three types of ecological pyramids i.e. pyramids of number, pyramids of biomass and pyramids of energy.

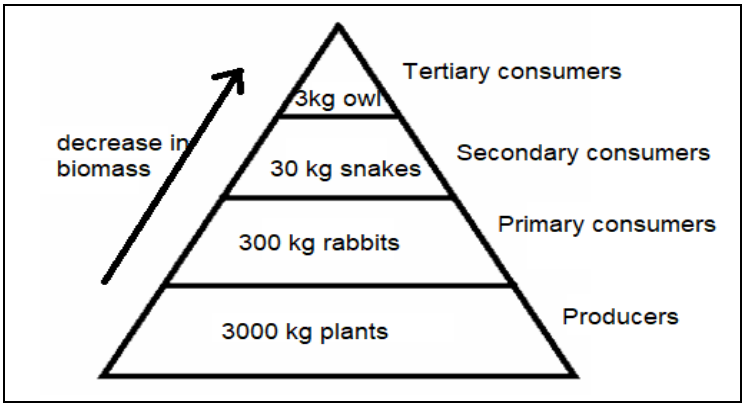
1.9.1 Pyramid of numbers

- Pyramids of numbers show the actual number of organisms on each trophic level.



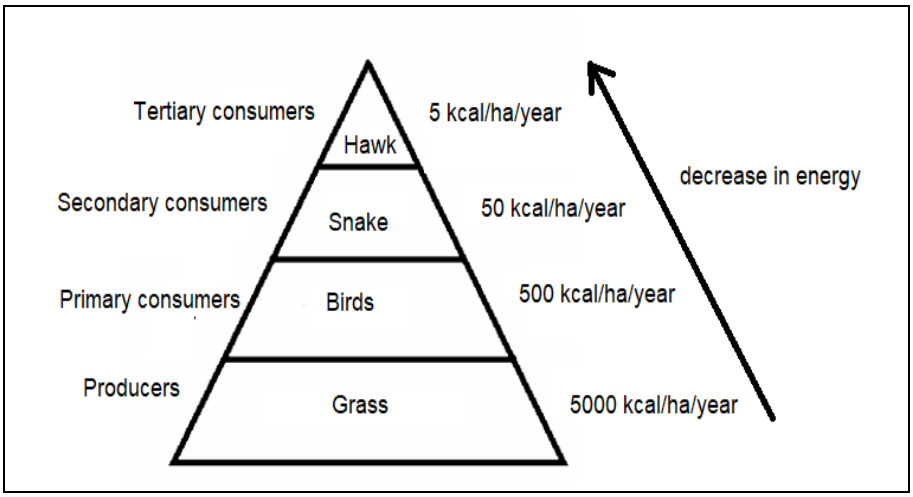
1.9.2 Pyramids of biomass:

- Pyramids of biomass show the total mass of the organisms at each trophic level.



1.9.3 Pyramid of energy

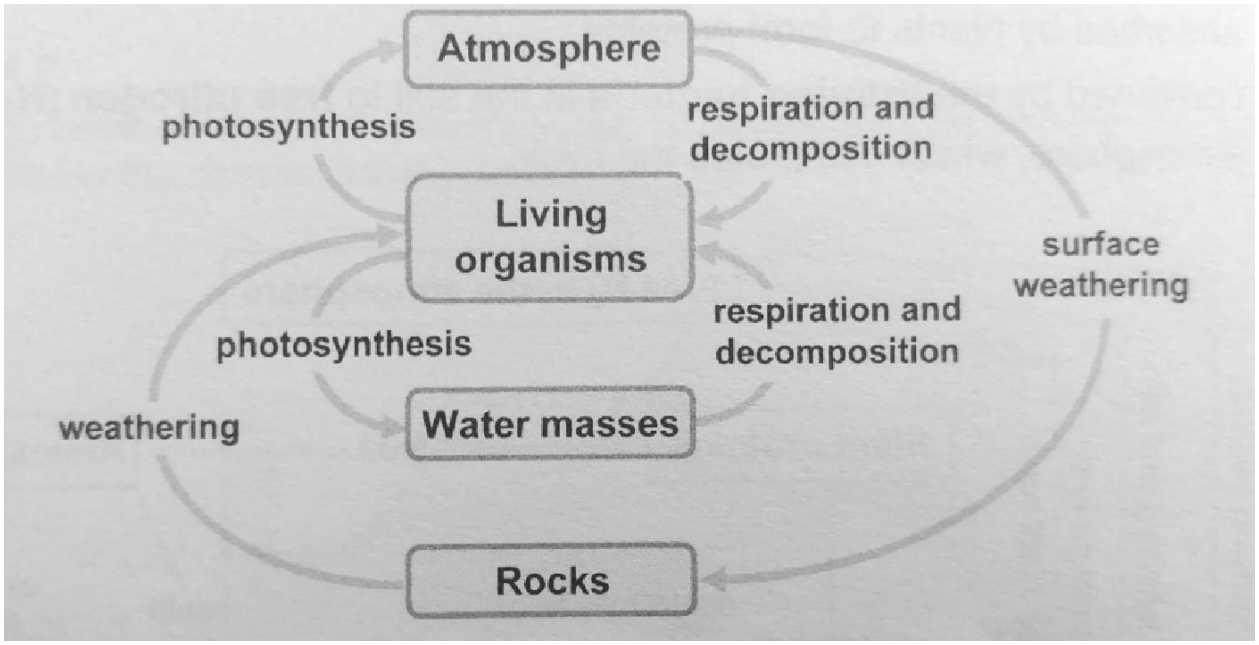
- Pyramids of energy show the amount of energy on each trophic level.



