SCIENCE

Unit 7

Conservation and Biodiversity

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LESSON 1

Conservation and biodiversity

About this lesson

In this lesson you are going to focus on biodiversity of the biosphere and the biodiversity of a particular ecosystem or biome.

In this lesson you will:

- define the concept of biodiversity
- recognise the importance of biodiversity
- become familiar with a range of indigenous and endemic species in South Africa
- understand the need for conservation of biodiversity
- draw a bar graph and interpret data from graphs

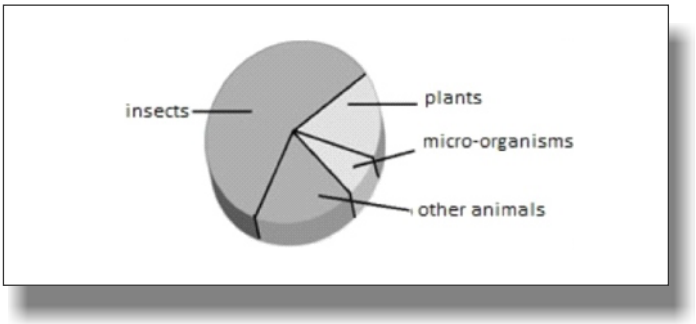
What is biodiversity?

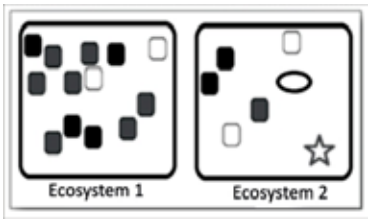
biodiversity:
variety of different species in an area
biosphere:
any place on Earth where living organisms may be found
ecosystem:
communities of different populations of organisms living in a particular area, as well as the abiotic (non-living) factors that influence the living organisms
biome:
many different ecosystems in one
prolific:
abundant, plentiful

There is a huge variety of different species of organisms on Earth, or in the whole **biosphere**. Sometimes when Life Scientists refer to biodiversity, they mean the variety of species in the whole biosphere. However, they could limit their description by referring to the **biodiversity** of a particular **ecosystem** or **biome**. You could refer to the biodiversity that exists within your garden at home or the town or city in which you live. In a rural area, you could talk about the biodiversity of a particular mountain or valley or river.

Different ideas about diversity

It is estimated that there are over 5 million species of living organisms on Earth. However, only about 1.5 million have been identified and described. The pie chart below gives you an idea of the proportions of different groups of living organisms that have already been identified and described. You can see that insects are the most **prolific** life forms on Earth, although some scientists have suggested that there might be more different types of bacteria than there are insects – we just haven't discovered them yet!





When we talk about biodiversity, we do not mean the number of individual organisms in an area, but rather the number of different species. In this diagram, let's imagine that each shaded block represents an organism. Organisms of the same shade belong to the same species. Ecosystem 1 has more organisms in it. However, ecosystem 2 has a greater biodiversity than ecosystem 1. This is because there are five different species in ecosystem 2, while there are only 3 different species in ecosystem 1.

There are different ways of measuring and describing biodiversity.

What we have been describing above is species diversity: the total number of different species present. This, as we have already seen, does not take into account the proportion and distribution of each species in an area.

Ecosystem diversity refers to the variety of different species which are present in a particular ecosystem. This is useful when comparing biodiversity in different ecosystems. For example, the biodiversity in an ecosystem that is made up mainly of farmland and croplands will be much lower than the neighbouring natural grassland ecosystem.

This is because farmers remove the natural variety of species in an area and plant one kind of crop, called monoculture, over a very large area, thus decreasing the ecosystem biodiversity.

In Unit 1 you learnt about genes and how they control what an organism looks like and how it functions. Genetic diversity refers to the variation in the genes or **genome** of a particular species. Genetic diversity results from sexual reproduction and from individuals from different populations mating and increasing the variation in the **gene pool** of a population.

genome:
complete complement of genes in an organism
gene pool:
all the possible versions (alleles) of all the genes a certain organism can possibly have; the gene pool of a population refers to the genes available to organisms that are likely to reproduce with each other in a particular area.
phenotype:
physical expression of the genes

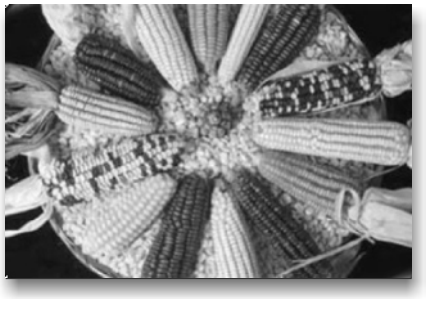
Remember that genes code for thousands of different functions as well as structures. While we may not be able to see the variation in functioning, we can see the variation in **phenotype**.

Genetic diversity is a way for populations to adapt to changing environments. For example, if a wetland is drained, the environment will change because of a lack of permanent water in the area. With more variation, it is more likely that some individuals in a population will possess variations of genes that are suited for the environment. Those individuals are more likely to survive to produce more offspring with that gene. The population will survive for more generations because of the success of these individuals.

These dogs all belong to the same species, Canis familiaris*; yet they show huge genetic diversity. The cobs of corn also demonstrate genetic diversity.*

Why are high levels of biodiversity so important?

The levels of biodiversity differ across different biomes. It is understandable that a desert area would have a lower level of biodiversity than a tropical rainforest. High levels of biodiversity are important because living organisms rely on one another to survive. The loss of one species in an area would cause a reaction amongst other organisms that rely on that one species and it could seriously affect the survival of an ecosystem.



Let's say Organism A eats Organisms B, C and D, all of which are present in the ecosystem. If Organism B is lost from the ecosystem, Organism A will still find food – C and D are still present. However, if C and D were not found in the ecosystem, Organism A would have no further food sources, and it would also die out in the ecosystem. This could cause a chain reaction in other places in the ecosystem's food web.

ACTIVITY 1

For this activity, you will need four pieces of string, each 2 m long.

In this activity, you are going to compare the biodiversity in two different areas. Think of two areas, close to where you live, that are different. Perhaps you have a river close by, so one of your study areas could be the bank of the river. If you have grassland nearby, this would make a good study area. Your garden at home or a park in town could be a study area. You could even choose a taxi rank! It would be a good idea to use a piece of waste land – in this way you will not be using an area of private property. Remember to ask for permission if you do use private property.

Once you have selected your two different areas, visit the first place and mark off a piece of ground 2 m by 2 m, with your piece of string. Carefully work your way across the plot of ground, recording the different species you see. List all plants and animals you see. Remember to lift rocks and stones and dig into the soil a little to find if there are larvae, earthworms, ants or other organisms just beneath the surface of the ground. Replace them gently if you disturb them.

When you record the different species you see, it does not matter if you do not know their names. Just use a descriptive phrase such as 'short plant with small yellow-green leaves that smell bad when crushed' or 'small brown ant' and 'large black ant'. If your plot of land has trees in it, remember to search the bark and the leaves for organisms.

Once you have thoroughly explored your area, repeat your activity in the second area.

Write up a short report of about 300 words, describing the biodiversity in these two areas. Use the terminology you have learnt in this lesson.

ANSWERS ON PAGE 113

Biodiversity in South Africa

South Africa has greater biodiversity than most countries. This is largely because of the range of biomes that exist in South Africa. There are many different climates and land forms such as mountains, high altitude plains, low altitude plains, swamps, lagoons, and coastal areas.

Although South Africa is only 1% of the total land surface of the world, about 10% of the world's total known bird, fish and plant species, and over 6% of the world's mammal and reptile species are found here. It is estimated that there are more species of plants in the Cape Peninsula than there are on the whole of the British Isles!

More than 20 300 species of flowering plants occur in South Africa. One of the most important areas for plant biodiversity in the world is the Cape Floral Kingdom in the south west Cape, with its distinctive fynbos vegetation.

In total, 243 mammals are found in South Africa. There are 17 threatened species in South Africa, including the black rhino, pangolin and giant golden mole. The riverine rabbit, roan antelope and wild dog are endangered.

Of the more than 800 bird species in South Africa, 26 are threatened, including the jackass penguin, Cape vulture, martial eagle, bateleur and Cape parrot.

In total, 370 reptiles and amphibians occur in the region, of which 21 are threatened. 220 freshwater fish species occur, of which 21 are threatened. There are more than 2 000 marine fish species in South African waters. 80 000 insect species are known to occur in South Africa, many of which are endemic. There are many more as yet undescribed species.

Some fun South African biodiversity facts!
Do you know which animal in South Africa is:
the world's largest land mammal?
the world's fastest mammal?
the world's tallest mammal?
the world's smallest mammal by mass?
the world's heaviest reptile?
the world's smallest turtle?
the world's largest antelope?
the world's largest bird?
the world's heaviest flying bird?

When we use the words 'threatened' and 'endangered', they have a very specific scientific meaning. If you look at the arrow which points towards **extinction**, you'll see that organisms at high risk of becoming extinct, are called 'endangered' species.

extinction:
no living organisms of that species left on earth

Critically endangered species are those where the risk of extinction is very high. Maybe there are no breeding pairs left in the wild, or the only individuals left are in captivity and not breeding. A species is considered 'vulnerable' if it is approaching endangered levels. 'Threatened' species are those that need careful protection and conservation so that they do not make it onto the endangered list.

Indigenous and endemic species

Indigenous species belong to a particular area. They have not been brought there from anywhere else. Although indigenous species may belong to a particular area, they can also be found in other areas too. Many animals and plants that are indigenous to South Africa are also found in other countries. For example, leopards, buffalo and zebra are found over large parts of Africa.

Endemic species also belong to a particular area, but endemic species do not occur anywhere else on Earth except in that particular place. A species can be endemic to a country, an ecosystem, or even to a patch of ground such as a small island or the top of a hill.

Endemic species in small areas are very often endangered species. This means that they are in danger of becoming extinct, which could easily occur if something happens to the relatively small area in which they are found.

discrete:
separate or isolated and not continuous

ACTIVITY 2

date of census	population size
Black rhino	
1960	2 000
1970	1 800
1993	897
1995	962
1997	1 043
2004	1 328
2007	1 512
2010	1 916
2012	1 700
2025	predicted extinction at current poaching rate
Cape Mountain Zebra	
1922	400
1937	160
1950	91
1956	126
1969	140
1984	412
1988	500
1998	1 200
2006	1 389
2011	1 500

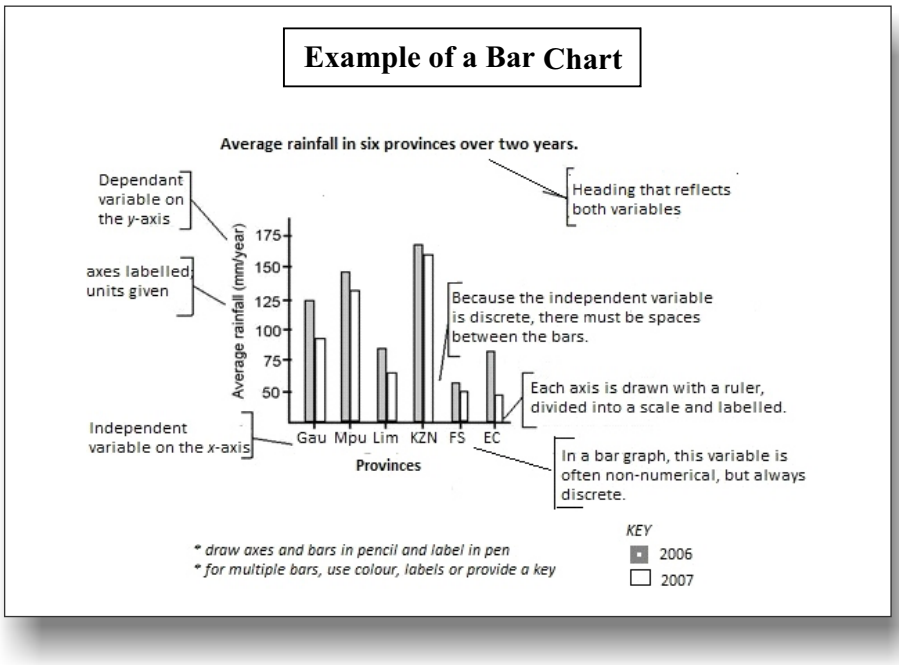
Unfortunately, many organisms have already become extinct in South Africa. The Black Rhino and the Cape Mountain Zebra were on the verge of extinction until special breeding programmes were put in place to save these two species from extinction. Over the years, the total population of these two species has been counted at different times. The table shows the population numbers of these animals, in South Africa, over the years.

1. Draw a bar graph to show the population sizes of these two species according to the information in the table.

   Remember, bar graphs illustrate the relationship between two variables, but unlike the line graph, the independent variable is **discrete**.

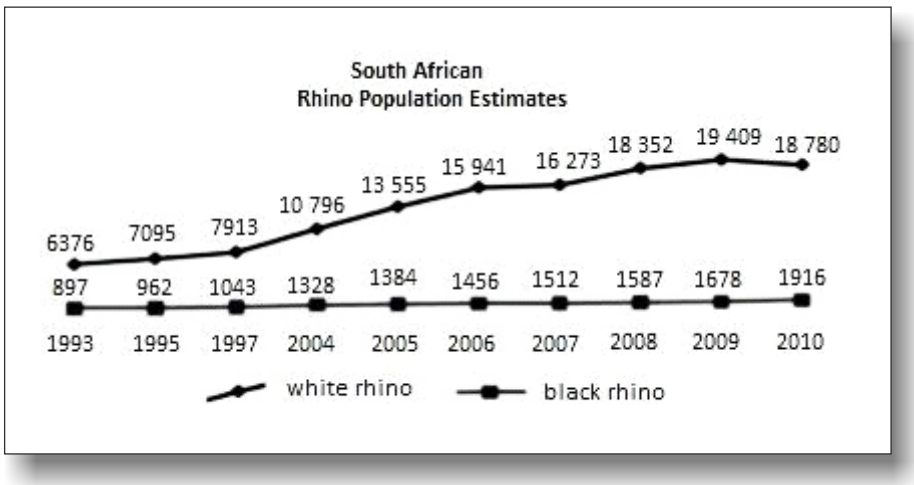
   Once you have drawn your two sets of axes, decide which axis will represent the years and which axis the population sizes. Also decide on a suitable scale for the years. The Black Rhino data only begins in 1960, whereas the data for the Cape Mountain Zebra begins in 1922. Remember that your x-axis, which reflects time, will need to be longer to accommodate the long time period.

Because you are recording the data for two species on one set of axes, think about shading the bars for one of the species.



2. From your graph, have conservation efforts been successful in saving these two species from extinction? Give reasons for your answer.

3. Consider the graph shown here of population numbers of White and Black Rhino in South Africa:



a. What was the total rhino population in South Africa in 2010?

b. What trend or pattern do you notice with the population of White Rhino? How does this trend compare to the population of Black Rhino?

4. Today, the Cape Mountain Zebra is not a highly valued animal for its coat or meat, and is therefore not poached. However, both the Black Rhino and the White Rhino have suffered from increased poaching since 2009.

   Why is rhino poaching so widespread? Conduct research at your local library or on the internet and then predict what you think may happen if the Black Rhino is not saved from poachers.

ANSWERS ON PAGE 114

COMMENT

It is very important that we protect biodiversity and in particular, those organisms which are threatened with extinction. Knowledge of biodiversity will help us protect and conserve the organisms found in South Africa and the biosphere.

CHECKLIST

Are you able to:

- ❒ define the concept of biodiversity
- ❒ recognise the enormous biodiversity on Earth and in South Africa
- ❒ discuss the range of indigenous and endemic species in South Africa
- ❒ describe the need for conservation of biodiversity
- ❒ draw a bar graph and interpret data from graphs

LESSON 2

The Five Kingdoms

About this lesson

So far, 1.5 million different living organisms have been identified! Faced with this enormous number of living things, scientists realised long ago that they needed a way to classify and name individual organisms if they were going to understand them properly. In this lesson you are going to learn how scientists classify information.

You are also going to see that all organisms that are in the Three Domains and Five Kingdoms of Life show all the characteristics of life.

Finally you will learn about plants and their characteristics and about animals and their characteristics.

In this lesson you will:

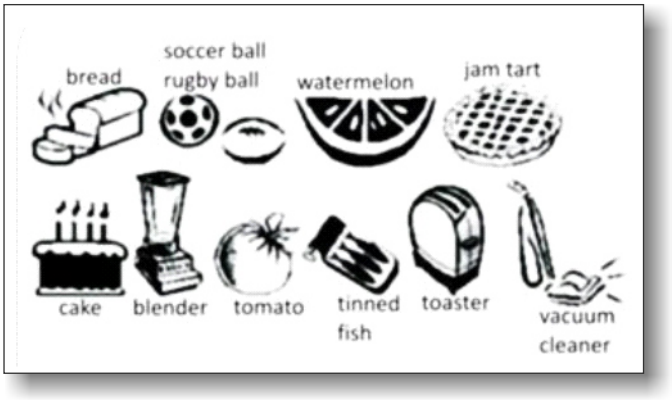
- recognise why a classification system is needed when Life Scientists study biodiversity
- learn how classification systems developed
- become familiar with the Five Kingdom classification system and the Three Domain system
- describe the diagnostic features of Bacteria, Protista and Fungi
- identify the distinguishing characteristics of plants
- recognise and describe the different groups of plants in the plant kingdom
- identify the distinguishing characteristics of animals
- recognise and describe some of the different groups of animals in the animal kingdom.

Thinking about classification

Imagine walking into a supermarket to do some shopping and all the goods were displayed randomly! How would you shelve these goods in order to make shopping far easier?

Classification is a way of organising things. When you classify things, you put them into groups or 'classes' because they have certain characteristics in common. Classifying things is something we do all the time without thinking because it helps us to see patterns and to keep things organised. People classify things to make it easier to understand and find them.

Classifying and grouping things in the kitchen makes it easier for you to find them again. If you wash and dry the dishes after a meal, you will probably put the cutlery (knives, forks, spoons) in one place, the plates in another and the cups and saucers somewhere else. This means that you will find them easily next time you need these items. It also makes your kitchen more organised. Even a visitor in your home would be able to find the cups and plates and cutlery.



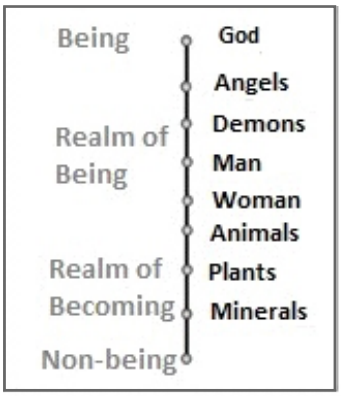
Classifying simplifies a situation. You find things more easily if they are organised.

philosopher:
person who studies ideas and theories about thinking
hierarchy:
order of things from simple to complex; least to most

How did classification systems develop over time?

Aristotle's classification system

Aristotle, a Greek **philosopher** born in 322 BC, produced the first written classification about all known life on Earth. He arranged groups on a *Scala Naturae* (Latin for 'ladder of nature') from the simplest to the most complex.



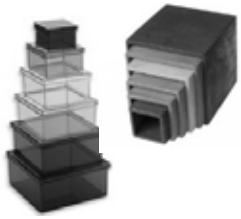
First, Aristotle divided things into living things, which he called the realm or kingdom of being and non-living things, which he called the realm of non-being. Minerals and metals were in the non-living group. Plants and animals were in the living group. He then placed groups of minerals, plants and animals in order on the ladder. Each group shared features with the groups above and below. Each group was more complex than the one below it, but not as complex as the group above it.

People accepted the idea of a **hierarchy** of species on a 'Ladder of Nature' for almost 2 000 years.

Linnaeus's classification system

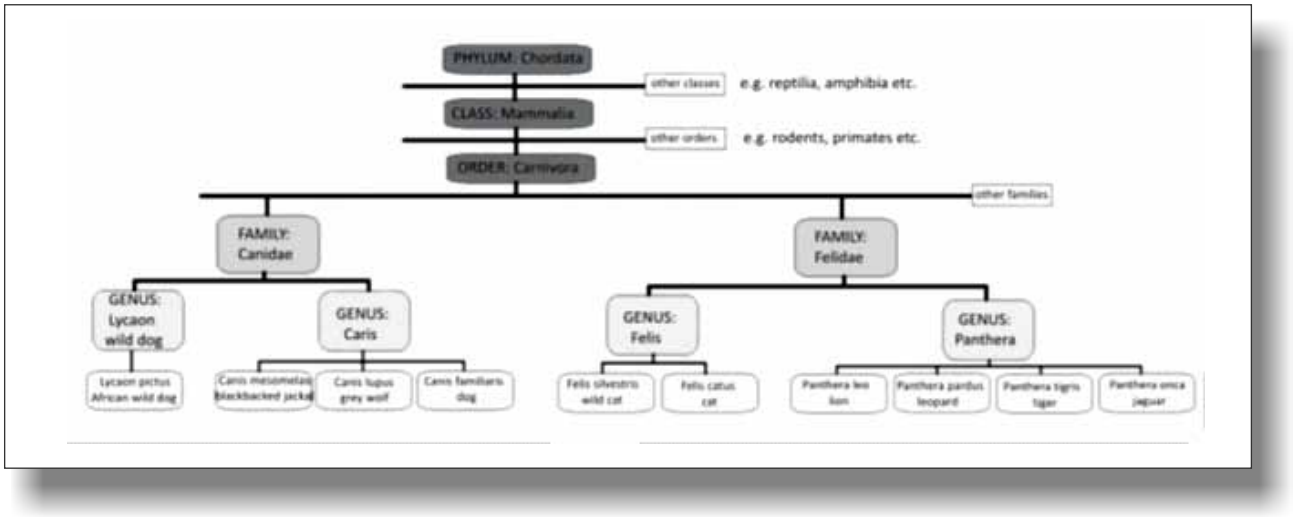
Carolus Linnaeus developed a systematic, scientific method of nomenclature (naming organisms) in the mid-1700s that is still used today. In 1753 he wrote a book called Systema Naturae. In this book he divided the living world into two kingdoms: Plants and Animals.

Whereas Aristotle had used features such as lifestyles and living habits to group organisms together, Linnaeus used the characteristic of similar body structures to subdivide each kingdom into groups called phyla. He then subdivided each phylum into classes. Linnaeus arranged groups of organisms into groups within groups, like boxes within boxes. He was the first scientist to construct 'nested hierarchies'. In a nested hierarchy each group is inside a larger group.



All these boxes could fit inside each other:

This nested hierarchy classifies members of the dog and cat family, according to Linnaeus's system.



ACTIVITY 1

Use the above dog and cat family classification to answer these questions.

1. If you were thinking about the idea of nested boxes ranging from larger boxes that held smaller boxes, which group would be the largest group, or box, in this classification system and which is the smallest group, or box?

2. Which group in the classification system is just smaller than an Order?

3. How many other species of organisms are shown to be closely related to a lion?

4. Which organism is more closely related to a domestic dog: a wolf or an African Wild dog? Give a reason for your answer.

5. Are jackals more closely related to African Wild Dogs or to Wild Cats? Give a reason.

6. Use everyday items such as the contents of your pencil box, or your kitchen cupboard or a toolbox, to create a classification system based on nested hierarchies. Use at most four different 'nests' or levels to your hierarchy.