1.10 Flow charts of cycles

Refer to the water cycle covered under section 1.5.5.1

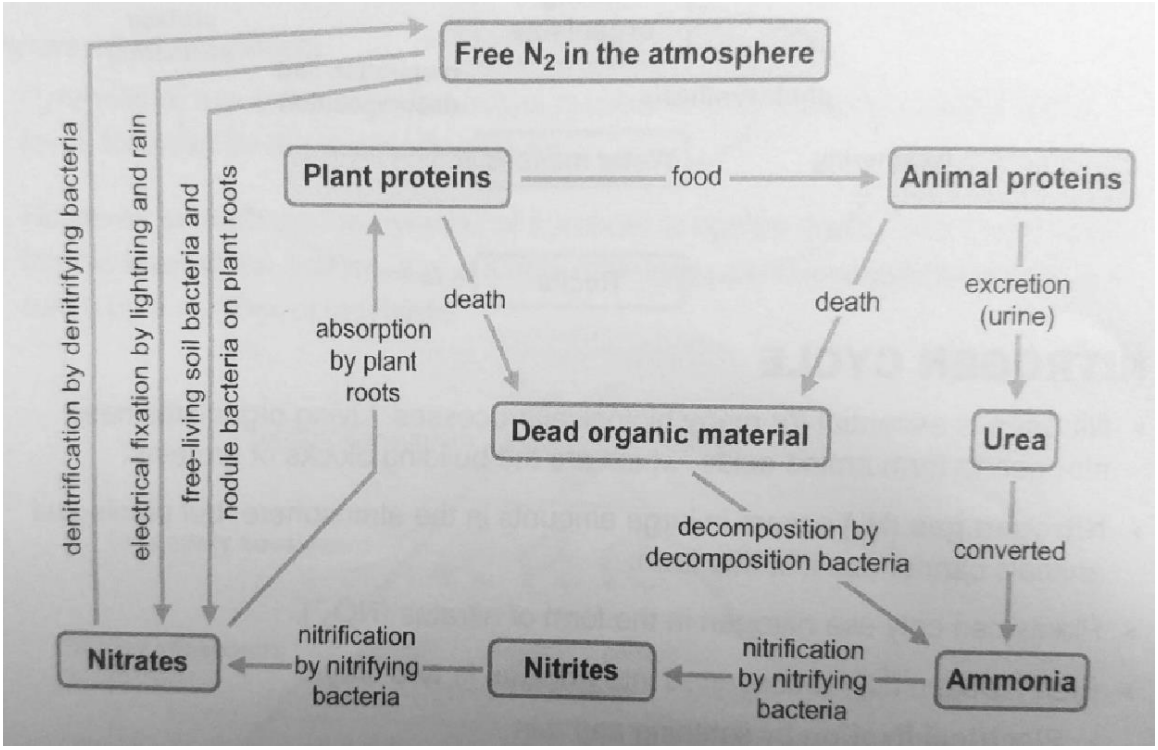
1.10.1 Oxygen cycle



- The earth has a fixed amount of oxygen, which occurs in the atmosphere, oceans, rocks and all living organisms.
- **Living organisms** (plants and animals) use oxygen in various forms.
- Through the process of **photosynthesis**, green plants use the carbon dioxide (CO_2) in the atmosphere to form carbohydrates and oxygen (O_2).
- Animals and plants absorb oxygen from the atmosphere to break down carbohydrates into carbon dioxide and water during the process of **respiration**.

- **Decomposers** (bacteria and fungi) use oxygen to decompose organic matter and release carbon dioxide.
- A large amount of oxygen is dissolved in **water** of oceans, lakes and rivers. Organisms living in water use oxygen for **respiration** and **decomposition** and release carbon dioxide in the water.
- Oxygen from the **atmosphere** combines with silicon and iron in rocks to form silicates and rust, resulting in **weathering** of rocks.
- Organisms such as lichens break down rocks (**weathering**) over thousands of years and release nutrients and oxygen for living organisms.