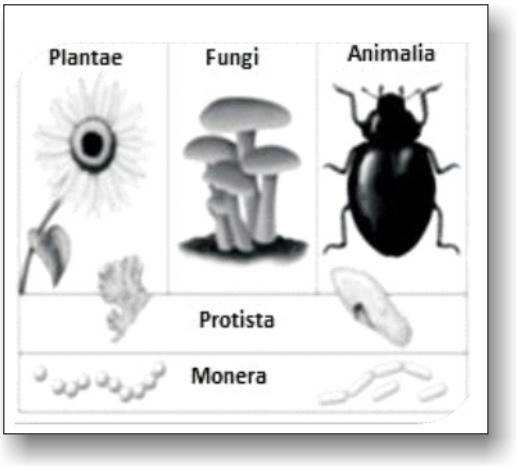
ANSWERS ON PAGE 115

Modern classification systems: The Five Kingdom System

Originally, biologists, including Linnaeus, said that there were two kingdoms of living organisms: the Plant Kingdom and the Animal Kingdom.

Over time, as biologists learned more about other organisms, they added kingdoms in recognition of basic differences they discovered among organisms. For example, during Linnaeus's time, the microscope had not been invented so Linnaeus did not know about the existence of many different kinds of micro-organisms. Once micro-organisms were discovered, a new classification system with three kingdoms for plants, animals and micro-organisms had to be developed.

In the early 1970s, an American scientist, Robert Whittaker, proposed a five kingdom system: Monera (bacteria and cyanobacteria); Protista (unicellular organisms); Fungi; Plants and Animals. Although this classification system is a lot bigger and more complex because we have learned a lot more about living organisms, it still uses the same methods that Linnaeus invented.

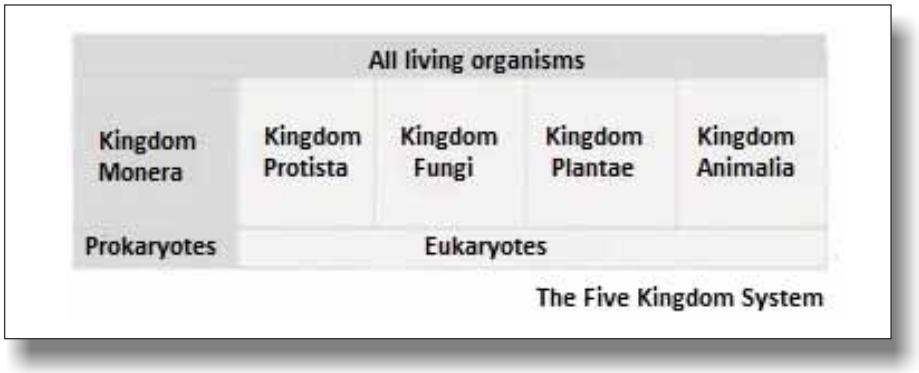


The kingdoms Plantae and Animalia are very familiar as they are the groups of organisms that both Aristotle and Linnaeus had originally identified. However, both Aristotle and Linnaeus included Fungi in the Kingdom Plantae. By the time Whittaker proposed the Five Kingdom system, scientists knew that Fungi were not plants at all. Fungi do not photosynthesise and they do not have the same cellular characteristics as plants.

So they were placed in their own kingdom. Micro-organisms were placed either in the Kingdom Monera or Protista.

The four kingdoms of plants, animals, fungi and protista are all eukaryotic organisms. Eukaryotes are organisms that have cells with a membrane-bound nucleus and membrane-bound organelles such as mitochondria and chloroplasts. You studied the structure and functioning of eukaryotic cells in Unit 1. Eukaryotes can be unicellular or multicellular.

The kingdom Monera is made up of bacteria and cyanobacteria which are prokaryotes. This means that they have no internal membranes surrounding organelles. Their DNA floats loosely in the cell and there are no organelles such as mitochondria or chloroplasts. Prokaryotes are unicellular. You studied bacteria in Unit 1.

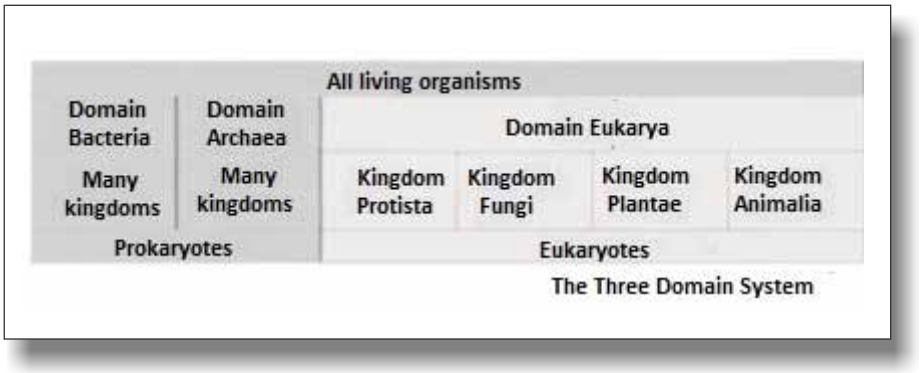


Modern classification systems: The Three Domain System

Recently, scientists have found new ways to investigate the similarities of organisms, for example by identifying and comparing the chemicals such as DNA and RNA, the carbohydrates that make up cell walls and the enzymes involved in metabolic activities such as the making of proteins in cells. During the late 1970s an American microbiologist, Carl Woese, discovered some micro-organisms that live in exceptionally hot habitats such as hot springs and volcanic vents. At first these micro-organisms were identified as bacteria. Woese soon discovered that the chemistry of these micro-organisms is very different to the chemicals and functioning of bacteria. He put these micro-organisms into a different group called the Archaebacteria meaning 'very ancient bacteria'.

Other types of Archaebacteria have also been found in salty habitats such as salt marshes and salt lakes, as well as in the oceans. It was difficult to know where to put these micro-organisms in the five kingdom classification, as they were prokaryotic, but very different to bacteria.

In 1990 Professor Woese suggested a new way to classify living organisms by grouping the kingdoms into three groups called domains. Each domain contains several different kingdoms. In this new classification system, animals, plants, fungi and protists are kingdoms in the Eukaryota domain because they all have cells with a nucleus. The Bacteria and Archaea are Prokaryota. However, they differ greatly in their chemistry and so are placed in two different domains.



The Three Domain System

ACTIVITY 2

Give the term for each of the following descriptions:

1. The group of heterotrophic multicellular organisms whose cells have nuclei but no cell walls.

2. The group of autotrophic multicellular organisms whose cells have nuclei and cell walls.

3. The kingdom of heterotrophic organisms whose cells have nuclei and cell walls.

4. The name of the inventor of the first classification system to use nested hierarchies.

5. An important domain of prokaryotes that is more ancient than bacteria.

6. A group of similar species.

7. A particular type of living organism; the unit of classification.

8. In the Five Kingdom system, all prokaryotes are placed in this group.

9. The kind of cell which plants, animals, fungi and protists possess.

10. The system of classification that most scientists use today.

ANSWERS ON PAGE 115

COMMENT

It is interesting to realise that scientific ideas change over time. As new information becomes available, scientists often have to modify what they had originally proposed or suggested. This shows that science is tentative it changes over time with new knowledge. Sometimes the new ideas are very different to the old ideas and we have to discard our old ideas. Other times, the new ideas can be incorporated into our existing knowledge.

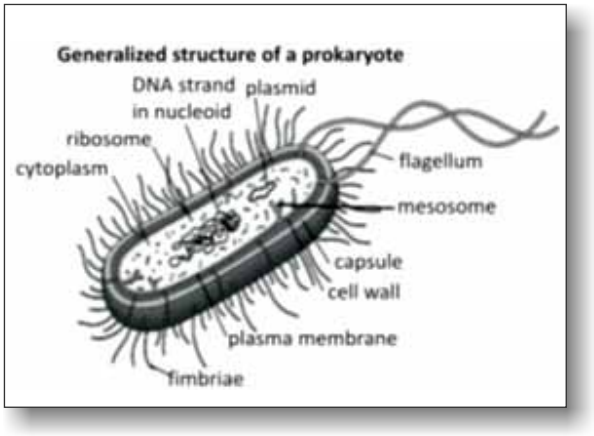
Bacteria, Protista and Fungi

In Unit 1 you learnt about Viruses. You learnt that viruses pose a problem to Life Scientists as they do not possess all the characteristics of life. However, all the organisms that are in the Three Domains and the Five Kingdoms, show all the characteristics of life. There is no debate over whether or not these organisms are living.

Bacteria

Bacteria are all prokaryotes because the cells do not contain a nucleus. Bacteria have very small cells. They are so small that scientists use chemical methods to identify and group them because the different phyla cannot easily be recognised by just looking at them under a microscope. The bacteria shown in the photos here have been magnified about 10 000 times.

Many bacteria have a slime capsule around the outside of a cell wall. Bacterial cell walls are made of a substance called peptidoglycan and not cellulose like plant cells have. Inside the cell wall is the plasma membrane. The plasma membrane is often folded into membrane structures called mesosomes. Some mesosomes carry pigments and can photo-synthesise, while others are able to convert glucose into ATP. Other mesosomes are able to fix nitrogen.



motile:
able to move
flagella:
singular flagellum
fimbriae:
singular fimbria
autotrophic:
an organism that is able to make its own organic food
chemotrophic:
making food from chemicals such as hydrogen sulphide or iron
heterotrophic:
an organism which cannot make its own food and must consume or eat food for nutrition
saprophyte:
an organism that gets its food by living on dead organic matter
parasite:
an organism that lives in or on a host and gets its food from the host
aerobic:
requiring oxygen
anaerobic:
does not require oxygen

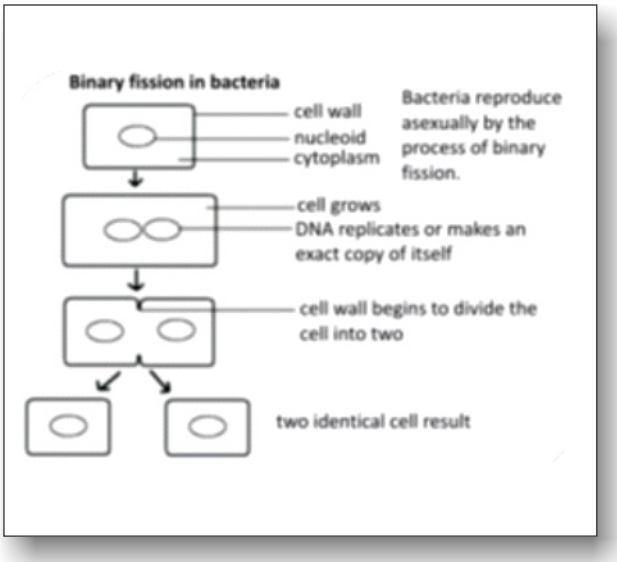
Some bacteria are able to move. Some of the **motile** forms have a few **flagella** which are long whip-like structures that revolve rapidly to drive the bacteria forward. Other motile bacteria have many smaller hair-like structures called **fimbriae** which help them move.

As you have already learnt, prokaryotes do not have DNA in the form of strand-like chromosomes in a membrane-bound nucleus. The DNA of a bacterium is called a nucleoid and it is found floating loosely in the cytoplasm. Bacteria also have plasmids which are small circular pieces of DNA floating in the cytoplasm. Although bacteria do not have any other membrane-bound organelles, they do have ribosomes which make proteins. However, these ribosomes are different in size to eukaryote ribosomes.

Some bacteria are **autotrophic**. Of these autotrophic bacteria, some are photosynthetic, while others are **chemotrophic**. A number of bacteria are **heterotrophic** and may be either **saprophytic** or **parasitic**. Some bacteria are mutualistic and live in very close relationships with other organisms, benefiting each other.

Bacteria have different modes of cellular respiration. Some have **aerobic** respiration and use oxygen to generate ATP, while others have **anaerobic** respiration and do not need oxygen to generate their ATP.

The process of reproduction in bacteria is known as binary fission. Binary fission is a form of asexual reproduction where a single organism makes a copy of its genetic material and then the cell splits in half.

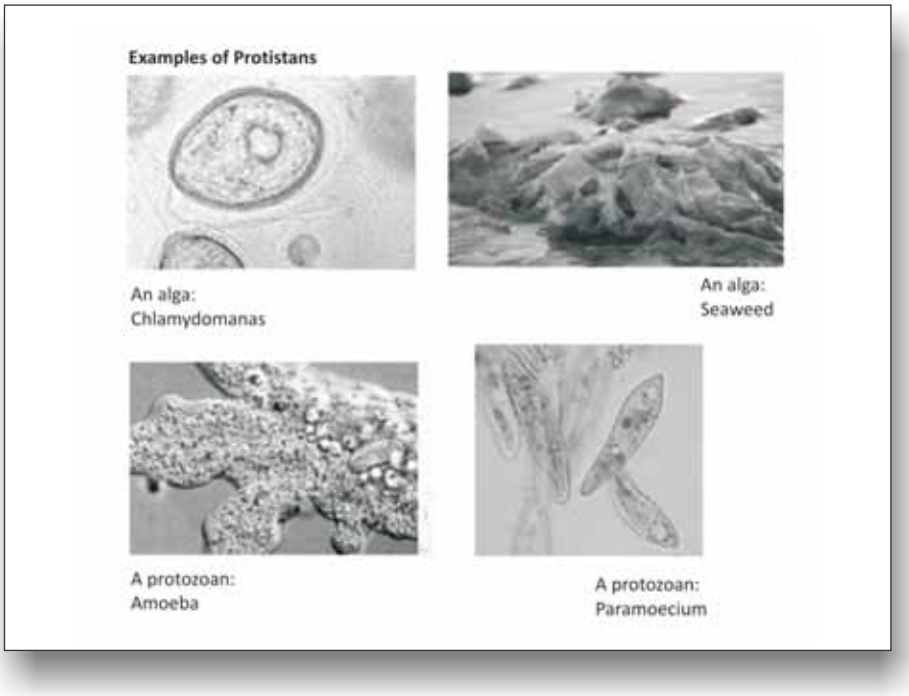


In unfavourable environmental conditions, some bacteria are able to form endospores. A portion of the cytoplasm and the genetic material dehydrate are then covered by a thick hard protective coat. The endospore can survive the harshest conditions: desert heat, dehydration, boiling, polar ice and extreme ultraviolet radiation. They can also survive for extremely long periods. Anthrax spores 1 300 years old were discovered to still be infectious when they germinated. To germinate, they need to absorb water. In a few hours, the hard coat is shed and a typical bacterial cell emerges.

Protista

The Protist kingdom is made of many different types of organisms. Although many thousands of different species are known, they are so small that it is likely that many thousands of species have not yet been discovered. Most of the organisms are unicellular but some are multicellular with all the cells more or less the same, that is, no specialised or differentiated tissues exist.

Protists are eukaryotic which means they always have a nucleus in the cell, as well as membrane-bound organelles that you studied when you investigated plant and animal cells in Unit 1.



The Protista are divided into two groups:

- Plant-like protists are single-celled organisms that contain chlorophyll and have a cell wall. They obtain their energy by photosynthesis. They live mainly in water and often make stagnant water go green in colour. Seaweeds and freshwater algae such as Chlamydomonas are members of this group.

- Animal-like protists are single-celled organisms with no chlorophyll and no cell wall. They feed by ingesting other organisms or absorbing organic substances through the cell membrane. They live mainly in water or as parasites in other organisms. They may cause diseases if they are parasitic. Malaria and bilharzia are caused by protistan parasites. Amoeba and Paramoecium are members of this group.

It is generally accepted that life originated in water. Fossil evidence suggests that the protists, in particular the algae, were the first eukaryotes. It is thought that plants evolved from green algae because green plants share the following characteristics with algae: they contain the same types of chlorophyll molecules; the structure of the chloroplast is similar; their cell walls are made out of cellulose; food reserves are stored as starch. It is also thought that animals evolved from protozoans non-photosynthesising protists.

Asexual reproduction by binary fission is the usual way these organisms reproduce, but sexual reproduction can take place.

ACTIVITY 3

1. In what ways are algae and plant cells similar?

2. You have listed ways in which plant cells and algae are similar. Yet algae are not part of the plant kingdom. Why not?

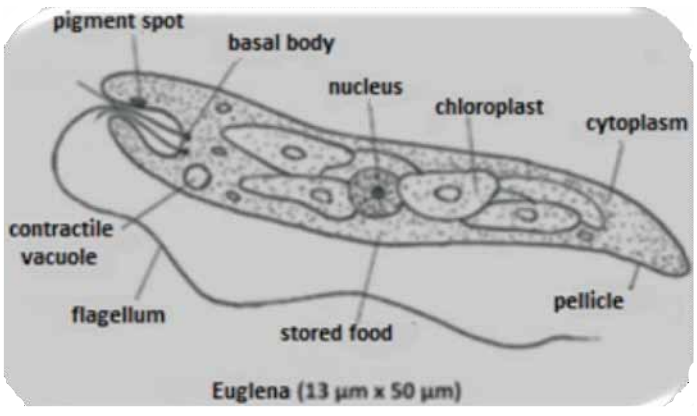
3. In what ways are protistans like or unlike bacteria?

4. All algae contain chlorophyll. Chlorophyll is green. Why then are there brown and red algae? Do the brown and red algae photosynthesise? Make some hypotheses or do some research!

5. Read the following information which describes the protistan *Euglena*.

Euglena has one or two long flagella that are used in locomotion. No cell wall is present. The cell is covered by a tough protein layer called the pellicle. Chloroplasts are present that contain the pigment chlorophyll. Food reserves are stored as a carbohydrate called paramylon. *Euglena's* possession of chlorophyll enables it to photosynthesise during the day. At night, however, *Euglena* is an active hunter, moving rapidly with its whip-like flagella to stalk prey.

Euglena poses a problem for scientists trying to classify it. How would you classify *Euglena*? Explain in detail, using evidence to back up your decisions.

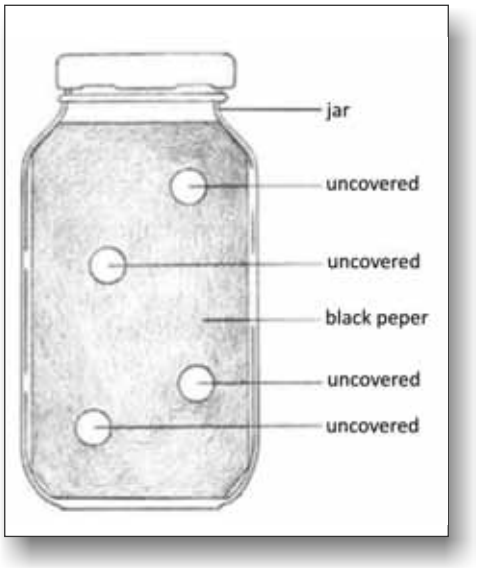


ANSWERS ON PAGE 116

ACTIVITY 4

Investigating the behaviour of Protista.

You will need a small jar, some pond, river or dam water, black paper, scissors and sticky tape.



Cut a piece of black paper so that it covers the outside of the jar. Now cut some holes in the paper. Fill the jar with pond water, seal it and attach the black paper with the holes in it to the outside of the jar. Put the jar on a windowsill in full sunlight. After a few hours of sunlight, remove the jar from the windowsill and remove the black paper.

1. What do you observe?

2. What is the aim/hypothesis of this investigation?

3. What variable was the scientist testing?

4. What other variables can you identify? How did you control them? Were they well controlled? Give reasons for your answers.

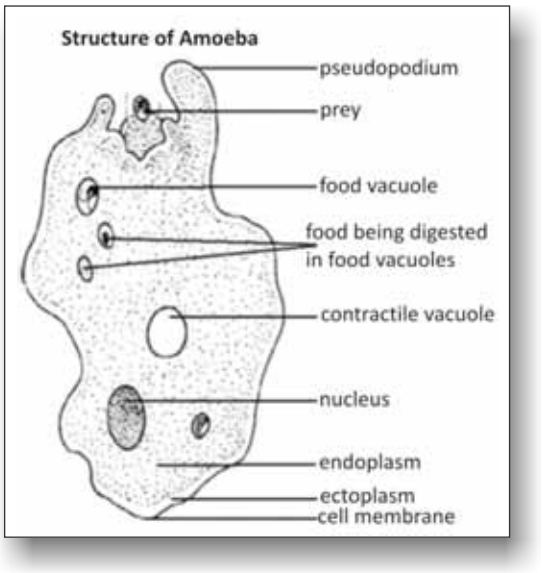
5. Identify any limitations associated with this investigation.

6. Give reasons for what you observed.

7. What do your results tell you about the motility of protistans? Explain your answer.

ANSWERS ON PAGE 116

Amoeba is an example of a heterotrophic protistan that lives in freshwater. It is about 0.3 mm across and inhabits the mud at the bottom of fresh water ponds. Like other animal cells, Amoeba has cytoplasm, a nucleus, a cell membrane and a variety of organelles in the cytoplasm. Although it is just a single cell, it exhibits all the essential functions of any living organism.



Amoeba is asymmetrical and changes its shape constantlyas it moves around finding food. Amoeba moves by means of pseudopodia, which are extended in the direction of movement. Amoeba will move towards chemicals that prey items produce.

pseudopodium: *false foot; pl. pseudopodia*

Amoeba encircles prey with **pseudopodia** and engulfs the small organism into a food vacuole where it is digested. The nutrients are then absorbed into the cytoplasm. The amount of water in relation to salts, that is the water balance, in the cytoplasm is regulated and controlled by a contractile vacuole which will pump excess water out of the cell.

When Amoeba's body volume becomes too large in relation to surface area, the Amoeba is no longer able to function efficiently. Amoeba reproduces asexually by binary fission. In favourable conditions, this process can take place every three days.

ACTIVITY 5

1. Match these statements to the diagrams:

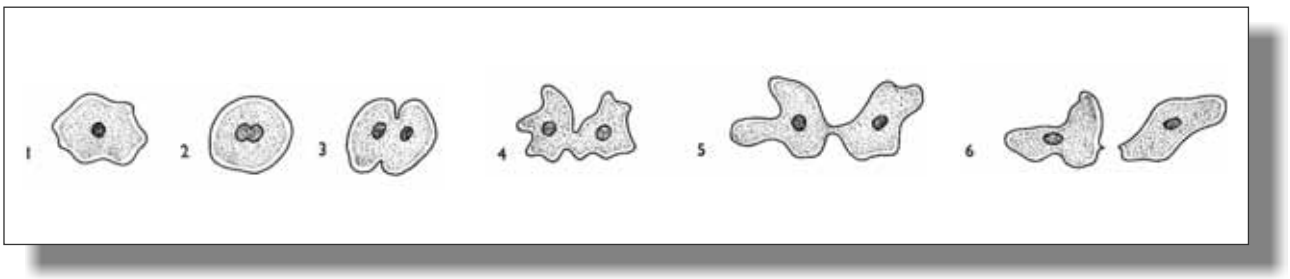
   Amoeba stops moving and rounds off.

   The nucleus begins to divide.