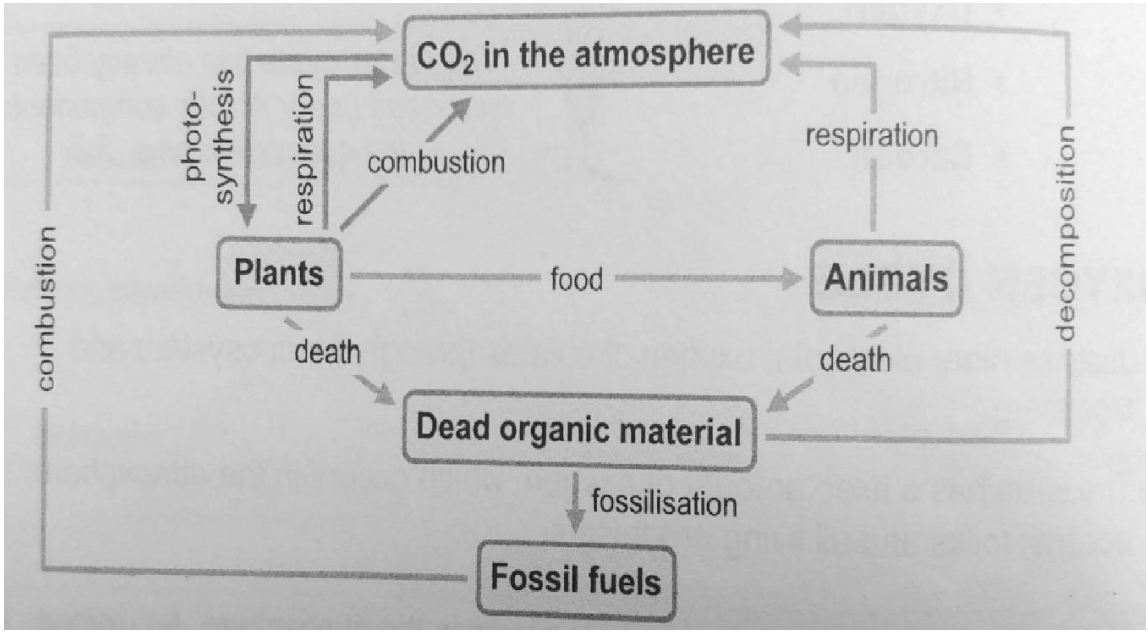
1.10.2 Nitrogen cycle



- Living organisms need **nitrogen** to form amino acids that are the building blocks of **proteins**.
- Nitrogen gas occurs in large amounts in the atmosphere, but plants and animals cannot use it in this form.
- Plants can only use nitrogen in the form of nitrates.
- Free nitrogen is converted into nitrates in two ways:
  - **Electrical fixation** by lightning and rain.
  - **Nitrogen-fixing bacteria** – bacteria in the soil absorb nitrogen from the soil and convert it into nitrates. Nodule bacteria on the roots of legumes convert free nitrogen to nitrates.
- The nitrates are absorbed by plant roots and the nitrogen in nitrates is used to form plant proteins.
- Animals eat plants and use the nitrogen to produce animal proteins.

- When plants and animals die, the proteins in their bodies are broken down into **ammonia** by **decomposition bacteria.**
- **Excretion** (e.g. urine) of animals contain **urea** which is also converted into **ammonia.**
- **Nitrifying bacteria** convert ammonia into nitrates which is returned to the soil and absorbed by plants.
- Nitrates in the soil are also converted to free nitrogen in the atmosphere by **denitrifying bacteria.**

1.10.3 Carbon cycle



- Carbon occurs in the form of **carbon dioxide** (CO_2) in the atmosphere, and some is dissolved in water.
- Green plants use carbon dioxide during **photosynthesis** to produce organic compounds e.g. carbohydrates.
- The carbon which forms part of organic compounds in plants is **transferred** to animals when they eat plant material.
- Sometimes dead plant and animal remains do not decompose but are fossilised to form **fossil fuels** (coal and oil).
- Carbon dioxide returns to the atmosphere in three ways:
  - **Cellular respiration** – organic compounds in plants and animals are broken down in the presence of oxygen and energy, water and carbon dioxide are released.
  - **Decomposition** – decomposers break down organic compounds in dead plants and animals and release carbon in the form of carbon dioxide.
  - **Combustion** – wood and fossil fuels release carbon dioxide during combustion.

2. BIODIVERSITY AND CLASSIFICATION

2.1 Biodiversity

- Refers to the variety of life forms that exist on Earth.

2.2 History of classification

2.2.1 The two-kingdom system

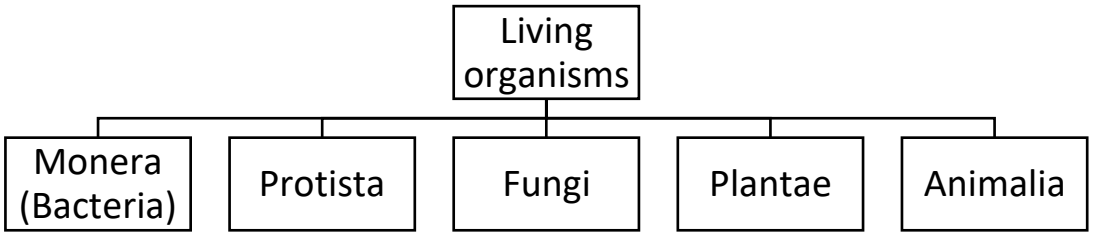
- Simple classification systems were based on shared physical characteristics.
- As information increases classification systems became more complex.
- A Swedish botanist, Carl Linnaeus, classified living organisms into two kingdoms i.e. Plantae (plants) and Animalia (animals).
- Linnaeus developed a classification system where seven categories under each kingdom are used.
- A kingdom is divided into phyla in animals but divisions in plants.

Table to show the basic classification of two organisms

Division	Lion	Pine tree
Kingdom	Animalia	Plantae
Phylum/Division	Chordata	Pteridophyta
Class	Mammalia	Gymnospermae
Order	Carnivora	Coniferales
Family	Felidae	Pinaceae
Genus	*Panthera*	*Pinus*
Species	*leo*	*ponderosa*

2.2.2 The five-kingdom system

- The most common classification system, the five-kingdom system was proposed by Robert Whitaker in 1969.



2.2.3 Naming of living organisms

- Carl Linnaeus designed a **binomial** system for naming of living organisms.
- The first word of the name is the **genus** and the second word is the **species.**
- The genus name is written with a capital letter and the species with a small letter e.g. *Panthero leo.*
- If the name is written by hand, the genus and species names are underlined e.g. Panthero leo.
- When typing the name, the whole name is typed in italics e.g. *Panthero leo.*

2.2.4 Biological keys

- A biological key e.g. a **dichotomous key** is an instrument used to classify living organisms.
- A dichotomous key always gives two choices at each step.
- At each step two statements are given based on the characteristics of the organism.
- If the right option is chosen at each step it will lead to the name of the organism.

2.2.4.1 Example of a dichotomous key

1	a. Three pairs of legs present	Insecta
	b. More than three pairs of legs present	Go to 2
2	a. Four pairs of legs present	Arachnida
	b. More than four pairs of legs present	Go to 3
3	a. Two pairs of antennae present	Crustacea
	b. One pair of antennae present	Go to 4
4	a. Antennae branched at tip	Pauropoda
	b. Antennae unbranched	Go to 5
5	a. Two pairs of legs on each body segment	Diplopoda
	b. One pair of legs on each body segment	Go to 6
6	a. Twelve pairs of legs present, eyes absent	Symphyla
	b. More than twelve pairs of legs present	Chilopoda

2.2.5 Differences between prokaryotes and eukaryotes:

Prokaryotes	Eukaryotes
Organisms with cells with no true nuclei	Organisms with cells that have true nuclei
Their genetic material /DNA is not enclosed by a nuclear membrane and occurs free in the cytoplasm	Their genetic material /DNA is enclosed by a nuclear membrane and occurs free in the cytoplasm
No true organelles occur in the cytoplasm	True organelles occur in the cytoplasm
Monera are prokaryotes	Protista, Fungi, Plantae and Animalia are eukaryotes

2.2.6 Main groups of organisms

	KINGDOM				
	Monera (Bacteria)	**Protista**	**Fungi**	**Plantae (Plants)**	**Animalia (animals)**
Characteristics	● Prokaryotes ● Single-celled (unicellular) ● Micro-organisms ● Heterotrophic and autotrophic ● Asexual reproduction	● Eukaryotes ● Most are unicellular but some are multicellular ● Heterotrophic or autotrophic ● Asexual reproduction, some reproduce sexually	● Eukaryotes ● Some are unicellular but most are multicellular ● Heterotrophic, most are saprophytes ● Asexual reproduction, some reproduce sexually	● Eukaryotes ● Multicellular ● Most plants are autotrophic ● Asexual reproduction by means of spores or sexual reproduction by means of gametes	● Eukaryotes ● Multicellular ● Do not have cell walls ● Animals are heterotrophic ● Reproduction is sometimes asexual but mostly sexual by means of gametes
Examples	Bacteria	Protozoa, algae, slime moulds and water moulds	Yeast, mushrooms, moulds	Mosses, ferns, conifers, flowering plants	Sponges, jellyfish, flatworms, roundworms, earthworms, snails, starfish, insects, spiders, fish, mammals etc.

3. HISTORY OF LIFE ON EARTH

3.1 Changes in the composition of the atmosphere

- When the earth formed, oxygen levels in the atmosphere were very low.
- Fossil records show that the first living organisms i.e. bacteria (prokaryotes) were anaerobic i.e. they did not need oxygen to survive.
- Blue-green bacteria appeared, and they used carbon dioxide in the atmosphere and released oxygen i.e. they could produce their own food through photosynthesis.
- The levels of oxygen started to increase in the atmosphere and aerobic organisms started to develop.
- The increase in oxygen resulted in an increased variety of living organisms on earth.

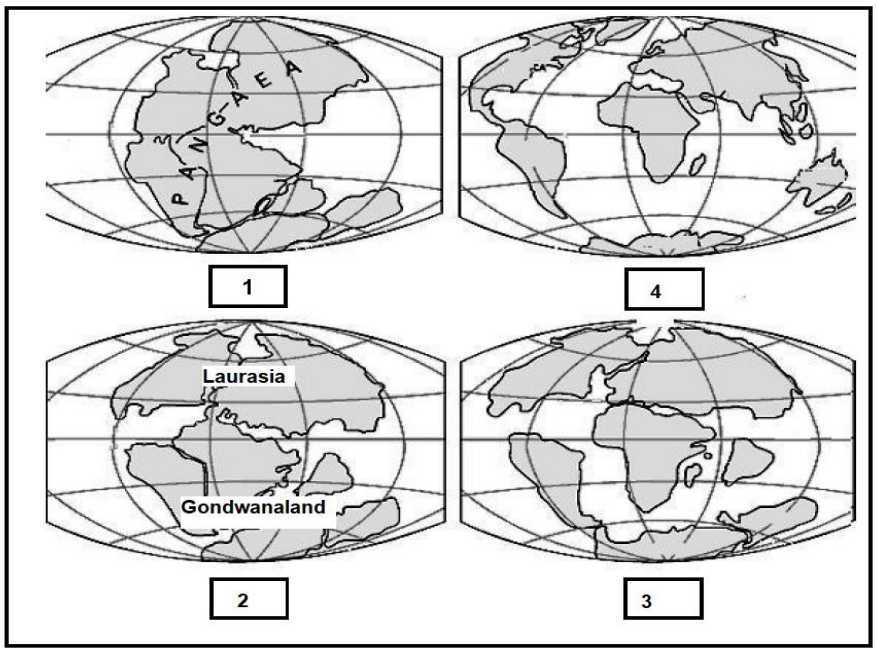
3.2 Changes in climate e.g. the ice age:

- An ice age is a long geological period of drastic decrease in temperature of the earth's surface and atmosphere.
- Many species died out during the ice ages and some migrated to warmer areas on earth.
- When the ice forms, the level of the ocean will decrease exposing more land.
- Ice ages therefore affected life on earth due to the extinction and redistribution of species.

3.3 Geological events

- The theory of **continental drift** proposes that the earth's continents moved and are still moving slowly.
- About 250 million years ago all continents were joined to form one large continent, called Pangaea.
- Pangaea eventually broke up into two supercontinents i.e. Laurasia in the north and Gondwanaland in the south.
- These two supercontinents eventually broke up further into the continents that we know today.
- By means of biogeography evidence has been found that the continents were once joined. **Biogeography** is the study of the present-day distribution of organisms.