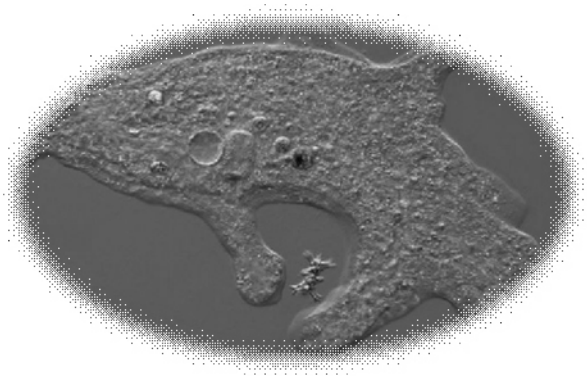
   The nucleus has divided and the cytoplasm starts to constrict.

   The constriction continues to divide the cytoplasm.

   The daughter amoebae separate.



2. The photo below of a live Amoeba catching prey, was taken down a microscope. Use what you have learnt about Amoeba to label and annotate the photo.



ANSWERS ON PAGE 117

Fungi

Most organisms in the Fungi Kingdom are made up of many cells, but some, such as yeast, have only one cell. The cells have a nucleus and a chitinous cell wall. The body of the multicellular types is usually made of fine threads.

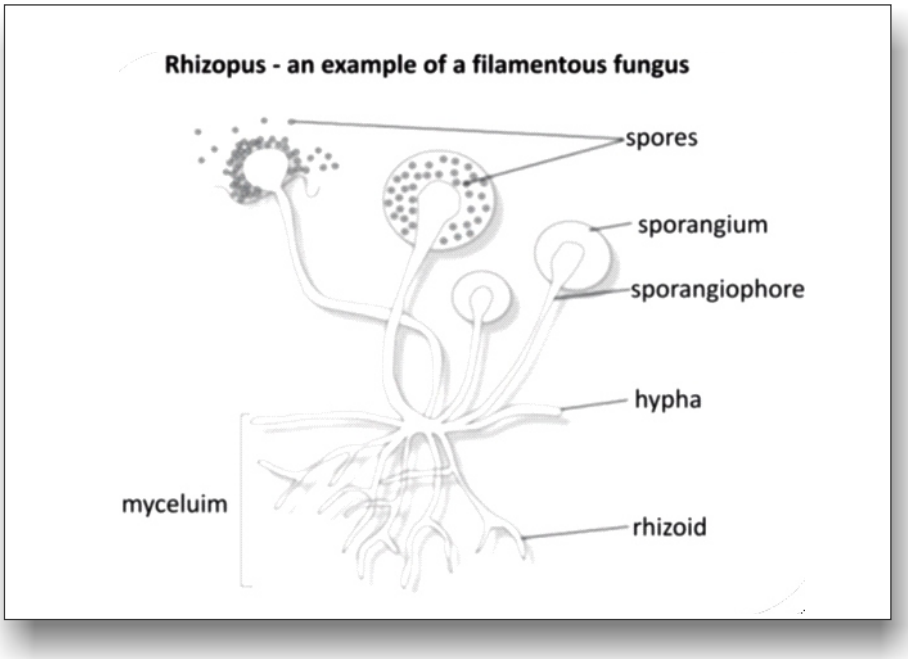
Think about this and write down your ideas!
In what ways are fungi like plants and in what ways are they like animals?
Why are Fungi classified in their own kingdom?

The fungi cannot photosynthesise. They are heterotrophic. Most are saprophytes that feed by absorbing organic substances that they have digested. Some are parasites living in or on other living organisms. Athlete's foot and ringworm are examples of fungi that are parasites on humans.

Fungi are not plants, because they are heterotrophic and cannot make their own food. They do not possess the same type of tissues that plants have and their cell walls are made from chitin and not cellulose. They do not store food as starch but as oil droplets and glycogen.

Fungi reproduce asexually by spores. They can also undergo sexual reproduction.

Rhizopus is bread mould, a filamentous fungus. This fungus grows on bread which is kept in dark, damp places. It develops from spores which are always present in the atmosphere.



The body of the fungus is made up of a mycelium. Each filament is called a hypha. The hyphae of fungi may have cross-walls, separating the filament into distinct cells. However, there are large pores in the cross-walls through which the organelles pass freely.

hypha:
pl. hyphae
chitin:
main component of insect exoskeletons
mycelium:
a networked mass of tube-like filaments. Pl. mycelia
sporangium:
pl. sporangia

Rhizopus is an example of a non-walled fungus. This state of freely flowing nuclei and other organelles is called a coenocytic state.

The main component of the walls of the **hyphae** is **chitin**, not cellulose as in plants, which makes the walls strong and flexible. If one looks at the **mycelium** growing on bread, one can see dark spots growing at the tips of some hyphae. These dark tips are the sporangia which are the reproductive bodies. The hyphae holding up the **sporangium** is called a sporangiophore.

ACTIVITY 6

Cultivating Fungi

You will need:

- 1 thick slice of bread
- 1 slice of cheese
- 1 soft fruit (e.g. plum, peach)
- 3 clear plastic sandwich or freezer bags
- masking tape and marking pen

What to do:

Slightly dampen the bread, cheese and fruit by sprinkling them with a bit of water. Do not make them very wet. Leave the food out on a table overnight. The next morning, put each piece of food in its own plastic bag. Loosely fold the top of the bag over.

Observe your samples every day over the next few days and record what you see. You may use diagrams as well as words to describe your observations.

Communicate your observations. You may do this in any meaningful way. You may decide to use tables, diagrams, a daily diary with written notes, etc. Make sure your report is easy to read, neat and accurate.

Keep the samples in a safe place. Dispose of the samples safely in an outside dustbin, preferably sealed in a plastic garbage disposal bag when you have finished observing them.

ANSWERS ON PAGE 117

COMMENT

Although micro-organisms such as bacteria, protista and fungi are often invisible to the naked eye, they are very important organisms. Many cause diseases, some are important decomposers in the ecosystem and many are used by humans to make foods such as cheese, bread and wine.

The Plant Kingdom

For about 500 million years, algae grew in water, limited by the need for water for both support and reproductive purposes. A limiting factor controls a process; in this case, water is an essential resource that, if in short supply, will limit the development and growth of organisms.

When plants evolved, the greatest challenge was to move from water onto land. Although living on land has many advantages such as availability of light for photosynthesis, and higher concentrations of carbon dioxide which diffuses easier in the air than in water, there are also distinct disadvantages or challenges. Water is a limiting factor and **desiccation** is a very real problem.

desiccation:
drying out

Not only will the adult plant be in danger of drying out, but a means is needed to protect the embryo or growing plant from drying out too. The force of gravity on land poses the problem of support, especially if plants are going to grow tall. Remember that the largest organisms on land are plants! Because terrestrial plants absorb their water from the ground, if they grow large, they need to have a mechanism to transport water and food throughout their bodies. Plants evolved certain mechanisms to overcome these challenges.

Distinguishing characteristics of plants

- Plant cells are eukaryotic.
- Plants are multicellular. The bodies of plants are made up of many cells.
- Plants are autotrophic and photosynthesise using chlorophyll. Starch is stored in chloroplasts.

- The cell walls of plant cells contain cellulose.

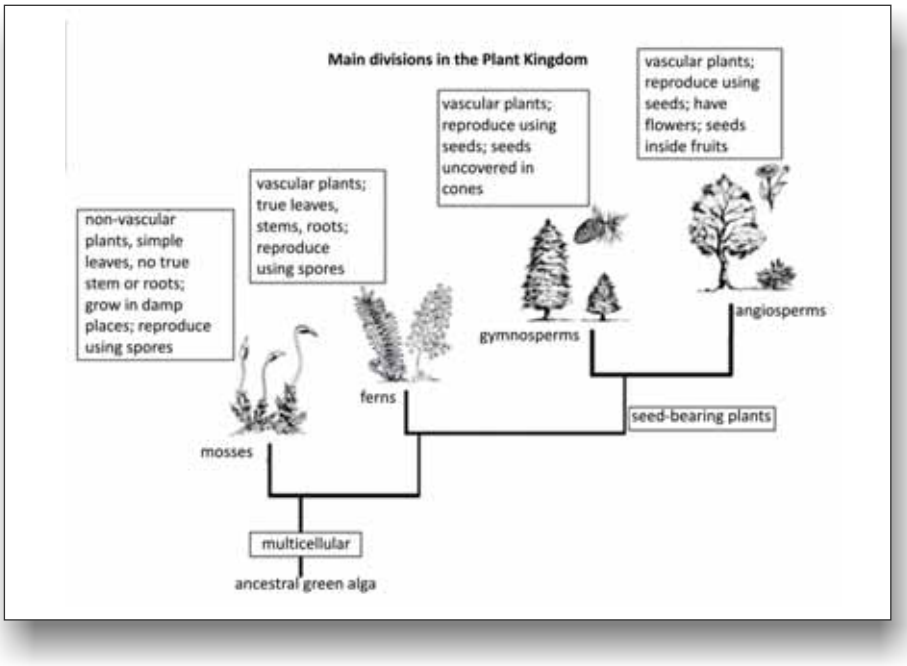
- Plants have different tissues such as xylem that transports water, phloem that transports organic food, sclerenchyma and collenchyma for support, parenchyma, important for photosynthesis and packing tissue and epidermis for protection.

- Plants have multicellular sex organs, which produce gametes for sexual reproduction. Some groups of plants, such as mosses and ferns, have sporangia, organs which produce spores asexually for asexual reproduction. Other groups of plants, such as gymnosperms and angiosperms, reproduce using seeds.

- The zygote and embryo of developing plants are protected within the body of the plant.

Divisions within the plant kingdom

There are four main divisions within the plant kingdom. This is a simplified diagram showing the relationships between the major groups within the plant kingdom.



Mosses belong to the simplest group of plants. They are all very small plants; most not even reaching a height of 2 cm. Mosses do not have support tissues to enable them to grow large. They do not have tissues such as xylem and phloem, so they cannot transport water and food through their bodies. They rely on moisture from the environment reaching their cells. This moisture also helps them to reproduce.

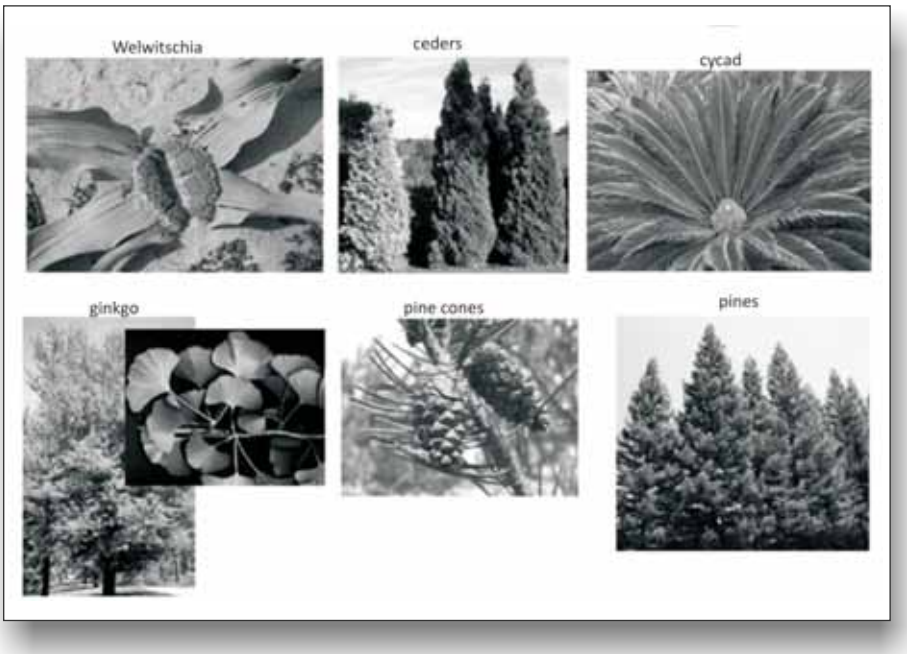
Mosses do not have true roots or stems. They have very simple leaves. They reproduce using spores. Mosses are found in damp, shady places and often grow across rocks or tree trunks in forests.

Ferns belong to a more complex group of plants that have vascular tissue such as xylem and phloem. However, like mosses, they reproduce by spores and therefore rely on water for reproduction. In ferns, the spores are produced in little clusters called **sori** on the underside of the leaves. The young leaves of ferns typically unroll as they mature. Ferns have simple support tissues, so they can grow larger than mosses. However, they do not develop secondary thickening. Millions of years ago, fern forests covered large areas of the earth's surface. When they died, the organic material of the ferns became compressed underground.

sorus:
spores; pl sori

Today, our coal, which is a 'fossil fuel', is derived from these prehistoric ferns. Gymnosperms tend to be larger plants. The largest trees in the world, giant sequoias, are gymnosperms.

Gymnosperms have vascular tissues to transport water and food throughout their bodies and they have well developed support tissues. They also have secondary thickening. This means that their trunks and branches grow in width over successive years. Gymnosperms reproduce with seeds which are 'naked'. This means that they are not covered by an ovary or inside a fruit. The seeds develop inside a cone or a berry-like structure.



There are different groups of gymnosperms that are fairly easy to recognise from their overall structure. Conifers have cones and needle-like leaves. Pines, firs, spruces, cedars, junipers, and yews are all conifers. The Maidenhair Tree (Ginkgo biloba) has rounded leaves and cycads resemble palms with large central cones. Welwitschia is found in the Namib desert and has only two very large leaves that spread across the ground.

Angiosperms are flowering plants. They produce seeds and enclose the seeds in the ovary of the flower. The flower protects the seed. After fertilisation, the seed is once again protected inside a fruit. Angiosperms are the dominant and most diverse group of plants on earth today.

The structure of the flower of different angiosperms varies greatly. They are all well adapted to a huge range of ecosystems. Angiosperms have developed different ways of getting the male gamete to the female gamete for fertilisation. This process, pollination, can be carried out by wind, water or by a range of different animals. In many cases the animals have co-evolved with the plant to bring about the transfer of pollen from one plant to another.

Do you recognise the pollinators in these pictures?

ACTIVITY 7

Insert the correct words into the statements. You can choose from the words in the box on the next page. You need not use all the words.

cones flower multicellular water photosynthesis ferns seeds spores unicellular stems roots leaves energy support Angiosperms Gymnosperms fruit mosses

Members of the Plant Kingdom are _____ organisms. They all carry out the process of _____ which means they use _____ from the sun to make food for themselves. Mosses are very simple plants that lack true _____ and _____. Both mosses and ferns use _____ for reproduction. They are very reliant on the presence of _____ to assist in their reproduction. Ferns have simple _____ tissues, which mosses lack. Gymnosperms are characterised by the presence of _____ that develop inside cones. Conifers are a group of gymnosperms that have needle-like _____. In the group of plants known as the flowering plants, or _____, the _____ protects the seeds before fertilisation, while the _____ protects the seeds after fertilisation.

If you discovered a plant that had true tissues that could support the plant, as well as roots and stems, but reproduced with spores, you would have discovered a member of the group known as _____.

If you discovered a plant that carried its seeds exposed on a cone-like structure, you could classify this plant as a member of the _____.

ANSWERS ON PAGE 118

COMMENT

Plants form the basis of most food chains on earth. They are the producers that convert sunlight energy into glucose which is chemical energy. Plants are therefore essential as food, either directly or indirectly, for all animals. Plants also produce oxygen as a by-product of photosynthesis. Organisms that undergo aerobic cellular respiration require oxygen to make ATP from glucose. Life on earth could not exist without plants.

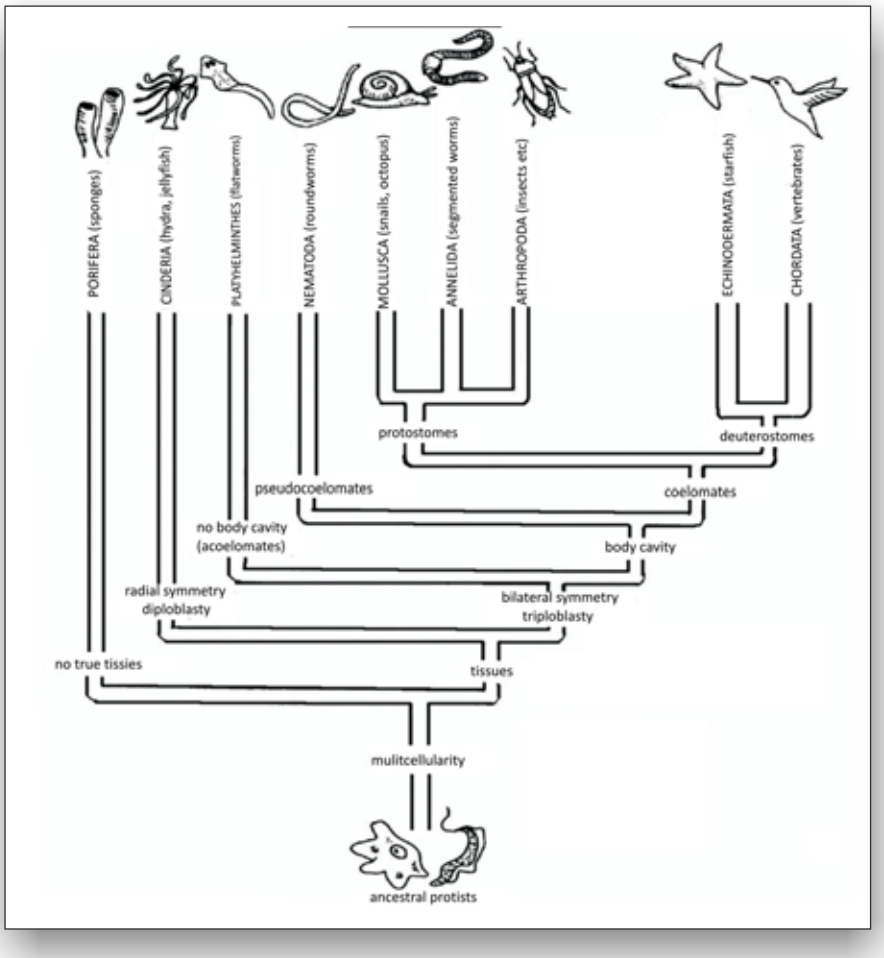
The Animal Kingdom

Most biologists agree that the first animals evolved more than 500 million years ago from protozoans which lived in the ocean. From these simple organisms, a great many varied organisms evolved. The organisms which evolved developed in complexity of their body plans and structures.

Distinguishing characteristics of animals

- Animals are multicellular.
- Animals are heterotrophic. They depend directly or indirectly on autotrophic bacteria, protista or plants for nutrition. In most cases, food is ingested and then digested inside a body cavity.
- Adult animals produce gametes. The egg is usually large and non-motile, while the sperm is much smaller and is **motile**. Specialised organs exist to produce the gametes. Although some animals can undergo asexual reproduction, animals are characterised by their ability to reproduce sexually.

motile:
able to move

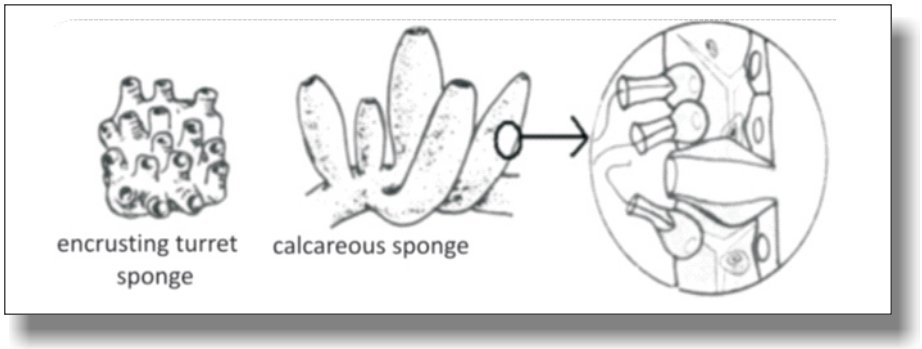


- Animal cells do not possess cell walls. Animal cells are surrounded by a membrane only. In all but one group of animals, the sponges, the cells are organised into tissues.

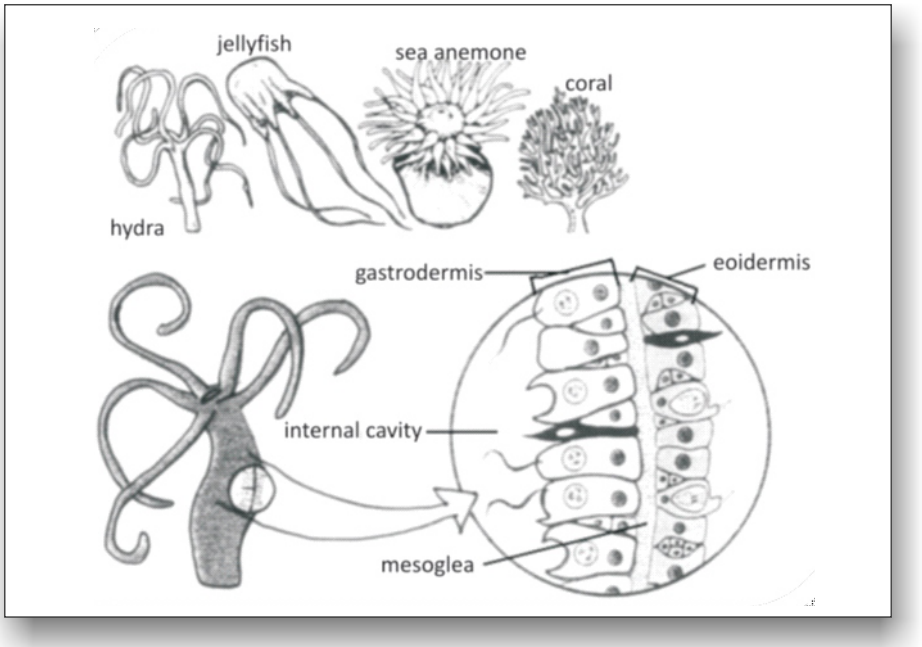
- Animals are able to move. This is largely due to their cells not having cell walls and therefore being more flexible, as well as due to the evolution of nerve and muscle cells.

The scheme on the previous page illustrates some of the evolutionary developments in body plan and structure of animals. You will need to refer to it as you work your way through this section.

One of the first characteristics to separate animanimals into two clearly distinguishable groups is whether they have a body made up of tissues and organs.