Study the diagrams below showing the movement of the continents



3.4 The geological timescale

- Scientists estimate that the earth is about 4,6 billion years old.
- The geological timescale divides the earth's history into three main eras i.e. ***Paleozoic, Mesozoic*** and ***Coenozoic eras.***
- Each of the three eras is divided into periods (*you do not need to memorise the names of the periods*)
- The period that precedes the Paleozoic era is known as the ***Precambrian***.

ERA	PERIOD	MILLIONS OF YEARS AGO (mya)	PLANTS AND ANIMALS
Cenozoic	Quaternary	2	• Modern humans • Modern mammal species evolve • Extinction of large mammals e.g. mammoths
	Tertiary	65	• Birds, mammals and insects • Primates (apes)
Mesozoic	Cretaceous	140-65	• Extinction of dinosaurs • Flowering plants spread
	Jurassic	190-140	• Dinosaurs dominant • First birds evolve
	Triassic	250-190	• First dinosaurs • First mammals • Gymnosperms are the dominant plants
Paleozoic	Permian	280-250	• Increase in reptiles • Gymnosperms
	Carboniferous	345-280	• Increase in amphibians • First reptiles • Ferns dominate
	Devonian	400-345	• First insects • First amphibians
	Silurian	435-400	• First plants and animals on land • Mosses
	Ordovician	515-435	• Algae dominant
	Cambrian	570-515	• Explosion of most animal groups • First vertebrates • Invertebrates
Precambrian		4600-570	• Eukaryotes • Prokaryotes • First invertebrates

3.5 Cambrian explosion

- The early forms of most animal groups appeared in the Cambrian period.
- 'Cambrian explosion' refers to the diversity of life forms that appeared in a relatively short period of time.

3.6 Mass extinctions

- A mass extinction occurs when many species disappear over the same period of time.
- There have been five mass extinctions throughout history, two of which are particularly important i.e. the extinction of about 90% of all life on earth (250 mya) and the extinction of many species, including dinosaurs (65 mya).
- The present time has been called the sixth extinction because of the negative effect of humans on the environment.

3.7 Fossil formation and methods of dating

- A fossil is a complete organism or the remains, imprints or traces of an organism that is usually preserved in rocks.
- Fossils are mainly found in sedimentary rocks.
- Sedimentary rock is formed when clay and sand particles are carried from one place to another by water and wind.
- Over thousands of years these sediments pile up, harden and form sedimentary rock.
- Fossils are also found in tree resin, ice and volcanic lava.

3.7.1 Ideal conditions for fossil formation (fossilisation)

- The organism must be buried immediately after it dies.
- The condition in the sediment needs to be acidic and contain no oxygen.
- The organism needs to have some hard parts e.g. an exoskeleton, shell, teeth etc.

3.7.2 The formation of fossils in sedimentary rock

- The plant or animal dies and is rapidly covered with sediment.
- Soft tissues decay with the help of bacteria and microorganisms.
- Hard body parts remain, and the organic material is hardened or replaced by minerals.
- More layers of sediment cover the dead animal or plant.
- Sediment hardens and the layers become compressed and form sedimentary rock.

3.7.3 Fossil dating:

- The age of fossils can be determined through two methods i.e. radiometric dating and relative dating.

3.7.3.1 Radiometric dating

- This type of dating uses different instruments to measure the radioactive elements e.g. uranium, carbon etc. in fossils or rocks.
- The more the radioactive element in a fossil has decayed, the older the fossil.
- For fossils older than 50 000 years the age of the rocks in which the fossils are embedded is determined.
- Carbon 14 dating is used to measure the age of fossils that are younger than 50 000 years.

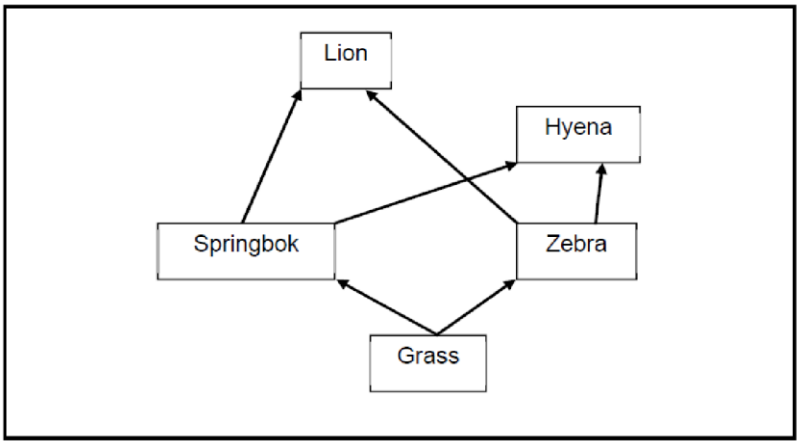
3.7.3.2 Relative dating

- As sediment is laid down on top of each other, the oldest rock will be below the upper layers.
- Older fossils will occur in sedimentary layers deep down and younger fossils will occur in layers closer to the surface of the earth.

4. REVISION QUESTIONS:

- Work through and answer the questions below.
- Please note that **HIGHER ORDER questions** are in **BOLD** and marked with a **(*)**

4.1 The diagram below shows a food web.



4.1.1 Name the organism that represents a…
(a) producer (1)
(b) primary consumer (1)

4.1.2 Explain what may happen if the hyena was removed from this ecosystem. (3)

4.2 Read the extract below.

Carolus Linnaeus established a hierarchical classification system of grouping similar organisms together. He grouped from broad groups called Kingdoms down to the smallest group called species.
Using his system, a lion is fully classified as follows:
Animalia, Chordata, Mammalia, Carnivores, Felidae, panthera leo.

4.2.1 According to Linnaeus' system, which class does the lion belong to? (1)
4.2.2 The lion's scientific or binomial name, panthera leo, has been written incorrectly. Rewrite it correctly. (2)

4.3 Read the extract below.

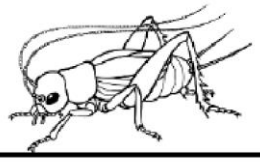
The Cape floral kingdom is the smallest of the world's floral kingdoms. It is home to more endemic (species that occur in one region and nowhere else in the world) and indigenous plants than in any other region in South Africa. Approximately 70% of the 9 000 plant species in this area are found nowhere else in the world.
The vegetation of this biome, which is mostly small bushes, grows in nutrient poor soil. They also survive the long dry summer conditions, as well as frequent fires.
The flora of the Cape is threatened, amongst others, by habitat destruction by humans. Already numerous species are extinct from this biome. Hence, its conservation is a national conservation priority.
In a bid to save this biome, there are several projects aiming at encouraging responsible travel to natural areas in order to conserve the environment, as well as improving the well-being of local communities.

4.3.1 What is a *biome*? (2)
4.3.2 What is the name of the biome in the extract above? (1)
***4.3.3 Give TWO reasons for the habitat destruction by humans. (2)**
***4.3.4 Calculate the total number of species that are endemic to this biome. Show your working. (3)**

4.4 Esethu and Christine read the extract below in a magazine.

HOW IS A CRICKET'S CHIRP RELATED TO TEMPERATURE?

Crickets are insects. Like all living things they have many chemical reactions going on inside their bodies, such as reactions that allow muscles to contract to produce chirping. Crickets, like all insects, are cold blooded and take on the temperature of their surroundings. This affects how quickly these chemical reactions that allow muscles to contract can occur.



They decided to conduct an investigation.

- They took 4 wooden boxes and placed 1 cricket in each box.
- Each box was also fitted with a temperature-controlled heater. These boxes were labelled A, B, C and D.
- The heater in box A was set at 10 °C, box B was set at 15 °C, box C at 20 °C and box D at 25 °C.
- Each box was left for 30 minutes for the crickets to get used to the temperature.
- They then recorded the number of chirps per minute.

Their results are shown in the table below.

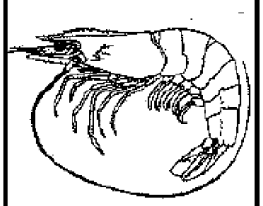
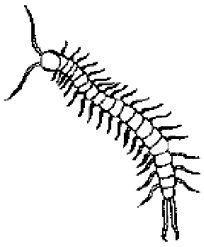
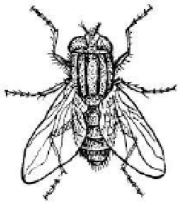
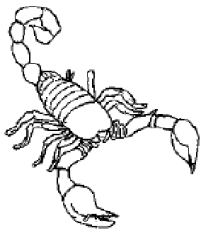
Temperature (°C)	Chirps per minute
10	40
15	75
20	105
25	140

***4.4.1 Write a suitable aim for the investigation. (2)**
***4.4.2 Name TWO factors that Esethu and Christine need to control to make their investigation more valid. (2)**
***4.4.3 Draw a line graph to represent the data shown in the table above. (6)**
***4.4.4 State TWO ways in which Esethu and Christine could improve the reliability of their investigation? (2)**
***4.4.5 In which season would you expect to hear more cricket chirping? Give a reason for your answer. (2)**

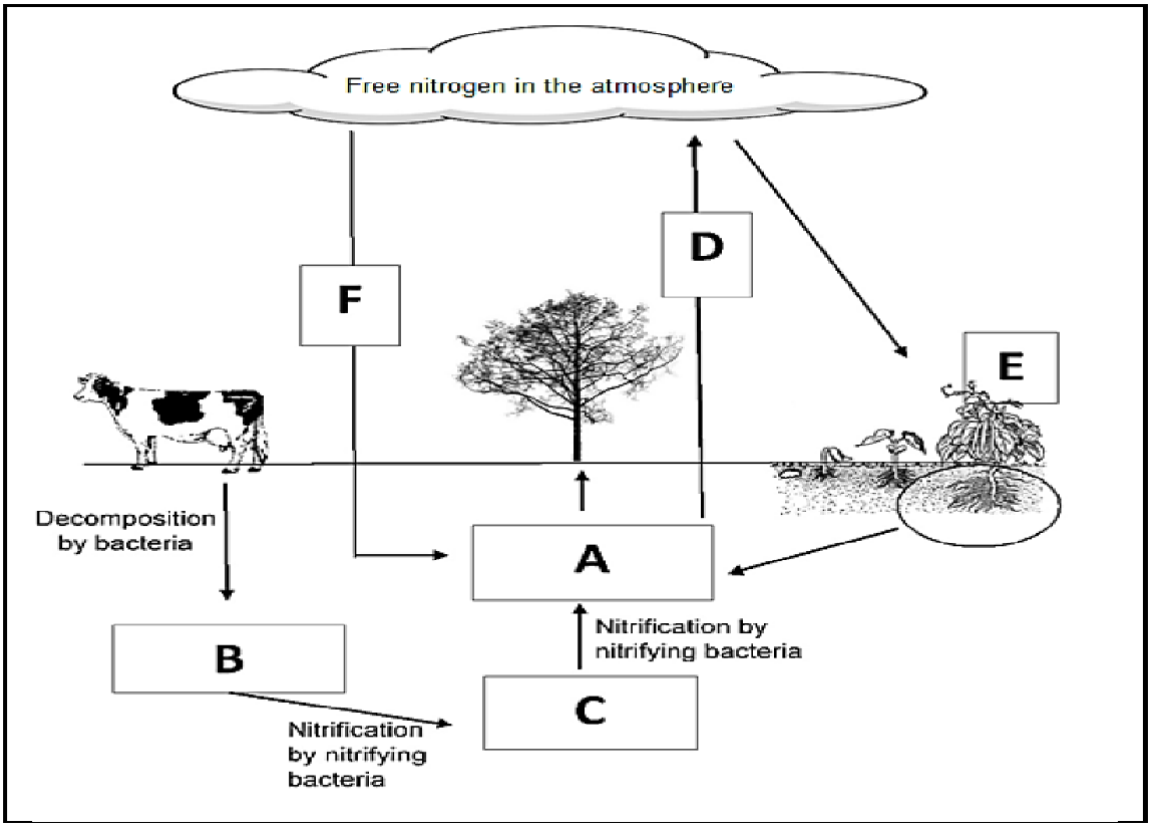
4.5 The table below shows some characteristics of arthropods. Use the information in the table to find the class of the animals labelled **A** to **E**.