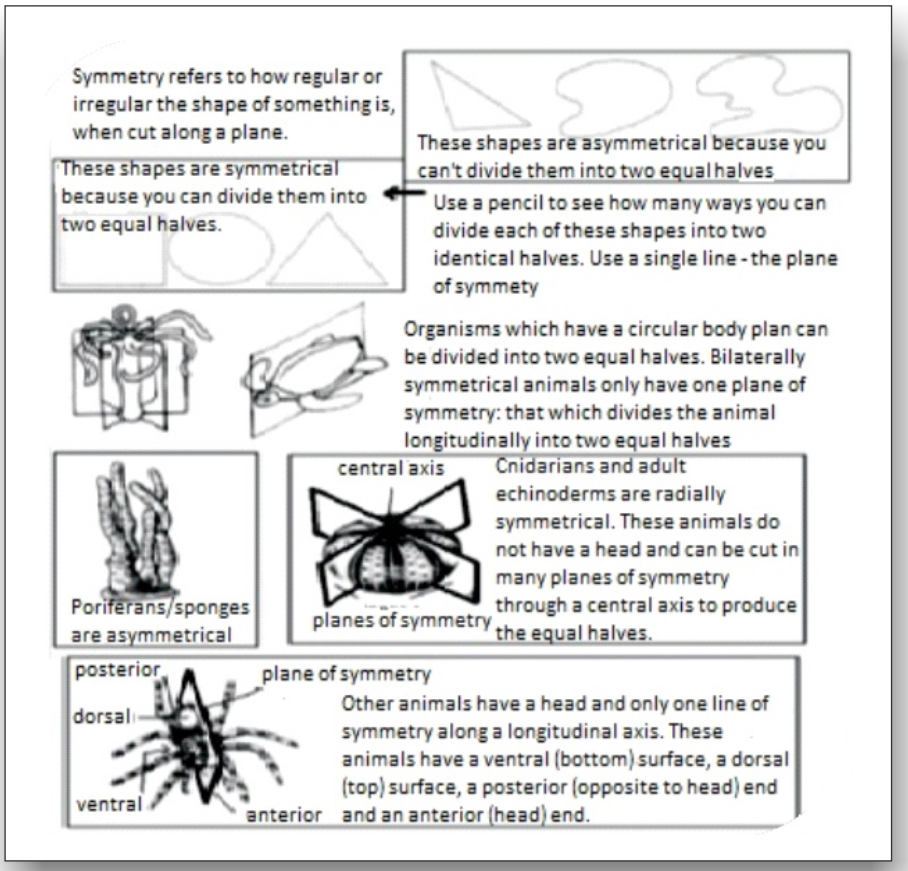


Sponges (Porifera) have a simple body structure where the body wall is made up of a loose collection of cells two to three layers thick. The inside of the body is filled with sea water.



Animals evolved tissues. This characteristic enabled them to begin to organise their bodies into specialised organs which performed certain functions.

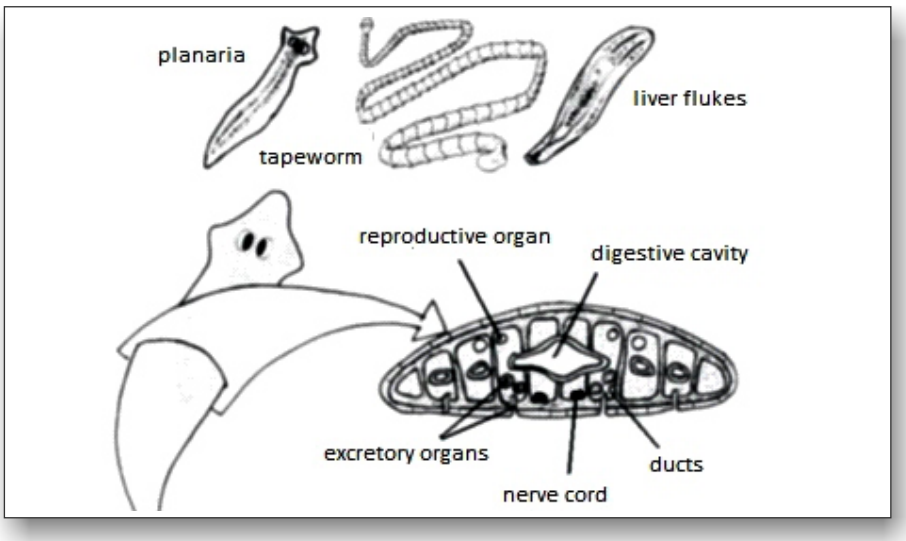
The most primitive of these organisms organised their bodies into two layers of cells around a hollow interior – the condition known as diploblasty. The Cnidarians are simple bodied organisms that live singly or in colonies in fresh or salt water. Their bodies have two layers, an inner gastrodermis and an outer epidermis. The two layers are held together by a non-cellular jelly-like material called the mesoglea.



At the same time that the body plans of diploblasty and triploblasty were evolving, another body plan related to shape of body was evolving. Certain animals became radially symmetrical, while others became bilaterally symmetrical. The bodies of most animals are symmetrical in some way. This means that their bodies can be divided into two equal halves. The plane of symmetry is the line which divides the body into two equal, mirror-image halves.

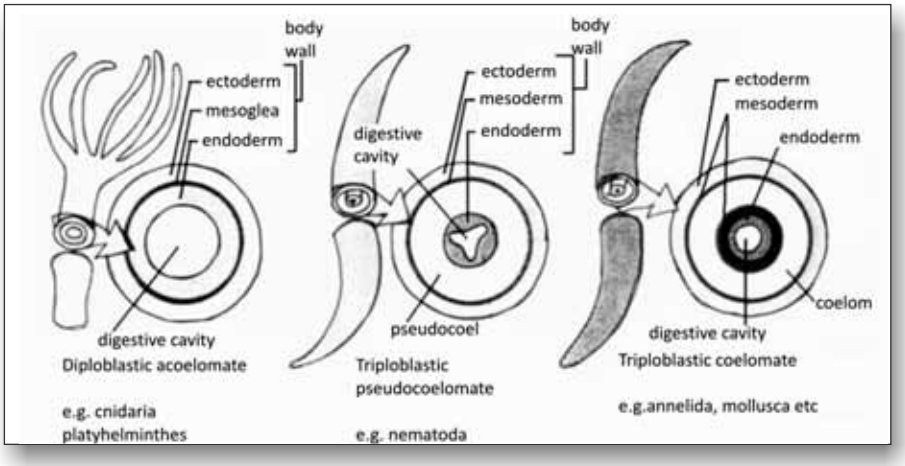
Poriferans are notably asymmetrical. As animals became more advanced, they became radially symmetrical. A radially symmetrical animal has a circular body plan with its body parts arranged around a central axis, like the spokes of a bicycle wheel. This means you can cut through the centre of the animal at many points, through a diameter, and get two equal halves.

Cnidarians are radially symmetrical. The bodies of other animals are bilaterally symmetrical. Their body parts are arranged symmetrically down the length or longitudinal axis/plane of the body.



Diploblastic animals are very simple in structure, and although there are different cell types, the organisation of the cells into tissues is very rudimentary or primitive. Triploblastic animals are more advanced. They possess three layers of cells in their body wall. The cells are arranged into tissues and specialised organs begin to develop. The outer layer is known as the ectoderm and it forms the epithelium ('skin'/covering) and the nervous system. The mesoderm is the middle layer which forms muscles, circulatory organs, reproductive organs and excretory systems. The inner layer is the endoderm which forms the digestive system.

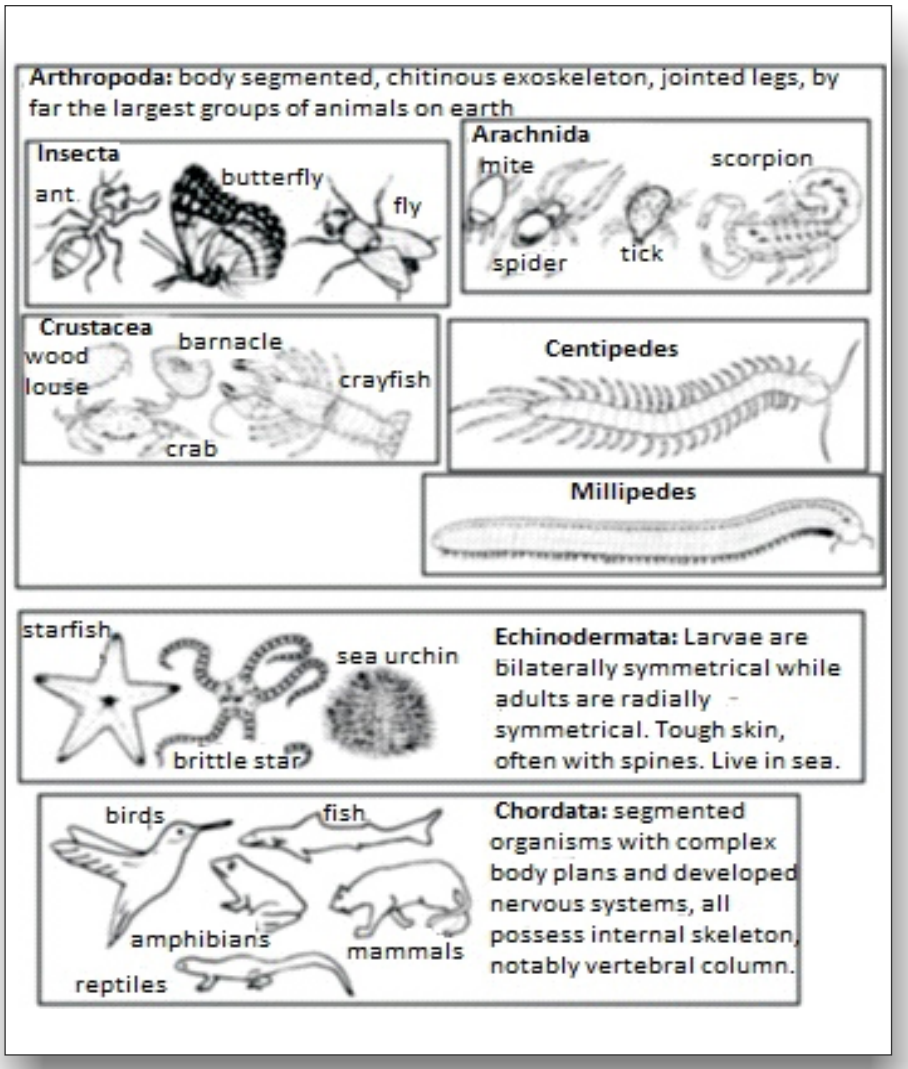
Platyhelminthes (the flat worms) have long, flat bodies. They live in fresh or salt water and many are parasites that live inside the bodies of other animals. They are the simplest of the Triploblastic animals. Their three layers of cells are organised into tissues and organs with very simple organ systems.



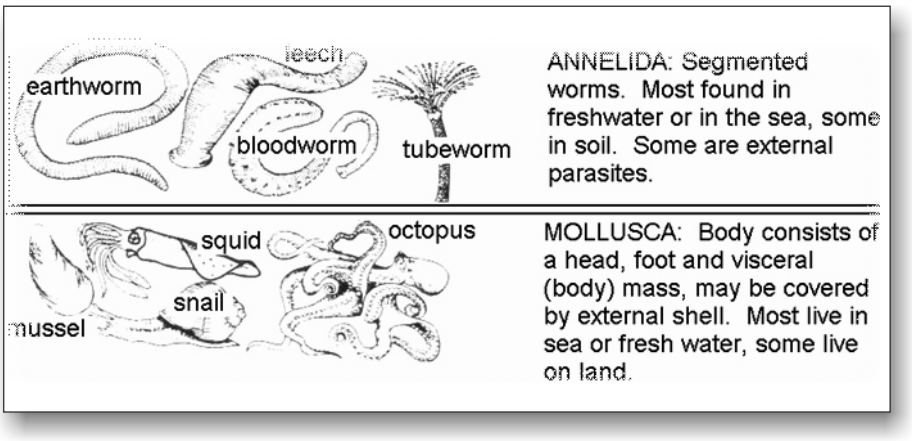
As animals increased in complexity, a cavity developed between the digestive tract and the body wall. This cavity is a split in the mesoderm and is known as a coelom. In Platyhelminthes, where there is no coelom (acoelomate), the internal organs are small and located in the tissue of the mesoderm. A body cavity / coelom is advantageous because it allows for space to develop larger and more complex organ systems and to protect these systems.

invaginates: gets

All organisms more advanced than the Nematoda are coelomate. However, there are two major groups of coelomates which differ according to their embryological development. Early in the embryonic growth of a coelomate, when the embryo is a hollow ball of cells, a portion of the ball of cells **invaginates** to form an opening called the blastopore. In protostomes, this blastopore becomes the animal's mouth, and the anus develops later from the other end of the ball of cells. In deuterostomes, the blastopore becomes the anus, while the mouth develops from the other end of the ball of cells.



Refer to the phylogenetic tree to see which groups of animals illustrated below are protostomes and which are deuterostomes.



ACTIVITY 8

Answer the following questions:

1. More advanced animals are bilaterally symmetrical. What are the advantages of symmetry and in particular, bilateral symmetry?

2. Which of the following terms apply to you? Once you have selected the terms that apply, correct the incorrect terms by supplying the correct terms.

   radially symmetrical, multicellular, coelomate, diploblastic, chordata, protostome.

3. Draw up a table in which you compare structural differences between Porifera, Cnideria, Platyhelminthes, Annelids, Arthropods and Chordates. The structural differences you should compare are: presence or absence of tissues; symmetry; body layers and body cavities in body wall.

ANSWERS ON PAGE 118

COMMENT

The animal kingdom shows enormous diversity and variation. They are able to live in a wide range of ecosystems across the planet. In the next Lesson, you will begin to explore how organisms are found in many different ecosystems.

CHECKLIST

Are you able to:

- ❒ discuss why a classification system is needed when Life Scientists study biodiversity
- ❒ describe how classification systems developed over time; including show how they changed as new information became available to scientists
- ❒ explain the Five Kingdom classification system and the Three Domain System
- ❒ describe the diagnostic features of Bacteria, Protista and Fungi
- ❒ identify the distinguishing characteristics of plants
- ❒ recognise and describe the different groups of plants in the plant kingdom
- ❒ identify the distinguishing characteristics of animals
- ❒ recognise and describe some of the different groups of animals in the animal kingdom.

LESSON 3

Ecology

About this lesson

In 1866, the German zoologist, Ernst Haeckel first used the word *ecology*. The word comes from two Greek words, *oikos* meaning 'home' and *logos* meaning 'study' or 'knowledge'. So, very literally taken, ecology is the study of the home, or **the environment where organisms live**. More correctly, ecology is the study of the **interactions** of organisms with one another and with the physical environment.

In this lesson you will also explore the abiotic factors in detail.

In this lesson you will:

- distinguish between biotic and abiotic factors
- see how the different levels of organisation are arranged in the environment
- understand how ecosystems function as a result of the interaction of biotic and abiotic factors
- describe the role abiotic factors play in the ecosystem
- describe how the biotic factors interact in an ecosystem
- observe how energy flows through an ecosystem in food webs.

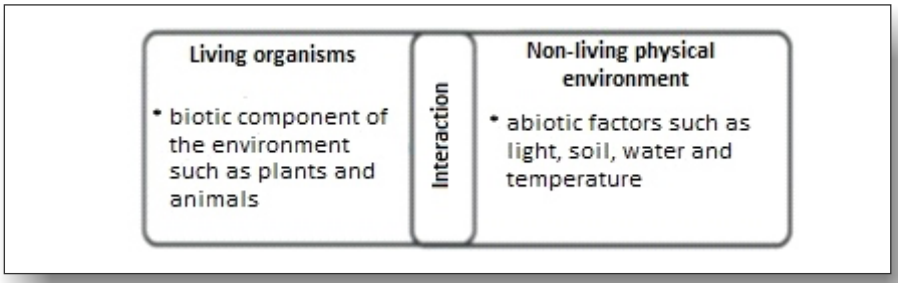
Ecosystems

In this Lesson you will be asked to do a long in-depth study of an ecosystem. It may be a good idea to scan ahead to all references to this study and see what you have to do, ahead of time. It may also be a good idea to tackle as much of this activity over a weekend.

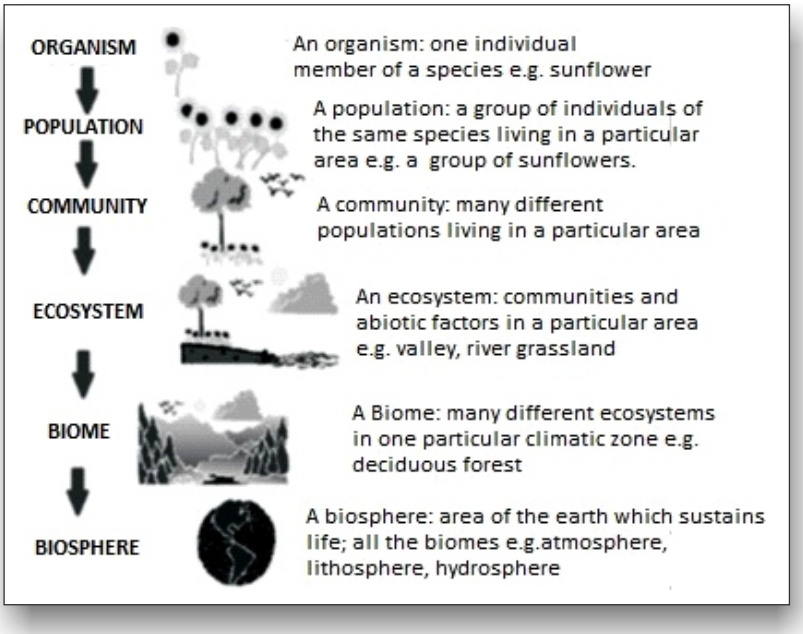
Take a friend with you to help you! Collect together all the things in a box that you will need to complete this Activity and set aside some time to explore your chosen ecosystem.

What do we mean by 'biotic' and 'abiotic' factors?

In any particular area in the environment, living organisms will interact with each other, and with the physical, or non-living factors in the environment. The living organisms are called **biotic factors**. The non-living or physcial parts of the environment are known as **abiotic factors**.



What are the levels of organisation in the environment?



When you learned about cells and tissues, you learned that organisms are organised from cells which combine to form tissues, to organs, to systems, and whole organisms.

Now you will learn that organisms are further organised as they occupy places in the biosphere. This scheme shows how the environment can be organised from simplest the individual organism to most complex the biosphere.

ACTIVITY 1

Study each of the examples below. In each one, decide whether or not the word in bold is correctly used as we have defined it in the levels of organisation. Record your decision and your reasons for it.

a. The **community** of ducks, geese, chickens and turkeys on the farm all compete for nesting space.

b. The Kalahari and the Sahara are both examples of desert **biomes**.

c. The **ecosystem** in the fishpond is made up of water, sunlight, temperature and soil.

d. The cheetah **population** of Africa is getting smaller every year.

e. The **population** of trees in Inkwezi forest is being damaged by people looking for firewood.

f. The **population** of elephants in the Lower Sabie region of the Kruger National Park suffered from a rare blood parasite.

ANSWERS ON PAGE 119

Some features of ecosystems

Terrestrial ecosystems are ecosystems on land. Aquatic ecosystems are ecosystems in water.

Rather than study individual living organisms on their own, life scientists tend to study the living organisms as they appear in a particular ecosystem. This is because no single organism can exist all by itself. It is reliant in some way on other organisms or on the environment in which it lives. In the same way, scientists often study the abiotic factors in an ecosystem to find out ways in which these factors affect the living organisms and bring about change in an ecosystem.

An ecosystem is a specific, defined area that contains living organisms that are affected by non-living factors. The components all interact with each other. The distribution of plants in an ecosystem depends on the type of soil, physical features and the climate (which includes water, temperature, light and air).

Biotic factors are the living organisms of an ecosystem. They all interact with each other and affect one another. The types of plants growing in an area determine which animals can live there.

Ecosystems can also interact with other ecosystems, as energy and nutrients move between different ecosystems. Ecosystems vary in size. An ecosystem can be can be the size of your garden or many square kilometres in size. Ecosystems change over time. The change may be due to natural processes such as fire, drought, flooding and disease. Ecosystems also may change due to human activities such as farming, building, mining, deforestation, introduction of alien species, and pollution.

ACTIVITY 2

Make sure that you are safe when studying this area. Take a friend with you if this area is isolated or lonely.

Find an ecosystem close to your home that you can study. It could be your garden, or a local park, or the banks of a river, or a piece of grassland. During the course of this lesson, you will be required to explore various aspects of your chosen ecosystem. Make careful notes of all your observations.

The first task is described here, but you will find other tasks later in this lesson.

Task One: Defining and describing the ecosystem.

a. Where is the **location** of the ecosystem? In what biome is it found?

b. What is the **size and shape** of your ecosystem? Measure and record the dimensions of your ecosystem.

c. What are the main **natural features** such as the shape of the land? How much plant and animal life is there in your ecosystem based on first impressions? Are there water sources?

d. What **human influences** are there? Are there any signs of human activities that should be noted?

e. Draw a map of your ecosystem on which you label the natural features and evidence of human influences you outlined in c. and d. Your drawing should have features typical of maps such as titles, direction indication and scale bar.

ANSWERS ON PAGE 119

COMMENT

Have you ever thought about how amazing life on Earth is? In a universe of billions of stars, our Earth is a minor planet circling an ordinary star, our Sun. Thousands of other stars are like our Sun, with planetary systems that possibly could support life. Yet, of all these, our planet is the only one that we know of that supports life. Until proven otherwise, the Earth, with all its diverse ecosystems and biodiversity, is unique.

Abiotic factors in an ecosystem

This scheme shows the different abiotic factors. There are three main categories of abiotic factors: climatic factors, edaphic factors, all related to the soil, and physiographic factors, all related to the shape of the land.

You will focus on some of these factors.

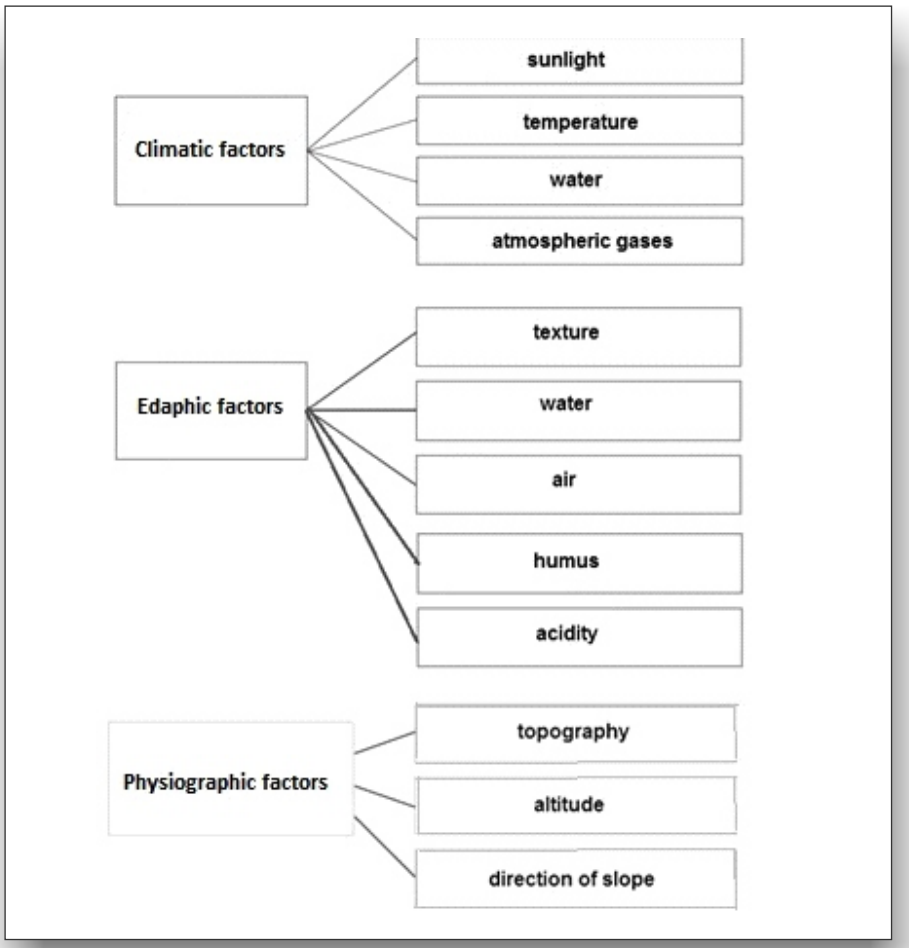
Climatic factors

Light

This is an essential abiotic factor, because it is the source of energy for photosynthesis. Photosynthesis provides food directly for plants and indirectly for animals.