CLASS	LEGS	WINGS	BODY REGIONS	ANTENNAE
Insecta	Three pairs	Some have	Head, thorax, abdomen	Yes
Arachnida	Four pairs	No	Cephalothorax, abdomen	No
Crustacea	Five to seven pairs	No	Cephalothorax, abdomen	Two pairs
Diplopoda	More than ten pairs, two pair per segment	No	Long worm-like, cylindrical	One pair, short
Chilopoda	More than ten pairs, one pair per segment	No	Long, worm-like, flattened	One pair, long

4.5.1 Match the correct letter of the organisms **A** to **E** to the class described in the table and give reasons why it belongs to that class. (10)

A	B	C	D	E
				

4.6 Study the diagram showing the nitrogen cycle below.



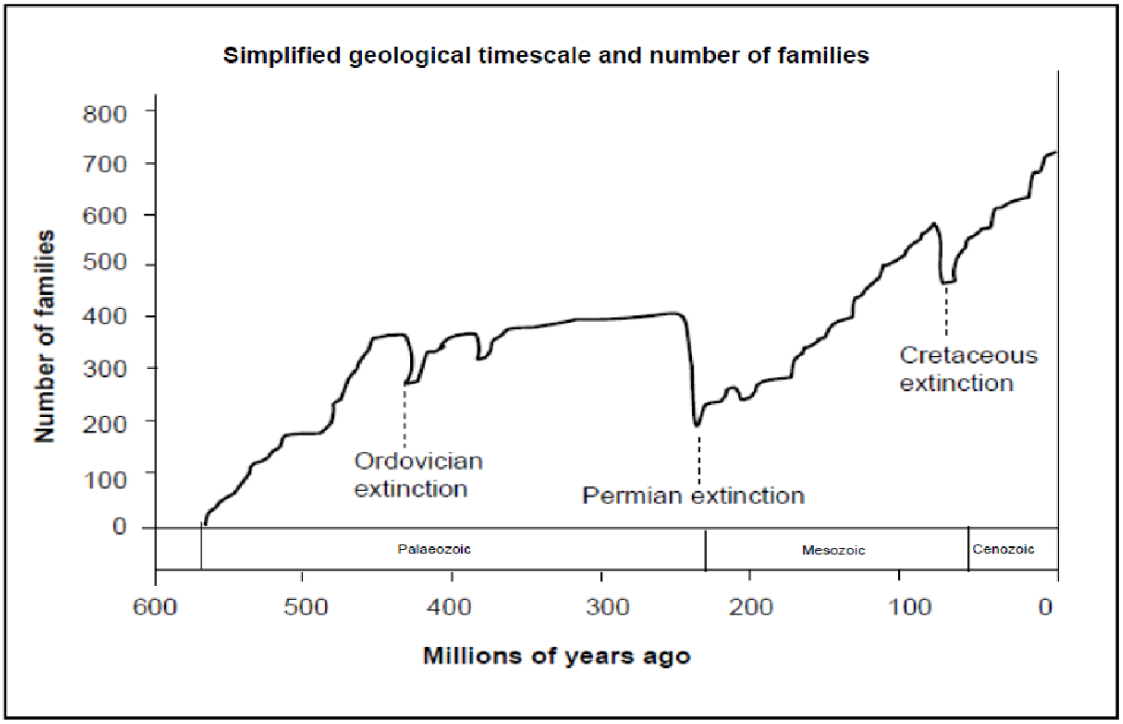
4.6.1 Identify the nitrogenous compound represented by labels **A**, **B** and **C.** (3)

4.6.2 Name the process labelled **D** by which nitrogen is returned to the atmosphere. (1)

4.6.3 Name the plants labelled **E** that form a symbiotic relationship with nitrogen-fixing bacteria. (1)

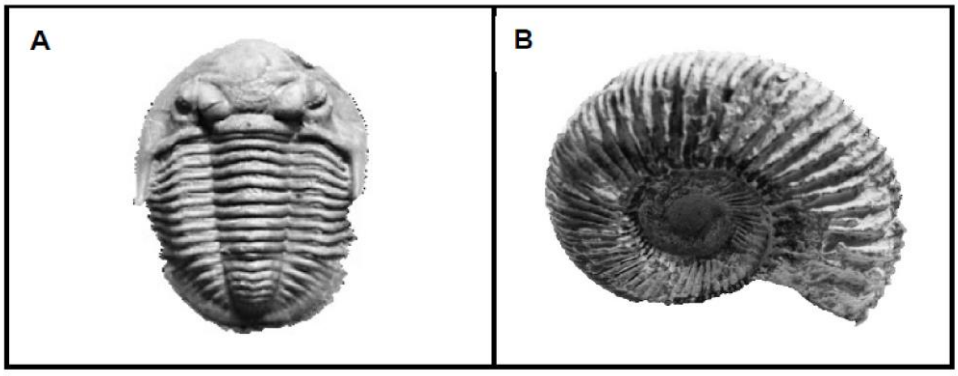
4.6.4 Name the weather phenomenon labelled **F** that is responsible for forming nitrates in the atmosphere. (1)