Certain organisms, such as acacia trees, grasses, lions, elephants and locusts are sun-loving and will live directly in the sunshine. Other organisms prefer less direct sunlight; while others, such as ferns, mosses, frogs and toads cannot live in the sun and must live in the shade.

Animals also show preferences for certain times of the 24-hour period, and are most active during these times. In both plants and animals, day-length is an important factor in determining certain actions or behaviour. Have you noticed how day-length affects plants? Some plants will get blossoms, fruit or lose their leaves according to seasons. It is usually the length of time there is daylight that influences changes such as these in the plant.



Temperature

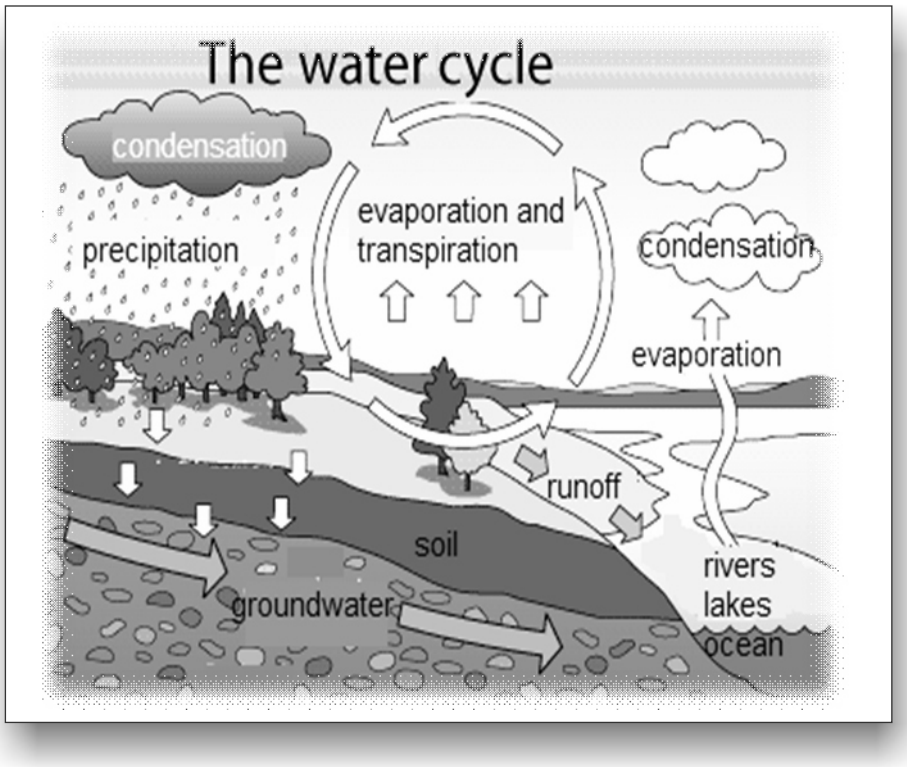
Organisms are exposed to temperature changes between night and day, summer and winter and also at different altitudes.

Certain plants will grow only in winter and some only in summer. Those that grow all year round, such as deciduous trees, are usually dormant in winter. The seeds of a number of plants will only germinate when they are exposed to a certain temperature. Vernalisation is when seeds need to be exposed to a period of cold. Some seeds, such as protea seeds and a number of fynbos species, must be exposed to extreme heat, such as occurs during veld fires before they will germinate.

Temperature also affects the behaviour of animals. Because temperatures vary across ecosystems, animals have evolved ways to cope with changing temperatures. Thick furs, feathers, insulating layers of fat beneath the skin, sweating, panting and burrowing under the sand are examples of adaptations to unfavourable temperatures.

Water

Water is essential to all living organisms. Plants absorb water through their roots and use the water during photosynthesis. Water evaporates from their stomata in a process called transpiration. Animals drink water which is essential for their metabolism and then excrete water and dissolved wastes.



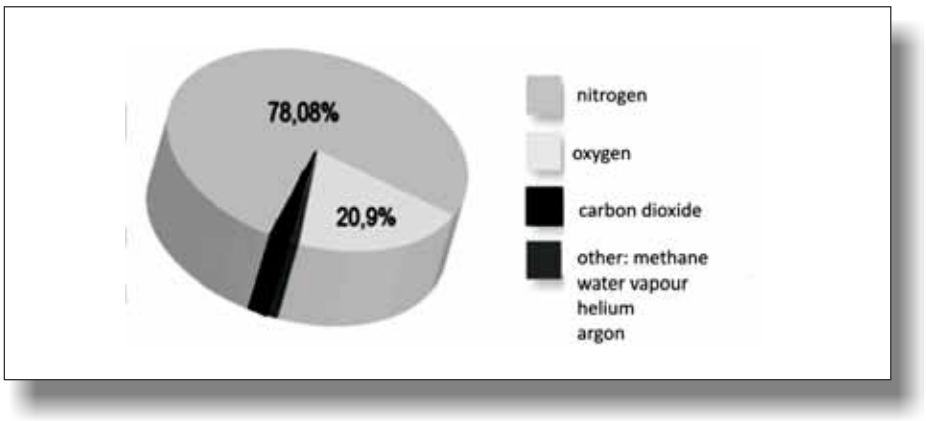
Because water is so precious to living organisms, they have evolved ways of reducing water loss. Plants may have waxy cuticles on their leaves and stems. Their stomata may be sunken and on the lower side of their leaves only.

Animals may have hairs, scales or tough exoskeletons which will limit water loss. In environments where water is scarce, some animals only emerge at night, when it is cooler, so that they won't lose water to sweating, panting and evaporation from their skin.

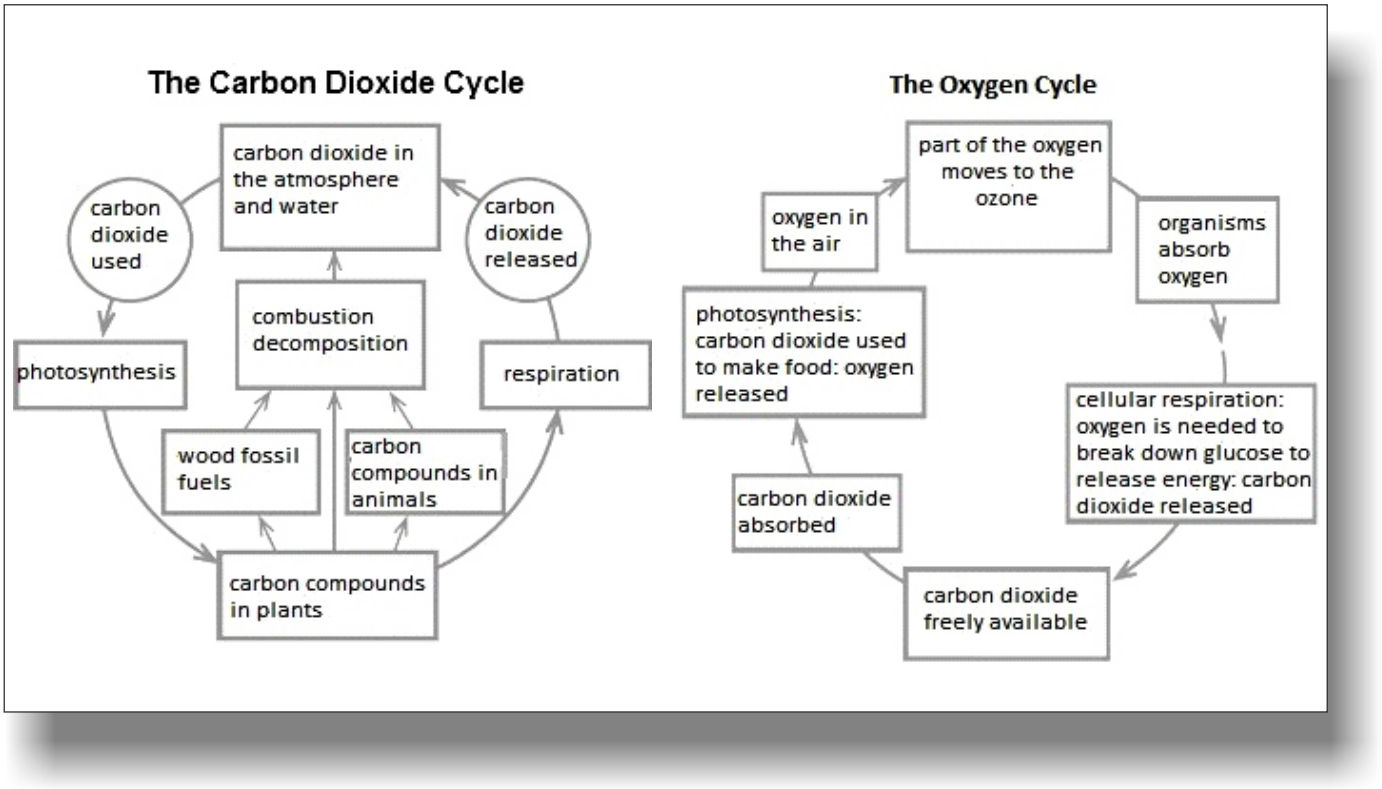
Water flows in a continuous cycle through the biosphere.

Atmospheric gases

There are gases in the atmosphere which are essential for the survival of living organisms. Atmospheric nitrogen comprises about 78% of the gaseous cover around the earth, oxygen about 21%, carbon dioxide about 0.03% and other gases make up the remainder.

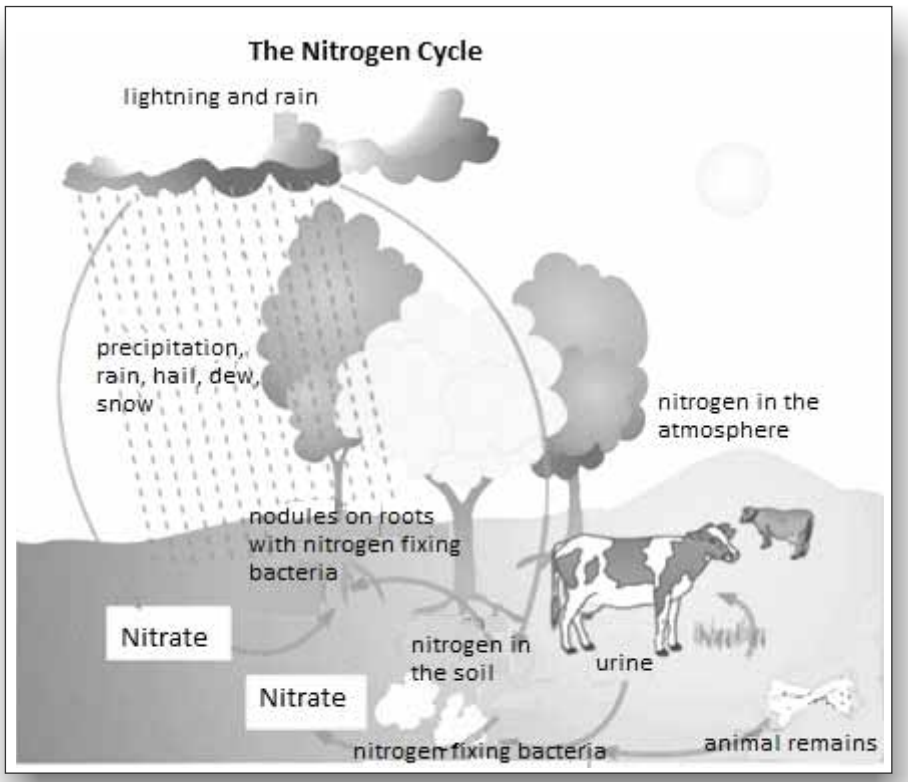


Oxygen is needed for the process of cellular respiration in both plants and animals. Carbon dioxide is needed for the process of photosynthesis in green plants. Plants exchange gases via their stomata.



Nitrogen is needed for the formation of proteins in all organisms. Nitrogen is the most abundant gas in the atmosphere. Although about 78% of the air is nitrogen, plants and animals cannot use it as a gas. Only special nitrogen-fixing bacteria can use nitrogen gas.

The nitrogen cycle is the movement of nitrogen between the atmosphere, the lithosphere and the living organisms of the Earth.



Nitrogen is removed from the air by processes called nitrogen fixation. This happens in the following ways:

- Nitrogen-fixing bacteria live freely in the soil. They also live in the roots of legumes such as peas, beans and clover where they cause swellings called nodules in the root. Nitrogen-fixing bacteria can absorb nitrogen gas from the air spaces in the soil. They use the nitrogen to make compounds called nitrates and ammonium salts in the soil.

- The high temperatures of a lightning flash cause some nitrogen and oxygen to join to form oxides of nitrogen. The oxides of nitrogen dissolve in rain and are washed into the soil where they form nitrates.

- Farmers and gardeners add nitrogen to the soil in the form of organic fertilisers such as manure and compost or in the form of nitrate salts and ammonium salts from inorganic fertilisers.

Adding the nitrogen to the air

Other bacteria in the soil called denitrifying bacteria change some of the nitrates into nitrogen gas, which goes into the air. This process is called denitrification.

What happens to nitrates in the soil?

- The nitrates in the soil are absorbed by plants. The plants use the nitrogen in the nitrates to make organic compounds called proteins. Proteins are passed from one organism to another in food chains when animals eat plants and/or animals.

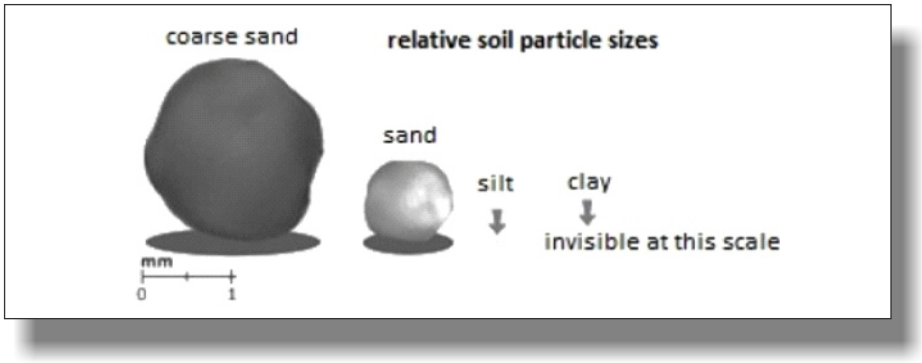
- When plants and animals die, their bodies decompose and the proteins go into the soil. Animal wastes also contain nitrogen in compounds such as ammonia, urea and uric acid. Nitrifying bacteria in the soil change the nitrogen in proteins and animal wastes into nitrates.

Edaphic factors/Soil factors

Edaphic factors are factors related to the soil. Soil is a mixture of small rock particles, air, water and organic matter. Soil contains living organisms including microscopic bacteria and fungi as well as larger organisms such as worms and insects. The organic matter in soil consists of plant and animal material like dead leaves and animal faeces. Various features of the soil control the development of plants and animals in a particular ecosystem. These features are:

Soil texture

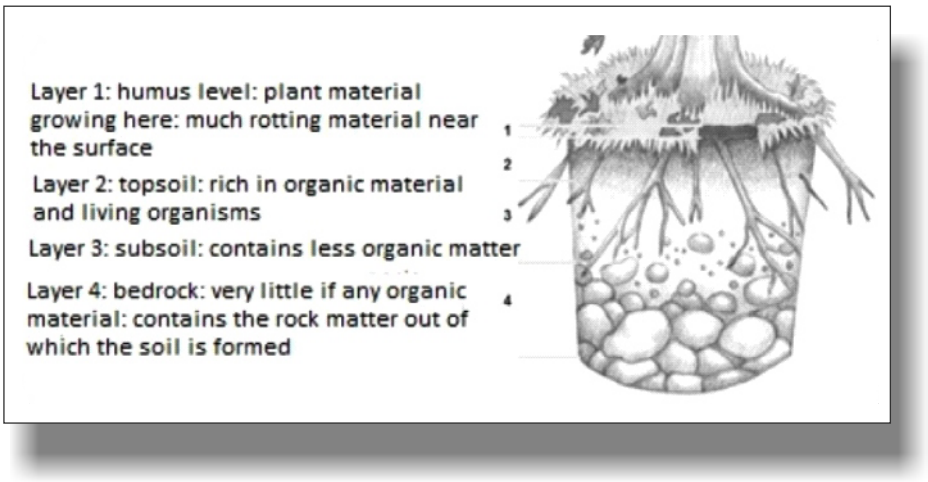
The texture of the soil refers to the size of soil particle that is characteristic of a certain area. Large soil particles will make the texture of the soil coarse. Small soil particles will make the soil texture fine.



In order to categorise and classify soil types, scientists measure the diameter of the soil particle size. Very seldom will soil be purely one of the types. Usually soil is a mixture of different particle sizes. When soil is a mixture of sand, clay and silt, it is called loam. Loam is generally a very good agricultural soil. It develops sods or clumps and holds/retains water well. It also usually has a large amount of humus present.

Humus is the dead organic matter in soils that is decaying (rotting). Humus is very important to the plants growing in the soil, because the minerals present in the decaying matter are freed into the soil, dissolved in the soil water and made available for plants to absorb the minerals they need. Soils with a high humus content tend to have a higher temperature. This is because bacteria, fungi and micro-organisms breaking down and decomposing the dead organic matter are undergoing cellular respiration to make energy for their own cell functions. This process frees heat energy into the soil.

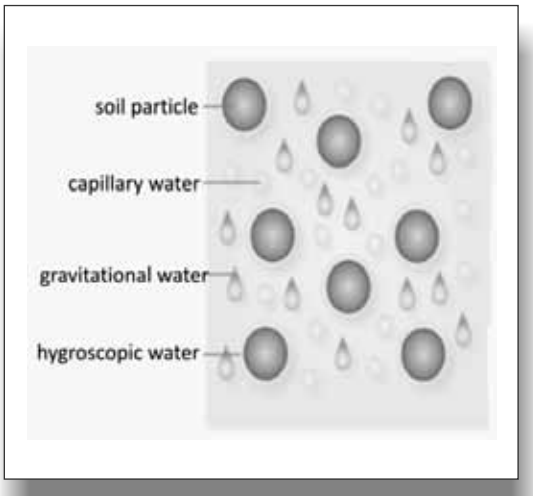
Soils with a high humus content are fertile soils that provide excellent foundation for plants to grow in. Generally humus is found in the upper layers of soil.



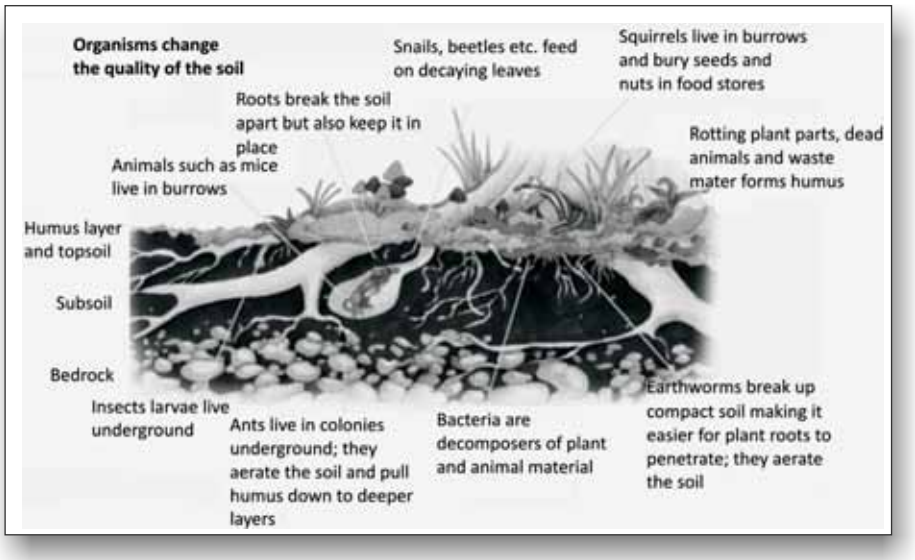
Soil water

Soil particles have space between them. Water can become trapped between the particles of soil. Which texture/type of soil would you say has the best water retaining ability? Which soil texture has the least efficient water retaining ability?

Hygroscopic water is found as a microscopic film of water surrounding soil particles. This water is tightly bound to a soil particle by molecular attraction so powerful that it cannot be removed by natural forces. Capillary water is held by cohesive forces between the films of hygroscopic water. This water can be removed by evaporation or by plant absorption, but cannot be removed by gravity. Plants extract this water through their roots. Gravitational water is water moved through the soil by the force of gravity. This is the water that can run off and through soil. The amount of water in the soil is controlled by the soil texture.



Soils with mainly clay-sized particles have more total pore space in a unit volume than soils that are mainly sandy. As a result, fine grained soils have higher water capacities than coarse-grained soils.

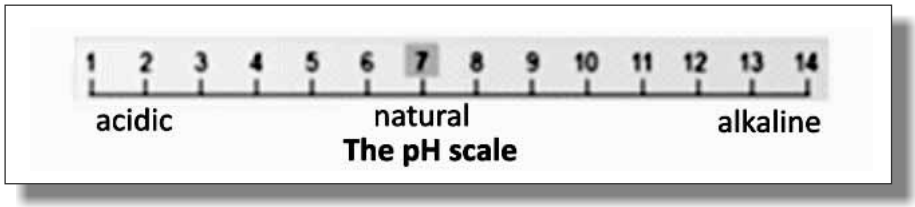


Air

Air can be found trapped in the tiny spaces between soil particles, especially in the topsoil. The amount of air present depends on the degree to which the soil is compacted. Many of the organisms living in the soil depend on this air for survival.

Soil pH

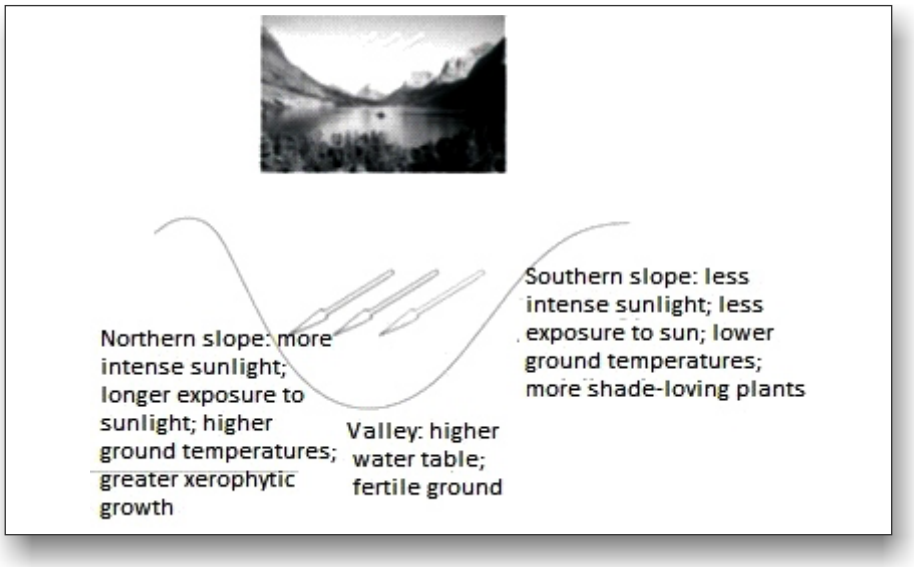
How acidic or alkaline a soil is can be measured on the pH scale. Most plants prefer a fairly neutral pH although specific plants such as sugar cane, potatoes, vines, pineapples and maize are adapted to more acidic soils and others, such as wheat, cabbages, barley, lucerne, beans and onions, grow better in alkaline soils. Very acidic coils are usually rather infertile.