4.7 The graph below shows the major extinction events.



4.7.1 When did the Cenozoic era begin? (1)
4.7.2 Which mass extinction took place towards the end of the Palaeozoic era? (1)
***4.7.3 Approximately how many families of species died out at the end of the Palaeozoic era? Show ALL working. (3)**
***4.7.4 Explain why the number of families of organisms rapidly increased after each mass extinction. (4)**

4.8 The images below are two different fossils.



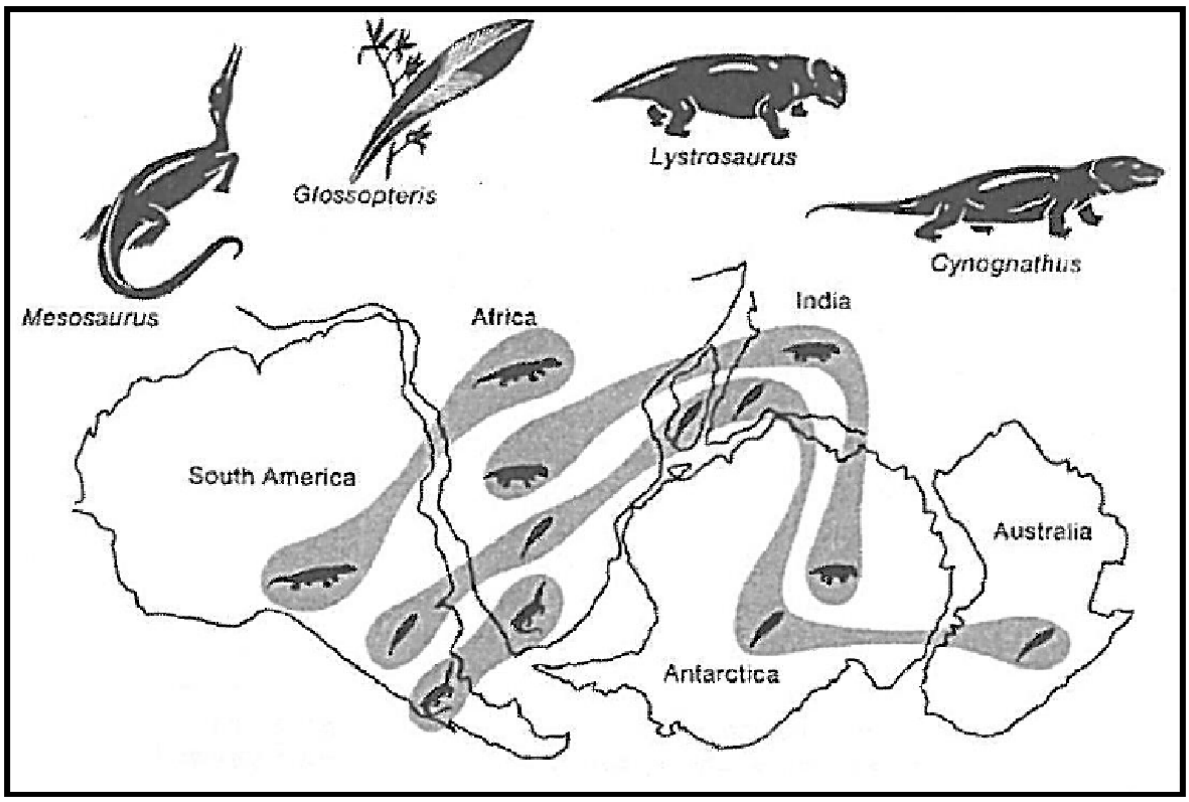
4.8.1 Describe how these fossils may have formed in sedimentary rock. (4)
4.8.2 Name TWO other ways that fossils are formed, other than in sedimentary rock. (2)
4.8.3 Scientists use radioactive isotopes such as carbon-14 or potassium-40 to date fossils. What is this method of dating fossils called? (1)

4.9 The table below shows the timescale of a part of Earth's history.

MYA	Era	Period	Fossils
298–251	Paleozoic	Permian	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, Land plants, Corals, Amphibians, Insects, many more reptiles, Cone bearing plants
323–298		Pensylvanian	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, Land plants, Corals, Amphibians, Insects, Reptiles
358–323		Mississippian	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, Land plants, Corals, Amphibians, First insects, First reptiles
419–358		Devonian	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, Land plants, Corals, Insects, First amphibians
443–419		Silurian	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, Land plants, Corals
485–443		Ordovician	Trilobites, Ammonites, Fish, Animals with shells, Sponges, Jellyfish, First land plants
541–485		Cambrian	Trilobites, First fish, First animals with shells, Sponges, Jellyfish

4.9.1 Which …
(a) period saw the arrival of the first land plants? (1)
(b) group of animals survived the longest in this era? (1)
4.9.2 What do we call a timescale like the one above? (1)
4.9.3 In which period above did an explosion (a large increase) in the number and diversity of fossils in the fossil record occur? (1)

4.10 Study the map below.



4.10.1 What do we call the study of the distribution of individual species? (1)

4.10.2 Name the supercontinent evident in the diagram. (1)

***4.10.3 Using the diagram above, explain how fossil evidence supports the fact that Africa and South America may have once been joined as part of the same continent. (2)**

4.10.4 Which organism's fossil remains are found on all the land masses shown above? (1)

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