Physiographic factors

Physiographic factors are associated with the physical nature of the area, such as altitude, slope of the land, position of the ecosystem in relation to the sun and rain-bearing winds. These factors affect the types of plants growing in the area, which will in turn affect the animals found in the area.

Topography/slope and shape of the land



The slope of the ground describes how steep or how flat the land is. The angle of the slope affects the way that water runs over the land. The humus and topsoil layers of a very steep slope may be more easily eroded than in a flat piece of land. If the slope is steep, water will run down it very quickly and not much of the water will soak into the soil where plants can absorb it. A steep slope is more likely to have thin, dry unfertile soil but a flat slope will tend to have thicker, moister, fertile soil. This in turn affects the types of plants and animals that are found on different slopes.

Aspect

The aspect is the direction that the slope faces. In the southern hemisphere, slopes that face north get more sunlight and are warmer than slopes that face south. This in turn affects what types of plants and animals can survive on the slope. For example, proteas grow well on the cooler south facing slopes of hills, but not as well on the warmer north facing slopes.

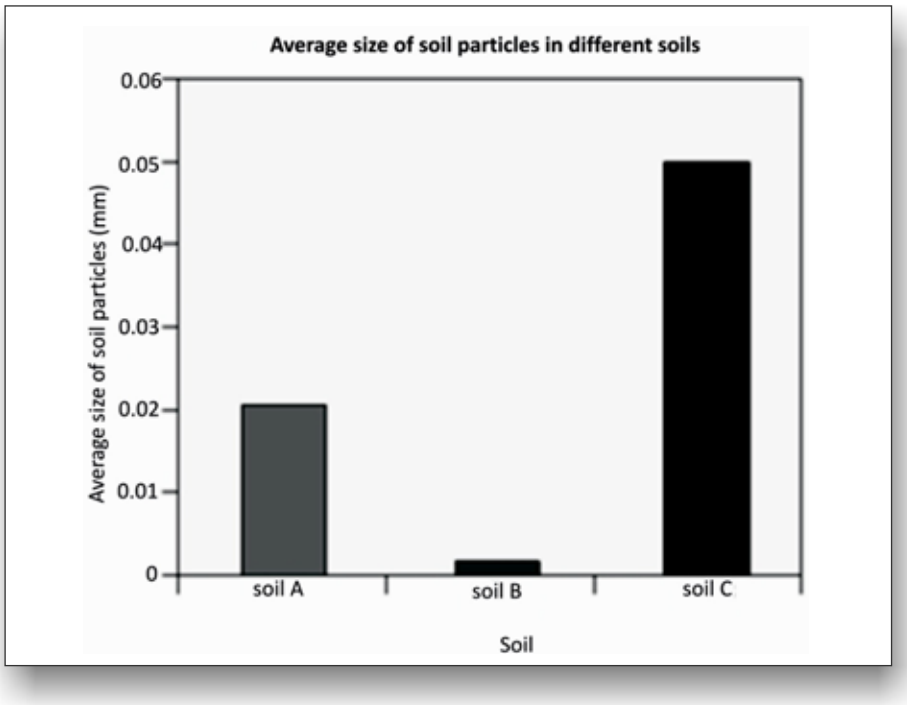
Altitude

The altitude is the height of the land above sea level. The usual pattern observed is: the higher the altitude, the lower the temperature. You have already learnt that temperature affects the types of plants and animals that are found in an area. For example, at the bottom of a mountain there might be trees and soft plants that need warm conditions. But at the top of the same mountain there might be tough grasses that are able to survive the colder conditions.

Xerophytic plants are those adapted to very scarce water availability. Some of them, such as aloes, may have succulent leaves and thorns to stop animals from eating them.

ACTIVITY 3

Study the graph and answer the questions that follow.



a. Which soil would be able to hold water for the longest time after a rainstorm?

b. Explain your answer to a.

c. Which soil would you to expect to have the highest air content?

d. Explain your answer to c.

e. Which of the soils would you classify as a sandy soil?

f. Explain your answer to e.

g. What problem would plants growing in Soil C face?

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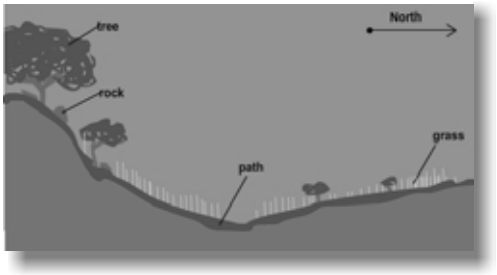
ACTIVITY 4

1. A group of learners studied the abiotic factors of an ecosystem near their school in South Africa. The drawing is a side view of the ecosystem that one of the learners drew. Study the drawing and answer the questions that follow.



   a. Describe slopes A and B in terms of:
      i. aspect
      ii. slope

   b. i. Which slope do you think would experience the highest temperatures?
      ii. Explain your answer to b

   c. Which slope do you think will have the highest water content in the soil? Explain your answer.

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ACTIVITY 2 continued

Task Two: Analysing the Abiotic Factors in your Ecosystem.

Climatic factors in the ecosystem:

Go back to the start of this activity on page 38 to remind yourself what is required for your investigation into your chosen ecosystem.

a. How does sunlight affect your ecosystem? Are there parts of your ecosystem that get more sunlight than others? Is there a difference in the type of plants in the sunny and the shady parts of the ecosystem? Use these questions to investigate and describe your ecosystem.

b. What is the average temperature in your ecosystem during the day and at night? Does the temperature vary seasonally? Are there places in the ecosystem that are warmer/cooler? Use a thermometer to measure the temperature in your ecosystem, then record and analyse the results you obtain. Account for differences in temperature and how these differences affect the living organisms that are found there.

c. During which seasons does your ecosystem receive rain? What are the rainfall figures for your ecosystem? How does rainfall affect the organisms in the ecosystem? What natural sources of water can be found in your ecosystem? Is there any evidence of other ways in which water affects your ecosystem, such as soil erosion?

d. How does wind affect your ecosystem? Is it protected or exposed? Are there any sources of air pollution in or nearby your ecosystem? Is there any evidence of other ways in which the air affects your ecosystem, such as wind erosion?

e. Can you observe any special adaptations amongst the living organisms to the different climatic factors in your ecosystem?

Many ecosystems have special features that you may wish to highlight. Combine all your findings and investigations into a scientific report describing the effect of climatic factors in your ecosystem.

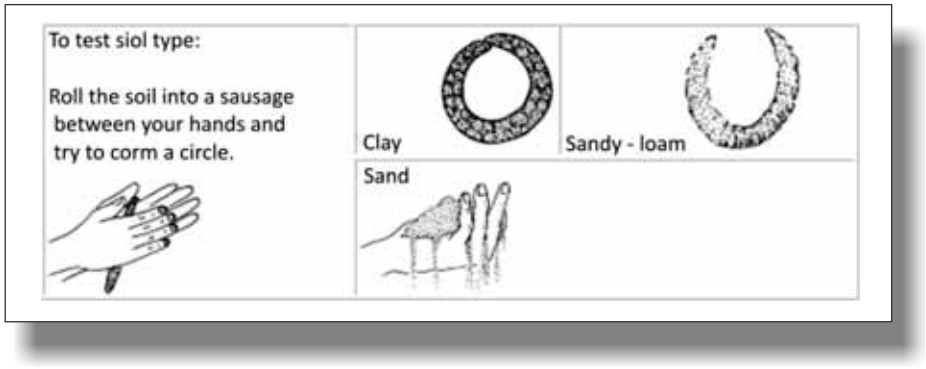
Edaphic factors in the ecosystem:

a. Investigate the soil texture by doing the 'sausage test'.

   i. Take a small handful of soil from your ecosystem and wet it with a little bit of water.

   ii. Roll the soil into a ball. If the soil just crumbles and cannot form a ball, the soil is sandy. If the soil can form a ball, it may be clay or loam soil.

   iii. Roll the ball of soil into a sausage shape and then try to bend the sausage into a ring shape. If the sausage bends a bit but breaks before it forms a ring, the soil is loam. If you can bend the sausage to form a ring, the soil is clay.



What is the texture of the soil in your ecosystem? What do you predict the water retention capacity of the soil?

You can test this by taking a soil sample and finding out its mass, then heating it to evaporate the water and finding the new mass. The loss in mass would be water.

b. Is there humus in the soil? What does it seem to be made up of?

c. Can you dig a trench in your ecosystem to get a soil profile? Make diagrams of what you observe.

d. Do you think that the soil in your ecosystem is good for plant growth? Explain.

e. Can you do tests to determine the pH of the soil in the ecosystem?

Physiographic factors in the ecosystem:

a. Make an annotated drawing that describes the physiographic features of your ecosystem. At what altitude is this ecosystem? In which direction does it face? Are there any steep slopes? Can you notice any consequences of the shape of the land in your ecosystem?

b. Can you determine how the shape of the ecosystem affects the plants and animals you find there?

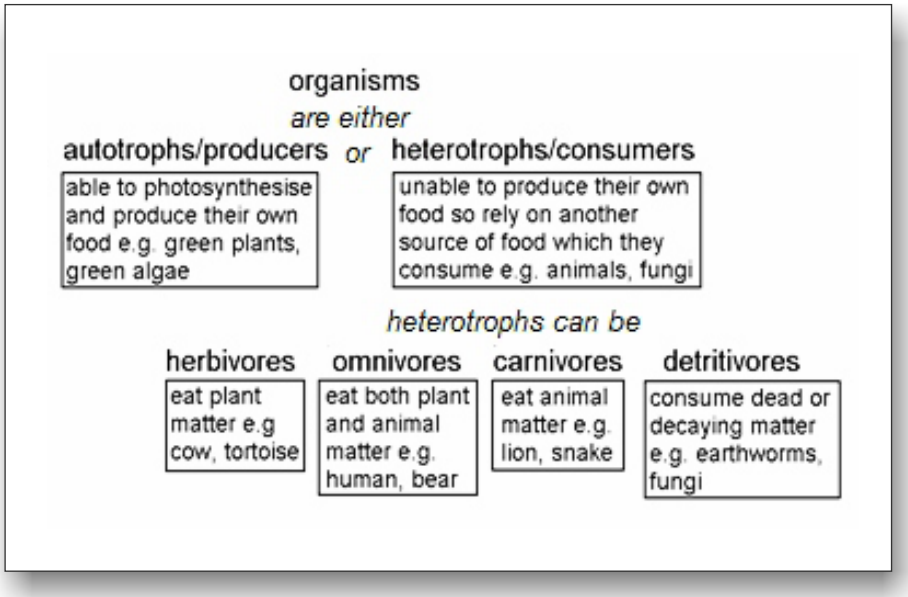
Do not be limited by the focus questions posed in this task. Think of other ways you can observe and describe, scientifically, the abiotic factors in your ecosystem. Combine all your findings and investigations into a scientific report describing the effect of abiotic factors in your ecosystem.

COMMENT

All living things in an ecosystem depend on the abiotic factors for survival. Living things would not be able to survive if not for the balance between many abiotic factors in the ecosystem.

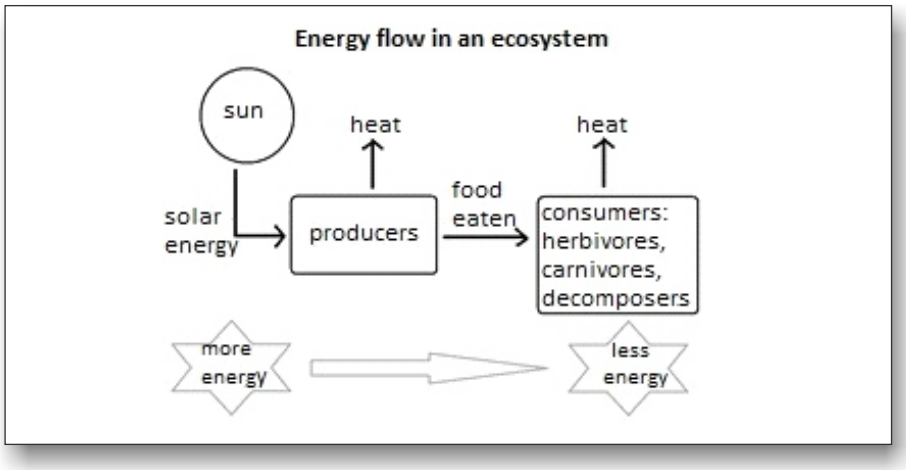
Biotic factors in an ecosystem

The biotic factors are all the living organisms in an ecosystem. They can be subdivided into different groups, depending on the way in which they obtain their nutrition. As organisms obtain their nutrition from different sources, it is possible to see how energy flows through the ecosystem.



Trophic levels in an ecosystem

In an ecosystem, there are many different kinds of living organisms that all interact, usually based on their individual need for food. We can classify the different kinds of organisms in an ecosystem, based on the way they obtain their food. All organisms can be split into one of two groups: they are either autotrophic or heterotrophic.



As the flow chart shows, plants and other photosynthetic organisms rely on the sun for energy to make carbohydrates. These organisms are known as producers or autotrophs.

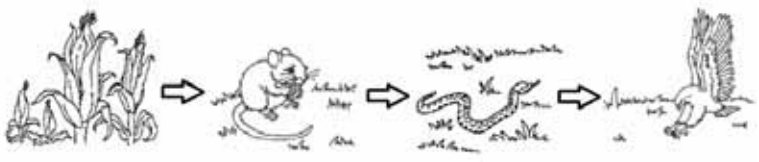
All other organisms are heterotrophs or consumers. They rely on the food produced by the autotrophs. Heterotrophic organisms can be split into different groups, depending on what they eat. Some consumers eat plants directly, while others eat animals that ate plants. Heterotrophs can be divided into different groups, depending on how they obtain their energy.

In order to describe the relationships and interactions between the organisms in the ecosystem, ecologists use the flow of energy through the different organisms. The word trophic means food. Trophic levels describe the feeding level or energy level an organism occupies in the ecosystem. When we study an organism in an ecosystem, we can classify it according to the 'food level' it occupies. This table summarises the trophic levels in an ecosystem.

first trophic level	Producers	manufacture food by photosynthesis	maize plant
second trophic level	primary consumers	eat producers; herbivores	mouse
third trophic level	secondary consumers	eat herbivores	snake
fourth trophic level	tertiary consumers	top predator; eat herbivores and carnivores	eagle

Food chain and webs in an ecosystem

There are ways of illustrating the flow of energy through an ecosystem. Food chains illustrate a linear flow of energy through the ecosystem. A food chain is like a flow diagram, naming the organisms that are related through their feeding or trophic levels. Very basically a food chain shows who eats whom. The order of the organisms in the food chain should reflect the flow of energy and the direction in which the energy and nutrients flow. The diagram here could be represented by the food chain:

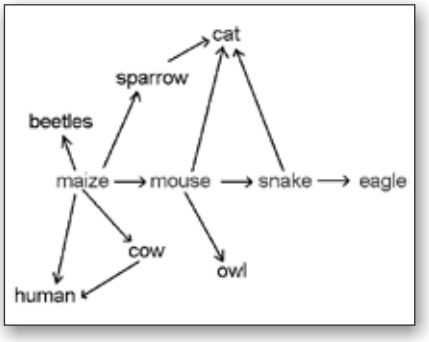


maize → mouse → snake → eagle

It is important to remember when you draw a food chain that the arrows must always point in the direction of energy flow. The food chain tells us that energy stored in the producer, which is at the first trophic level, is transferred to the herbivore which is the primary consumer at the second trophic level (the mouse) when it eats the producer (the maize). Energy in the mouse is transferred to the snake which is the secondary consumer at the third trophic level when the snake eats the mouse. Energy in the snake, which is the tertiary consumer at the fourth trophic level, is transferred to the eagle when it eats the snake.

Can you see a problem with exclusively using food chains to illustrate feeding interactions and energy flow in an ecosystem?

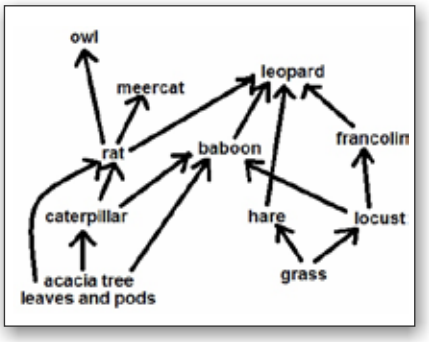
Do mice only eat maize? Do snakes only eat mice? Do eagles only eat snakes?



The diagram shown here is an example of a food web. Food webs are more realistic pictures of feeding relationships in an ecosystem as they show that many herbivores feed off the producer, just as the primary consumers are seldom eaten by only one predator. A food chain is a rather simplistic representation of reality in an ecosystem. Organisms very seldom have only one kind of other organism eating them.

Most food chains connect with other food chains, since most organisms are the prey of more than one predator. Different food chains are linked together to form a food web. Food webs are more realistic representations of the complex feeding relationships in an ecosystem. Food webs are ways of showing how the biotic components of an ecosystem are interlinked.

ACTIVITY 5



Study the food web and answer the questions that follow.

a. In what kind of biome and ecosystem might you expect to find a food web such as this?

b. Analyse the food web and determine:
   i. the producer/s
   ii. the herbivore/s
   iii. the secondary consumer/s
   iv. the top carnivore/s

ANSWERS ON PAGE 120

c. Where does the energy for this food chain come from?

ACTIVITY 2 continued

Go back to the start of this activity on page 38 to remind yourself what is required for your investigation into your chosen ecosystem.

Task 3: The Biotic Components of an Ecosystem

Task 4: Biotic factors in the ecosystem

a. You must identify as many of the biotic components of the ecosystem as you can. Use classification keys and field guides to name the organisms using their scientific names. If you only know common names of the organisms, or names in indigenous languages, this is quite acceptable. If you are unable to classify or name the organism in any

way, give it your own common name based on its appearance or where you found it.

b. Draw a bird's eye view of the ecosystem on a large sheet of paper or cardboard. Using a symbol to represent the different organisms you have found, indicate on this map where in the ecosystem the organisms are located. Do not forget to include a key.

c. After careful observation of the organisms in their natural habitat, classify each organism as to whether it is a producer, consumer (and the specific type of consumer) or decomposer. If it is a consumer, work out what it eats. Also try and work out if anything in the ecosystem eats it. Can you draw food chains and then construct a food web describing the trophic interactions in your ecosystem?

Do not be limited by the focus questions posed in this task. Think of other ways you can observe and describe, scientifically, the feeding relationships in your ecosystem. Combine all your findings and investigations into a scientific report describing the trophic relationships in your ecosystem.

COMMENT

All the living things in an ecosystem are dependent on the abiotic factors. However, they are all dependent on each other too for their survival. Energy flows into the ecosystem and through the ecosystem as the living organisms obtain their food.

CHECKLIST

Are you able to:

- ❒ distinguish between biotic and abiotic factors
- ❒ describe the different levels of organisation in the environment
- ❒ explain how ecosystems function as a result of the interaction of biotic and abiotic factors
- ❒ describe the role abiotic factors play in the ecosystem
- ❒ describe how the biotic factors interact in an ecosystem
- ❒ observe how energy flows through an ecosystem in food webs

NOTES

LESSON 4

Biomes

About this lesson

In Lesson 3, you saw how ecologists organise the environment.

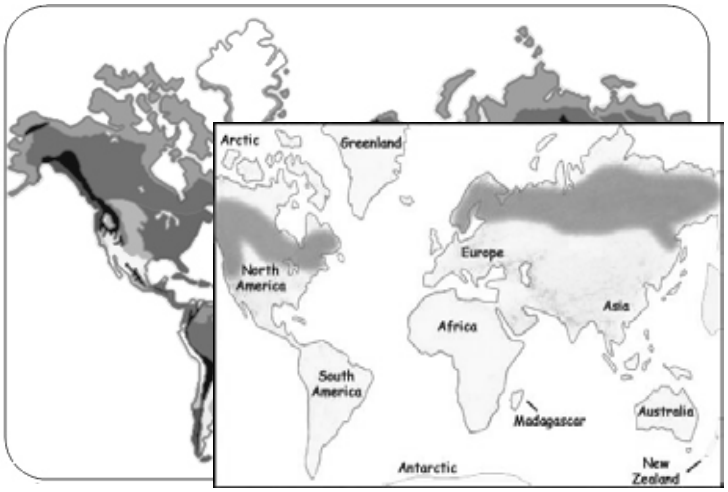
This lesson focuses on the biome level of organisation. In this lesson you will briefly learn about some major global biomes which are not found in South Africa.

In this lesson you will:

- define what is meant by a biome
- describe some of the major global biomes not found in South Africa
- describe the physical characteristics of some of the major biomes found in South Africa
- describe the fauna and flora characteristics of the major biomes in South Africa.

Global biomes

What is a biome?



The biosphere is made up of a number of regions with climates that are suitable for the survival of certain kinds of organisms. These regions are called biomes. The climate is important because it controls the type of vegetation that grows in a biome. Herbivores are usually restricted to the type of vegetation that they eat. Carnivores will be distributed according to their diet prey species. So the climate indirectly controls where animals live.

This map above shows how the land is divided into biomes, shown by colour shading. However, if you are able to find a large colour map of biome distribution across the earth, this will be a useful resource. Try these internet websites:

http://www.blueplanetbiomes.org/world_biomes.htm

http://www.physicalgeography.net/fundamentals/9k.html

http://www.planetpals.com/habitats.html

A biome is not restricted to a particular continent nor is it restricted to a particular hemisphere. This is because a similar climatic condition can occur on different continents and in different hemispheres. If the climatic conditions are similar, it is likely that the vegetation will be similar and therefore, the animal life will also be similar.

For example, desert conditions can be found on all continents and in both hemispheres. The Kalahari desert in Namibia, the Sahara Desert in North Africa, the Great Australian Desert in Australia and the Gobi Desert in Asia are found in different places in the world, but they all belong to the same biome. This is because the climatic conditions, geography and life forms in these deserts are very similar.

What are some of the global biomes that are not found in South Africa?

The shaded area on this map is tundra.

Tundra biome

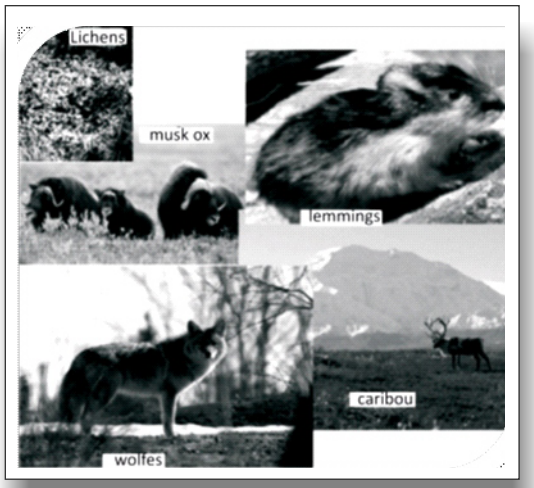
This biome is very cold. It covers about one fifth of the land on earth. The word 'tundra' comes from a Finnish word that means treeless plain, which is a good description of the biome.

Tundra is located in the arctic circle, Antarctica, northern parts of North America and Asia. There is very little rainfall in the tundra; winters are long, and summers short.

In the summer the soil becomes very soggy from melted snow and rain. The moisture sinks into the ground and freezes as permafrost.

There is low diversity of organisms that live here. Many lichens, mosses, and small shrubs flourish in the arctic tundra. The plants that live in the harsh permafrost soil usually adapt to the weather by being short and grouped together to resist winds.

You might find lemmings, caribou, polar bears and arctic hares in the tundra. Some migratory birds also live in the tundra during part of the year.



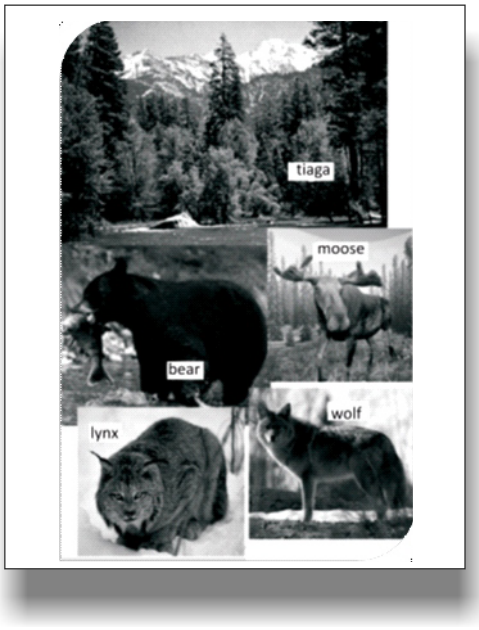
Coniferous forests/taiga biome

This is the largest terrestrial biome on earth. It extends in a broad band across North America, Europe, and Asia to the southern border of the arctic tundra. Much of the taiga was once covered with glaciers. As the glaciers receded, cuts and depressions were left in the landscape that have since filled with rain creating lakes and bogs.

The shaded area on this map shows where the taiga is found.

Long, cold winters, and short, mild, wet summers are typical of this region. Winter days are short, while summer days are long. Precipitation is relatively high in the taiga and falls as snow during the winter and rain during the summer. Compared to other biomes, the taiga has less diversity in plant life. The most common type of tree found in the taiga is the conifer, or cone-bearing tree.

Conifers include pines, spruces and firs. There may also occasionally be deciduous species present, such as oak and birch. The soil in the taiga is thin, acidic and not very nutrient rich. It also is rocky. The cold climate of the taiga makes it a difficult place for many animals to live. Many have thick coats of fur to insulate against the cold, and some hibernate. This means that they become dormant or slow down their activity and sleep for much of the coldest periods. Others migrate to warmer areas in the chilly winters.



Animal populations are mainly seed-eating squirrels, small mammals such as ermine and moles and larger browsing animals such as deer, moose, elk, and snowshoe hare.

The bogs and ponds in the taiga provide a great summertime breeding place for many different insects.

The shaded area on this map is rainforest biome.

Migratory birds often come to the taiga to nest and feed on all these insects. The typical predators for this area are grizzly bears, wolves, lynxes and wolverines.

Rainforest biome

Rainforests are important because they help maintain global weather patterns. Water that evaporates from trees falls in other areas as rain. Rainforests are lush and warm all year long.

Temperatures don't even change much between night and day.Trees are the predominant plant form in rainforests and the floor of the forest is covered in ferns, mosses and smaller plants. There are more than 20,000 varieties of orchids found in the rainforest. Trees in rainforests can live for 500-1000 years! Tropical rainforests are home to half the plant and animal species on Earth.

Scientists believe that there is such a great diversity of animals in tropical rainforests because they are one of the oldest biomes on earth. Animals in the tropical rainforest are specially adapted to live in this unique environment. A common characteristic found among mammals, birds, reptiles and amphibians, is an adaptation to living in trees.

Monkeys, deer, jaguars, leopards, birds, amphibians, reptiles and a huge range of insects live in rainforests.

ACTIVITY 1

The tundra, taiga and rainforest biomes have been described for you on maps, in words and with some pictures of the wildlife typical of these areas. Go to your local library or search the internet to find out about the alpine biome, the deciduous forest biome and the desert biome. Illustrate your notes with a map and some pictures of characteristic wildlife.

ANSWERS ON PAGE 121

COMMENT

Many biomes exist across the globe. Although South Africa has a wide range of biomes, some very interesting biomes, such as the tundra and taiga, are not found in South Africa.

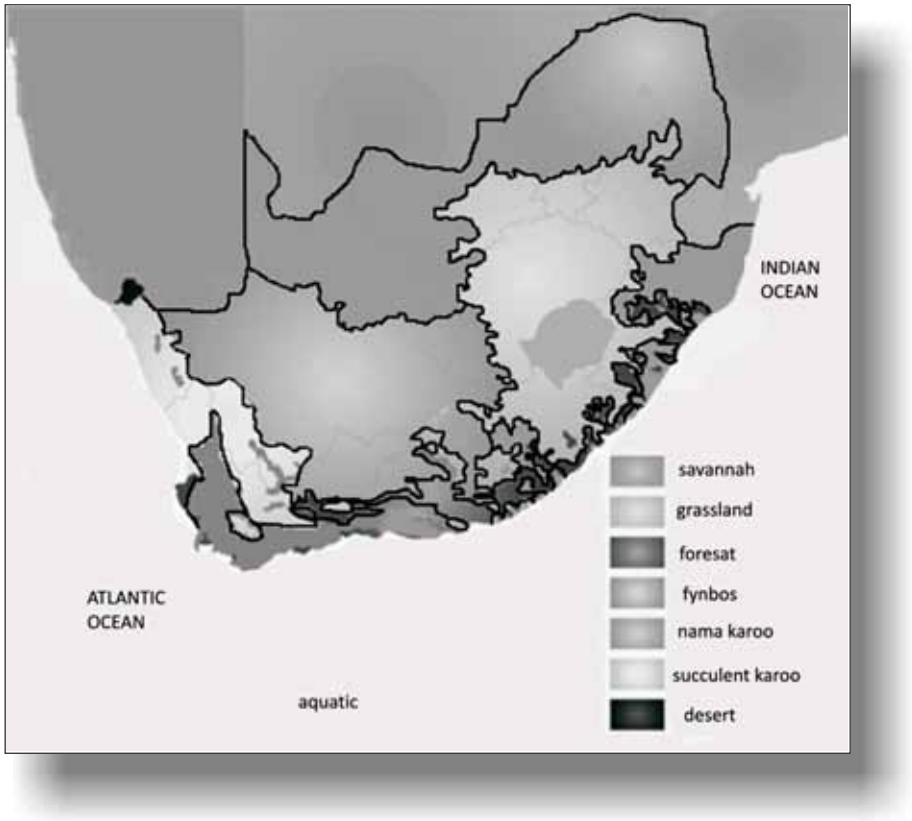
South African biomes

In South Africa, there is a wide range of biomes. However, some biomes, such as the tundra and the taiga do not occur here. In this section, you will study biomes that are found in South Africa.

fauna:
animal life
flora:
plant life

What biomes are found in South Africa?

Use the map to locate each of the biomes described below. Which biome do you live in?



Grassland

Climate
summer rainfall
warm or hot summers
cold, dry winters with frost
most rivers perennial

Soil
usually fertile, mostly loam with good drainage

Flora
Mainly grasslands with a few trees that grow along rivers and in the hills. Most grass is coarse and grows in patches with interspersed areas of bare ground; not many trees in the grassland because of little rainfall.

Fauna
Animals include blesbok, reedbuck, grey rhebok, eland and black wildebeest. Some birds include Ibis, francolin, blue crane and guinea fowl.

Savannah

This biome covers half the surface of Africa, large areas of Australia, South America, and India.

Climate
mild winters
very hot summers with rain

Soil
sandy, often clay-like or loam.

Flora
The savannah is also known as the bushveld because it is grassland mixed with trees. The Acacia tree is an interesting plant in the savannah. It has an umbrella shape, with branches and leaves high off the ground that giraffes like to eat. Baobab trees also live in the savannah. They cope with dry conditions by storing water under the bark of the tree.

Fauna
Africa's best known wild animals are found here: the hippopotamus, giraffe, warthog, zebra, rhinoceros, elephant, buffalo, and predators such as the lion, leopard and cheetah. There are many kinds of birds such as starlings, wagtails, hornbills and widowfinches. Insects are prolific.

Fynbos

Fynbos is a biome that is only found in the winter rainfall area of South Africa. Fynbos is our local name for the temperate scrubland biome. It is known by other names in other countries, for example, Australia has the mallee, Chile the matorral, and America calls it chaparral.

Climate
cool, wet winters
hot, dry summers

Soils
sandy and rocky, well drained

Flora
This biome gets its name from a group of evergreen plants that have very small, hard leaves, which hold moisture. The plants are also very well adapted to fires. They have root systems designed to get as much water as possible. The fynbos is composed mainly of scrub and shrubs, such as heathers and protea plants and restios, which are a kind of reed that grow in place of grass.

Fauna
Animals include the Cape sugarbird, protea-seed eater, grysbok, bontebok, Cape gerbil, geometric tortoise and Victoria's warbler. Baboons, leopards, lynxes, porcupines and eagles are found in the mountains of this biome. Prolific insect life.

Succulent Karoo

Climate
some rain in winter
very hot, dry summers

Soil
mostly sandy and well drained.

Flora
Many plants in this biome have thick fleshy leaves and are called succulents. Some of the trees have white stems to reflect the heat. In the northern areas, there is very little plant growth in summer. However, after the winter rains, the ground may be covered with a carpet of colourful flowers such as Namaqualand Daisies for a few weeks in Spring.

Fauna
The dassie rat, Namaqua dune mole rat and the Cape horseshoe bat and birds such as starlings and the Cape francolin occur here. Many insects.

Nama-Karoo

Nama-Karoo is what we call warm semi-desert scrub in South Africa.

Climate
mostly semi-desert as rain is very rare
very hot summers
cold winters with frost
rivers flow only after it has rained.

Soil
sandy, freely drained.

Flora
Scattered small, woody shrubs and grasses. Trees only grow along river banks.

Fauna
Animals that are adapted to the hot dry environment include the bat-eared fox, red hartebeest, pygmy rock mouse, springbok, ostrich and riverine rabbit. There are birds such as the red lark, Karoo lark and dusky sunbird.

Aquatic biome

Aquatic biomes are very different from terrestrial biomes because water is very different from air. Water temperature does not change quickly so aquatic organisms do not need to protect themselves from changes in temperature. Factors that affect aquatic organisms are that it is difficult to move through water and warm water usually has less oxygen than cold water. South Africa has several **freshwater** and **marine** biomes in South Africa.

Freshwater biome

Streams and rivers
The water always moves in one direction and may move very powerfully in some places. Water in cold mountain regions has more oxygen while water near the sea has less oxygen.

Plants that live in fast moving water must be very flexible so they do not break. Animals that swim in the water are streamlined to reduce the drag of the water. Animals that crawl on the bottom live under rocks so that they are not washed away by the water currents.

Lakes and dams
Water movement is quite gentle. Water is usually warmer with less oxygen than water in a flowing stream.

The plants are larger but need special ways to get enough oxygen. The water lily, for example, has large leaves that float and collect air that can go to the roots in the mud. Animals that swim in the water may be less active since there is less oxygen. Organisms living in temporary lakes become dormant so that they can live without water during the dry periods.

Wetlands
Wet areas such as vleis are very important because they act as sponges that prevent flooding and natural filters that improve the quality of the water. There is very little oxygen in the wet soil because water fills the air spaces between the soil particles.

Plants such as reeds that live in wetlands have their roots in soft mud that has little oxygen. Prop roots support reeds and the plants have special air passages that take air to the roots. Animals such as frogs, dragonflies and mosquitoes that have an aquatic period in their life cycle live in wetlands.

Marine biome

Pelagic biome
The pelagic biome is the open sea where most living organisms swim freely. In the west where the ocean is cold, the South African seas show a distinct annual pattern. In spring and early summer, increasing sunlight causes the producers to multiply.

They stop multiplying when they have used up the nutrients. In the autumn the nutrient levels increase as nutrient-rich water from the deep ocean rises and mixes with the surface water. This effect is less noticeable in the ocean in the east because the water is warmer.

The producers are phytoplankton, which are microscopic protists that give the sea its green colour. These simple cells are responsible for about 90% of all the photosynthesis that takes place in the world. They start the pelagic food chains.

The consumers are mostly fish with streamlined bodies. Most fish are found near the surface because the phytoplankton needs light for photosynthesis. Other types of organisms such as snails and squid are also common. Organisms that live in deeper parts are predators or depend on food that sinks from the surface.

Benthic biome
The benthic biome is the ocean floor. In shallow seawater, it may be light enough for photosynthesis. In deep water, there is no light and very high pressure because of the mass of water above. The water may be nutrient rich because of dead material that sinks from the surface layers. The amount of oxygen is low. Many of the fish lie on the bottom. They are usually flattened in shape and well camouflaged so that they are hidden from pelagic predators. Other kinds of animals include crabs, lobsters, snails and octopuses.

Rocky shore biome
The rocky shore is the region between the highest and lowest tides. It has very special conditions because of the continuous movement of water caused by waves and tides. The conditions are very difficult in this biome. Twice a day the tide rises to cover the area with crashing waves and twice a day it dries out completely when the tide goes out. The temperature changes greatly with the tides. There are two distinct zones: the area near the top of the shore is mostly dry while the area near the bottom is mostly under water.

Some animals such as mussels and limpets fix themselves permanently to rocks while others such as crabs and snails find shelter in small holes or under rocks. A thick shell or body covering usually protects animals' soft bodies. The producers are mostly large types of algae with slippery mucus to prevent drying out and a strong 'root' region called the holdfast.

Sandy shore biome
The sandy shore may look empty but there are many organisms hiding under the sand. The sandy shore is unstable because the sand may be washed or blown away or new sand may be added. The organisms are constantly affected by the wave action.

There are few producers in the sand because the surface is too unstable and there is no light below the surface. Animals such as snails and small crabs that live here burrow into the sand. They are mostly scavengers that live on plant or animal remains that are carried along the beach by the wind or sea.

ACTIVITY 2

1. Indicate which of these statements are true or false. If a statement is false, say why.

    a. Rivers have more oxygen than lakes or dams.

    b. Cold water has less oxygen than warm water.

    c. Wetlands cause flooding.

    d. Sandy shores are areas between the highest and lowest tides.

    e. Most organisms swim freely in the pelagic biome.

    f. Phytoplankton in the pelagic biome are the most abundant producers in the world.

    g. Sandy shores are empty with no life.

    h. There are two distinct zones, mostly dry and mostly wet in rocky shores.

    i. The benthic biome is the open sea.

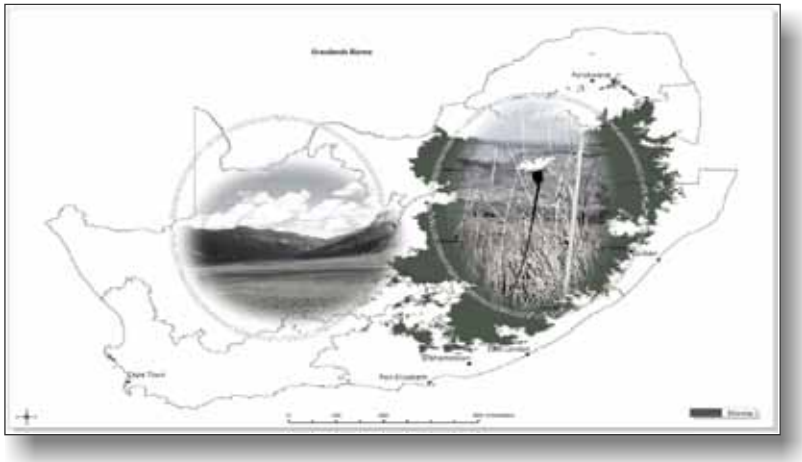
    j. The pelagic biome on the west coast of South Africa is colder than that on the east coast.

ANSWERS ON PAGE 122

ACTIVITY 3

1. Read the following passage about one of the biomes found in South Africa and answer the questions that follow:

The grassland biome is situated inland. The region is fairly dry, receiving between 400 and 800 mm of rain annually in the summer months. The summers are hot and the winters are very cold. The biome is characterised by flatlands covered with grasses. Many small herbaceous flowering plants grow among the grasses. There are very few trees except along river banks and in some rocky outcrops. The fibrous root systems of the grasses hold the soil in place. When the grasses die, their leaves and roots add organic matter to the soil. The grassland biome provides grazing for large herbivores such as antelope, zebras and wildebeest. The herbivores in turn provide food for predators including leopards and lions. The grassland also provides habitats for many small mammals such as mice, hares and mongooses, reptiles such as lizards and snakes and many birds. In some places within this biome, many hectares have been cleared for farming of cereal crops such as maize. Grasslands have also been used for extensive grazing of domesticated animals including cattle, goats and sheep. Some areas are used as game farms and wildlife reserves used for hunting or ecotourism. There are also large areas within the biome that have been urbanised.



a. Describe the climate in the grassland biome in terms of annual rainfall and seasonal variation of temperatures.

b. Describe the vegetation in the grassland biome.

c. Why are there hardly any trees in the grassland biome?

d. List two ways that grasses improve the soil in the grassland biome.

e. Draw a food chain for the grassland biome that includes a large herbivore that is found in the grassland biome.

f. Give an example of a human activity that negatively influences the grassland biome. Give a reason for your answer.

g. What is ecotourism?

h. Give two reasons why the grassland biome should be conserved.

ANSWERS ON PAGE 122

COMMENT

South Africa has a wide range of biomes which supports extensive biodiversity.

CHECKLIST

Are you able to:

- ❒ define what is meant by a biome
- ❒ describe some of the major global biomes not found in South Africa
- ❒ describe the physical characteristics of some of the major biomes found in South Africa
- ❒ describe the fauna and flora characteristic of the major biomes in South Africa

NOTES

LESSON 5

Importance of biodiversity

About this lesson

Throughout this Unit you have learnt about the variety and importance of biodiversity. You have seen that all forms of living organisms are interlinked in the role they play in the ecosystems they live in. In this lesson you will further focus on the importance of biodiversity.

In this lesson you will:

- explain why biodiversity is important in its own right
- discuss how ecosystems can be of use to humans

Why is biodiversity important?

The benefits that we gain from biodiversity go far beyond the mere provision of raw materials.

Our food and energy security strongly depend on biodiversity and so does our vulnerability to natural hazards such as fires and flooding. Biodiversity loss has negative effects on our health, material wealth and it limits our freedom of choice. As all cultures gain inspiration from or attach spiritual and religious values to ecosystems or their components, for example, landscapes, trees, hills, rivers or particular species, biodiversity loss also influences our social relations.

Why is biodiversity important in its own right?

Imagine a situation where the producers in an ecosystem are negatively affected and begin to die. What would happen to the herbivores in this ecosystem? What would happen to the other consumers that rely on these herbivores for their food? What would happen to oxygen levels in an aquatic ecosystem if the producers were not undergoing photosynthesis at the same rate?

All biodiversity in an ecosystem is linked. The removal of one species will affect the other species in the ecosystem. There are some organisms that have only one, very specific food source. If this food source is taken away, the dependent organism could go extinct in that ecosystem.

The links in the ecosystem go beyond obtaining food. Flowering plants rely on animals for pollination. If animals did not bring about pollination, flowering plants would not be able to reproduce. Animals also disperse seeds of various plants to ensure the survival of the plant.

Why is biodiversity important to humans?

Apart from the fact that biodiversity is important in its own right, ecosystems can be seen to provide useful services to humans. Humans use plant and animal matter to help them survive.

The most obvious thing that humans obtain from other living organisms is the oxygen that producers release as a by-product of photosynthesis.

Humans obtain foods from living things. There are very few food substances that humans consume that do not have their origins in plant or animal matter.

Fabrics such as cotton and linen are derived from plants. Wool and leather are derived from animals. Humans have used plant material to make shelters. Did you know that polishes, cosmetics, adhesives and even toothpaste are derived from a wide range of living organisms?

Did you know that many **pharmaceuticals** are derived from plants? Aspirin, a widely used pain killer, and penicillin-based antibiotics are only two examples from a long list of products that have their sources in biodiversity.

pharmaceuticals: *drugs that are used to help cure or prevent diseases*
pathogens: *disease-causing organisms*

Many forms of biodiversity, ranging from insects to worms to fungi to micro-organisms such as bacteria and protistans, cause disease in humans. Parasites, pests and other **pathogens** are instrumental in causing death in human populations.

We are also able to appreciate the beauty of biodiversity and obtain pleasure from being close to natural biodiversity, from the scent of flowers, or the comfort that pets can give.

The natural environment and human influences

In Lesson 4, you read descriptions of **biomes** that did not include human influences or interactions with the environment. You read about natural environments that function successfully as a result of natural processes and interactions between biotic and abiotic components of the environment. In these natural environments, change does occur over long periods of time.

If one of the factors in the environment changes, it affects all the other factors in the environment. For example, if rainfall decreases, the soil dries out and plants may no longer be able to grow in the drier soils. The animals that relied on those plants as specific foods will also die out or move away. The community of plants and animals will change as those that are suited to the new conditions survive or move into the area and those that are not well adapted to the new conditions die or move to another area.

As you will come to realise in learning about Life Sciences, humans are biotic components of environments that have changed the natural environment in the shortest period of time, geologically speaking.

Humans are part of the environment. We rely on the environment for many things such as food, fuel, building materials, fibres for clothing and medicines. We practise many activities such as farming, fishing, building, mining and industry which all have significant effects on the environment.

These effects can change the community of plants and animals that live in the environment. This may make it difficult for us to survive in the environment too.

Humans are the only species to have directly caused the extinction of thousands of other species. We are also the only species to affect the environment negatively to such a critical point that the natural balance in the biosphere has been changed. Global warming and pollution have altered the balance of gases and temperature to such a point that climate changes have resulted and habitats have been destroyed.

How humans affect the atmosphere

- Air pollution is the addition of harmful substances into the atmosphere. Burning fossil fuels such as coal, oil, gas, paraffin, petrol and diesel releases carbon dioxide, sulphur dioxides and nitrogen oxides into the air. These gases are poisonous. They dissolve in water droplets in the air to form acid rain, which is harmful to organisms.

- Global warming. The carbon dioxide released by fossil fuel burning is a greenhouse gas. It increases the natural greenhouse effect causing the atmosphere to get warmer. This is called global warming or climate change.

The following words are said to have been spoken by Chief Seattle, a Native American Chief, many years ago. Do you agree with what Chief Seattle had to say?

"Teach your children what we have taught our children; that the earth is our Mother. Whatever befalls the earth befalls the sons of the earth. If men spit upon the ground, they spit upon themselves. This we know – the earth does not belong to man; man belongs to the earth. All things are connected like the blood which unites one family. Whatever befalls the earth befalls the sons of the earth. Man did not weave the web of life; he is merely a strand in it. Whatever he does to the web, he does to himself."

How humans affect the hydrosphere

- Water pollution is the addition of harmful substances to a body of water. Sewage and chemicals from farming, mining and industry flow into rivers or get into groundwater sources. Oil spills at sea are especially damaging. Water pollution can kill the organisms in aquatic biomes.

- Humans need large dependable water supplies. When dams are built, river ecosystems change into lake ecosystems and upstream valleys are flooded, changing them from terrestrial to aquatic ecosystems. Draining wetlands to make fields for planting crops destroys the natural habitat of the wetland plants and animals and replaces it with fields of one type of plant.

How humans affect the lithosphere

- Soil pollution is the addition of harmful substances to the soil. The soil is polluted when we litter, dump solid wastes in landfill dump sites and allow chemicals from domestic waste, farms, mines and industries into the soil. Land pollution kills organisms in the area.

How humans affect living organisms

- Biodiversity is the variety of living organisms on Earth. Biodiversity depends on the many different habitats on Earth. Humans cause loss of biodiversity by destroying habitats. Land is cleared for farming, building and mining and is also cleared when trees are felled for timber or fuel.

- The over-harvesting of natural plants and animals from the wild for food or medicines causes loss of biodiversity.

- The introduction of alien species of plants and animals which replace the indigenous plants and animals causes loss of biodiversity.

Farming activities and building of urban environments change the community from a community of many different types of plants and animals adapted to the natural habitat to a community of only a few plant and animals species. Often these few species are alien species that can survive in the habitat humans have made.

ACTIVITY 1

In Lesson 4, you selected and described, in great depth, how a particular ecosystem functioned.

Assess the impact of humans in the ecosystem you have been studying. Have we positively or negatively impacted on the ecosystem? Have you, while you have been investigating, made any impact on the ecosystem? If some of the impacts have been negative, can they be reversed? Can further positive changes be made to the ecosystem to benefit all the organisms in the ecosystem and to improve the quality of the abiotic components of the ecosystem?

In a series of flow charts, plot out all the possible changes we could make to that ecosystem. Show the consequences of these changes in the flow chart.

Do not be limited by the focus questions posed in this task. Think of other ways you can observe and describe, scientifically, the impact humans have in your ecosystem.

Combine all your findings and investigations into a scientific report describing the impact of humans in your ecosystem.

ANSWERS ON PAGE 123

COMMENT

We should never forget that humans are biotic components in ecosystems. Therefore, humans are natural factors in ecosystems. However, because of the needs of humans, many ecosystems are irreversibly changed. In the next Unit, we will focus on the negative changes humans make causing great threat to biodiversity.

CHECKLIST

Are you able to:

- ❒ explain why biodiversity is important in its own right
- ❒ discuss how ecosystems can be of use to humans.

LESSON 6

Humans and the destruction of biodiversity

About this lesson

The greatest threat to biodiversity is human action. Humans adapt the environment to suit their own needs and in so doing, they impact on, or influence biodiversity. Unfortunately, much of this impact is negative. Humans tend to take away natural resources from other living organisms in an ecosystem, or poison the natural resources with human waste.
You will focus on some ways in which we negatively impact on the environment and on biodiversity.

In this lesson you will:

- explain how habitat destruction, pollution and the introduction of invasive alien species destroy biodiversity
- discuss the phenomenon of extinction of biodiversity.

What are some of the ways humans destroy biodiversity?

Destruction of habitat

The destruction of a habitat occurs when ecosystems are destroyed by careless use or resources are exploited. This happens when humans take things from the area with little thought to how this will affect the habitat.

Pollution

Humans generate waste products that affect air, water and soil and even bring about global climate changes.

Introduction of invasive species into new habitats

Trading, poaching and hunting of **endangered species**, greed, superstition and ignorance further place in danger threatened biodiversity, even causing **extinction**. Not only are important species endangered through hunting and trading, but very often, human cruelty is a key feature. Animals in particular are made to suffer because of human greed.

You will now focus on each of these concepts in further detail:

What is habitat destruction?

sustainability: *long-term responsible resource management; making sure that resources are used wisely so that future generations can also benefit from them*
degradation: *the quality of something becomes of less and less value over time*

Humans routinely destroy the habitat of other living organisms and do not do things to regenerate or restore the habitat. Humans use the resources from the land with little thought to **sustainability** for generations to come.

Habitats can be destroyed by land **degradation**. Land degradation affects the quality of the land negatively so that the land is unable to function effectively within an ecosystem.

These are some of the ways in which land degradation occurs in South Africa:

Deforestation

Deforestation is the removal of indigenous forests or woodlands to make space for farmlands, roads or buildings. Farmers and developers clear land for crops or commercial, industrial and urban development; forests are cleared as the wood is used for domestic, industrial and commercial purposes.

Overgrazing

If too many animals are kept on a pasture, they eat the grass down to the roots. Their hooves trample the soil surface into a hard layer. When it rains, rainwater cannot soak into the soil, so it runs off the surface carrying the soil with it.

Monoculture

Monoculture is the planting of the same crop every year on the same piece of land. Unless compost or fertiliser is added, the soil loses its fertility because the same nutrients are continually being removed from it. Areas with infertile soil are abandoned and the topsoil is quickly blown or washed away.

Removal of vegetation

Exposed soil can be easily washed away by fast flowing water, this happens especially along river banks.

Desertification

Land degradation occurs in arid and dry areas of the world. Grasslands or other ecosystems are turned into deserts as overgrazing and other practices remove what little vegetation there is.

Severe land degradation and habitat destruction decreases the wealth and economic development of a country. The link between a degraded environment and poverty is direct. Land degradation in rural areas leads to further urbanisation as people migrate from the lands to cities, as the rural land can no longer provide them with food. This causes overcrowding in urban areas.

As the land resource becomes less productive, less food is produced. There is competition for decreasing resources and potential human conflict can occur. Wars have been fought over resources or the lack thereof. Human territorial issues have been hotly contested in the past and are still issues that spark conflict today.

Noteworthy conflict zones in Africa include Darfur in Sudan, northern Kenya, and along the Nile River. Sudan's Darfur region is a striking example of a vicious cycle where environmental resources are being fought over and at the same time being destroyed as a result of violence - one that highlights that peace is not possible unless underlying and closely linked environmental and livelihood issues are resolved. Do you think that this could happen in South Africa?

Another possible conflict point is food security. This occurs with decreases in rainfall, extensive periods of drought and the degradation of arable land which will severely decrease crop yields in parts of the continent.

When serious habitat destruction has taken place, biodiversity also decreases and is often lost as lands can no longer support the natural wildlife and plants.

ACTIVITY 1

1. What term is used to describe the variety of species in a particular environment, habitat, ecosystem or region?

2. What term is used to describe land degradation occurring in the arid and dry areas?

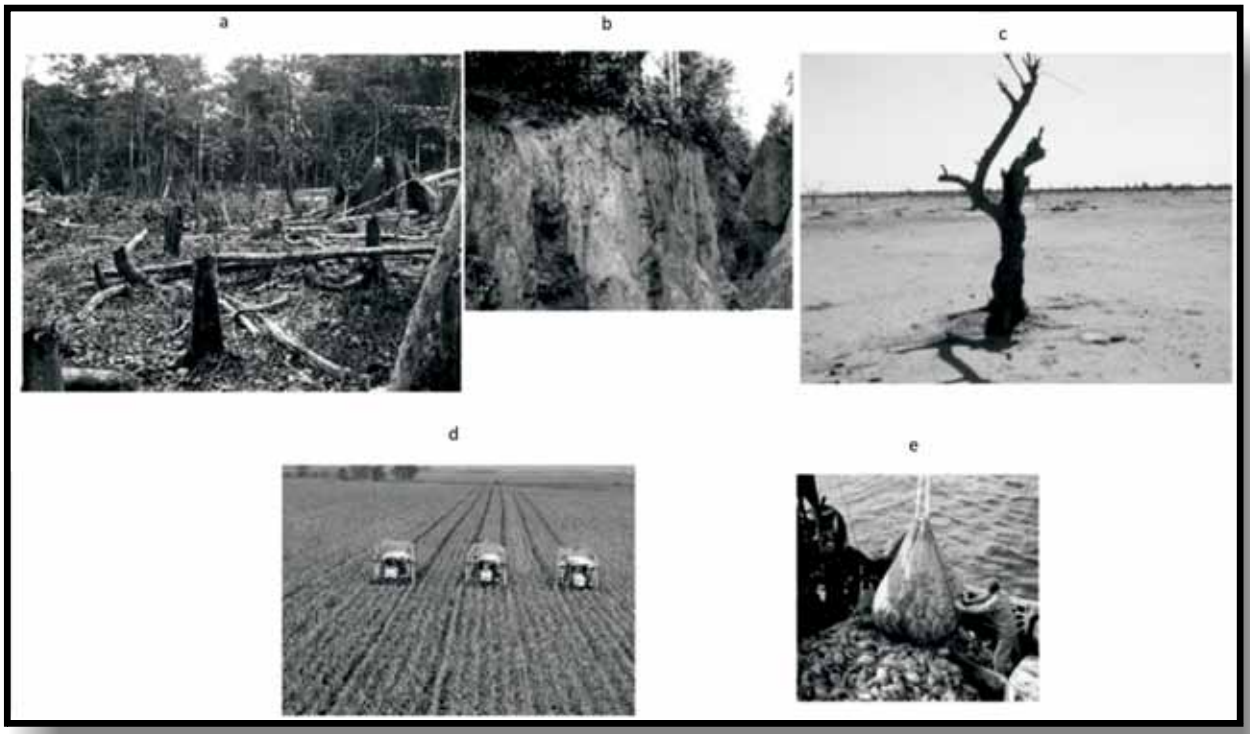
3. Which form/s of land degradation are cattle farmers mainly responsible for?

4. Explain what this statement from a news report means:

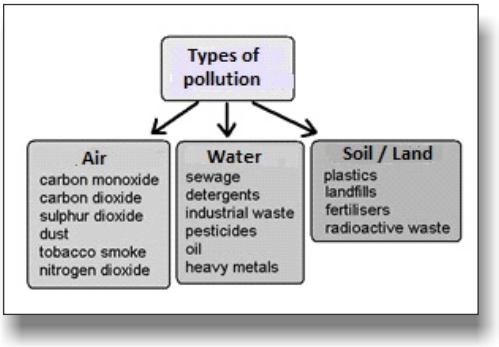
   Due to deforestation, by farmers practising monoculture, the biodiversity of the area was severely depleted.

5. Look at each picture. Describe the habitat destruction you see and state why it will result in loss of biodiversity.

ANSWERS ON PAGE 124



How does pollution destroy biodiversity?



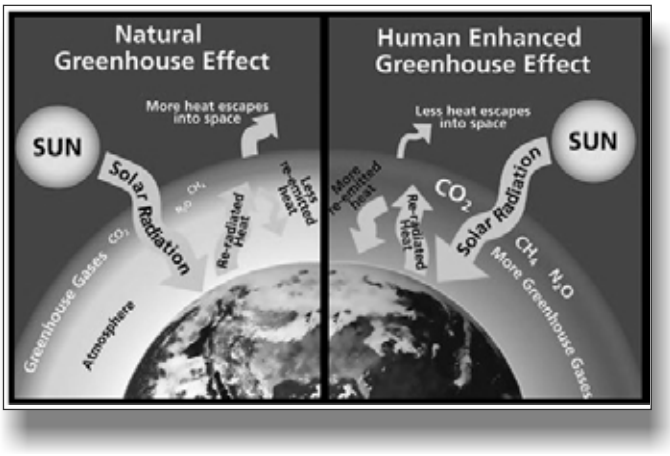
Pollutants are substances that bring about an undesirable change in the physical, chemical or biological characteristics of air, water or land. These changes are undesirable because they have harmful effects on the ecosystem. Often the biodiversity of the area is negatively affected as habitats and resources are poisoned and it becomes impossible to live in the polluted area.

Sometimes, an ecosystem can adjust to changes and adapt successfully. However, if the pollutants cause extreme damage, an ecosystem is unable to adapt to the changes and the ecosystem will become irreversibly damaged.

Some pollutants can be classified as degradable pollutants. This is because the pollutants are substances that can be broken down naturally or artificially to remove the danger to the ecosystem. Sewage is an example of a degradable pollutant. However, just because a pollutant is classified as degradable, doesn't mean that it is less harmful. Sewage pollution can cause death and disease, as explained in the section on water pollution.

Non-degradable pollutants are substances that cannot be broken down and cannot be removed from the ecosystem. Plastic is an example of a non-degradable pollutant.

Air Pollution



The air around us makes up the atmosphere. It consists of gases vital to the survival of living organisms. All living organisms require oxygen and produce carbon dioxide as a result of cellular respiration. Plants and other chlorophyll-possessing organisms such as green algae and autotrophic bacteria take in carbon dioxide and release oxygen into the atmosphere.

If vegetation has been removed due to deforestation, for example, carbon dioxide levels can increase. Human industry produces smog and excessive amounts of carbon dioxide into the atmosphere. Increased levels of what are known as 'greenhouse gases' cause an enhanced greenhouse effect, global warming and climate change.

The terms global warming and climate change are often used interchangeably, but the two phenomena are different. Global warming is the rise in the average global temperature due to an increase of heat-trapping greenhouse gases such as carbon dioxide in the atmosphere. Based on surface and atmospheric temperatures from thousands of locations, and from satellites worldwide, scientists have determined that the average global temperature has risen 0.8 degrees C, since 1880.

Climate change is a more general term that refers to changes in many climatic factors (such as temperature and precipitation) from the global to the local scale. These changes happen in response to global warming and other factors. The timing and amount of rainfall may change, potentially resulting in more frequent or heavier storms. This could lead to increased hillside erosion and flooding. On the other hand, less rain could fall in a particular area, causing the area to become more arid and dry. Any changes to the climate of an area will cause a corresponding change to the biodiversity of the area.

Water Pollution

Water makes up 70% of the earth's surface and is the most important natural resource on the planet. Water pollution is contamination by pollutants of the water masses such as lakes, rivers, dams and the oceans. The pollutants affect the quality of the water and have negative effects on ecosystems by destroying biodiversity.

Air pollutants such as sulphur dioxide and nitrogen dioxide combine with water droplets in the atmosphere to form acid rain. Acid rain falls into water resources and contributes to the problem of water pollution. When acid rain enters bodies of water, it lowers the pH of the water and negatively affects the aquatic ecosystems. Most organisms are adapted to living in a fairly narrow pH range. If the pH of a body of water is changed, organisms may die out and the food chains in the ecosystem will be negatively affected. Micro-organisms and insect larvae are particularly affected by the pH in water sources.

Urine, faeces and other household waste that is mixed with water is called sewage. Farms generate animal as well as human sewage. Sewage must be correctly treated and purified, before it is allowed to re-enter water systems. Pathogens in sewage cause illnesses and even epidemics in areas where raw sewage enters drinking and washing water.

Chemicals and heavy metals produced as waste products as a result of industrial processes end up in drinking water supplies and also seep into ground water sources.

Acid mine drainage is a very serious form of water pollution. It is the flow, or seepage, of polluted water from old mining areas. Depending on the area, the water may contain toxic heavy metals (such as uranium) and radioactive particles. These are dangerous for people's health, as well as plants and animals.

Acid mine drainage on the Witwatersrand has reached a crisis point. This is because some mining companies allow acid mine water to flow into streams, dams and sources of groundwater. On the West Rand, toxic water has already destroyed life in many dams and streams. Even some borehole water is polluted. In some areas the water has polluted the soil, so people cannot grow vegetables. On the East Rand, pumping of drainage water from the Grootvlei mine near Springs has stopped. It is expected that acid mine drainage will flow uncontrollably onto the surface of the ground within months. It is predicted that the Nigel district will be one of the first areas affected. It will also threaten the Blesbokspruit and the Marievale Bird Sanctuary which are already contaminated with toxic mine water.

The mining companies have been instructed to control acid mine drainage before the toxic water under central Johannesburg reaches an environmentally critical level.

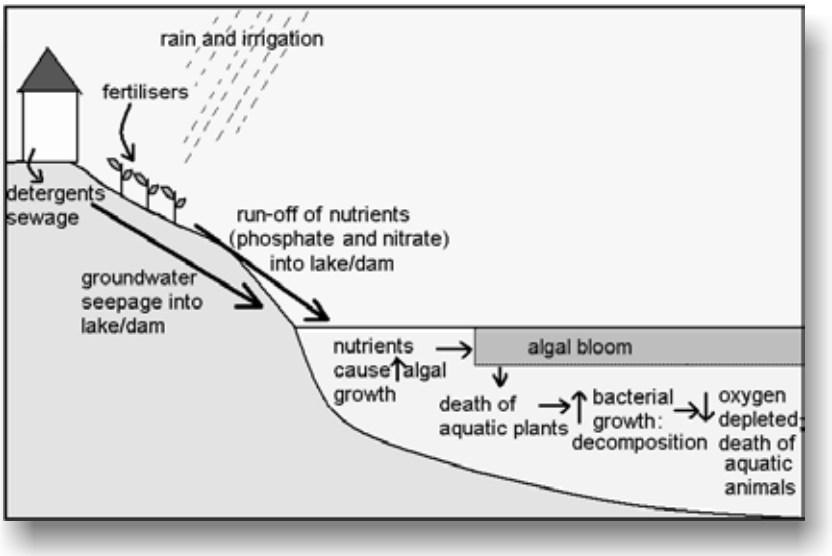
Water is also used as a cooling agent in many industrial processes. Heated water is pumped back into water masses killing aquatic organisms which are specifically adapted to a narrow temperature range. This causes significant ecosystem destruction. This is also known as heat pollution.

One of the greatest water pollution disasters is oil pollution at sea, caused by accidental and deliberate oil spills by tankers. Oil washes ashore causing destruction to tidal and coastal ecosystems.

Farmers spray crops with pesticides that run-off into water supplies. Pesticides can cause damage in the water source, or be carried to a different location and be washed onto land to cause damage. Soaps and other detergents have phosphates added to them to assist in the cleaning process.

Detergents and fertilisers contain phosphates. Phosphates are substances which promote the growth of plants and other organisms, including micro-organisms. These phosphates enter water masses and cause a phenomenon called **eutrophication**.

Cultural eutrophication occurs when human activities introduce excessive nutrients to water bodies. Look at the diagram and follow the steps and you will be able to trace the significant damage that cultural eutrophication can cause.



The nutrients that are artificially added to water sources are usually phosphates from detergents and fertilisers or nitrogenous matter from sewage. Although these substances are not always directly applied to the water, they are introduced as run-off from agricultural lands and areas of human settlement. The excessive nutrients that have been introduced to the water enrich the water and encourage a drastic increase in the growth of algae and other micro-organisms. This increase in algal growth is called an 'algal bloom'. The algae and other micro-organisms are microscopic and individual organisms cannot be seen with the naked eye. However, under circumstances of serious eutrophication, the numbers of these micro-organisms increase so dramatically, that they are clearly visible to the naked eye.

Algal bloom can be detected in water masses suffering from eutrophication. The excessive algal growth blocks sunlight entering the water and water plants that require sunlight for photosynthesis begin to die. The dead organic matter must be broken down. This decaying process results in a massive increase in the numbers of bacteria living in the water. Bacterial decomposition drastically reduces the oxygen levels in the water and as a direct result, fish and other aquatic organisms die.

Hartebeestport Dam is one of the most well known examples of a large eutrophied body of water, however, smaller bodies of water all over South Africa are threatened by this process.

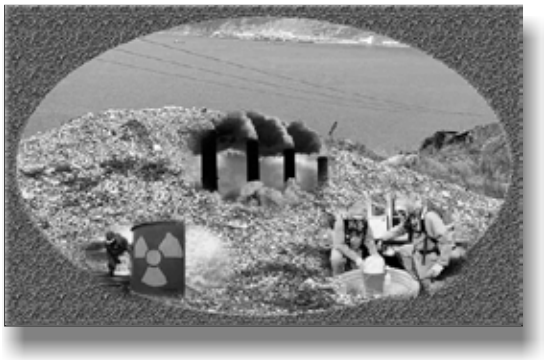
Soil Pollution

Soil is one of the major abiotic factors in an ecosystem. When we talk about land or soil pollution, we mean not only surface littering with various forms of waste, but also, contamination of the soil so that the plants and the animals that rely on the soil are negatively affected.

Items such as plastic bags, plastic bottles and other plastic articles, nylon substances and cans are all examples of waste which is considered 'litter' and which is not bio-degradable.

These wastes can remain in an ecosystem for many, many years without breaking down or decomposing. Apart from litter being unattractive in an ecosystem, it has a negative impact on animals, in particular, living in the ecosystem.

Animals try to eat what might have been left inside the plastic and as a result they eat the plastic which blocks their digestive system and causes them to starve. They can also get trapped in plastic products and die. Plastic bags and nets can wrap themselves around birds' beaks and animals' snouts and cause them to suffocate. Drains and waterways get blocked by litter, causing further environmental and health problems.



A very significant and important soil pollutant is radioactive waste.

Radioactive waste is extremely dangerous to all forms of life and to all ecosystems because some radioactive pollutants remain active and dangerous for hundreds of years. Radioactive waste can be seen as the ultimate non-biodegradable waste!

ACTIVITY 2

1. Modern farming techniques often include the use of fertilisers to increase crop production.

    a. Which substance is normally included in fertilisers, which is needed by plants for the formation of all amino acids?

    b. Describe one danger of the excessive use of fertilisers to the environment.

2. Study the table showing the amount of medical waste produced by three provinces over a number of years.

   Medical waste is produced by healthcare facilities, such as hospitals, clinics, doctors' offices, veterinary hospitals and laboratories. It includes radioactive waste, contaminated syringes and sharp instruments, and other matter.

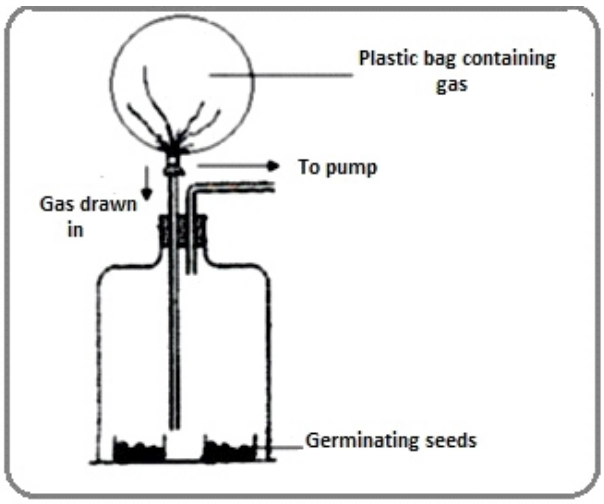
Provinces	Amount of Medical Waste (Tonnes)				
	1995	1997	1999	2001	2003
Province A	357	398	410	426	450
Province B	283	290	300	312	330
Province C	230	240	245	270	290

   a. Which province has shown the most rapid increase in the amount of medical waste produced?

   b. What was the percentage increase of medical waste produced by the province named in 2a over the period 1995 to 2003? Show all workings.

   c. Give two negative effects of dumping medical waste.

3. A student designed a hypothetical investigation to test the effects of car exhaust fumes on germinating seeds. She made this diagram and suggested that the investigation should be performed the investigation three times under each of the following air compositions:



   A Exposed to normal atmospheric air
   B Exposed to exhaust fumes

The student then suggested that the following results might be obtained under each of these conditions over a seven-day period:

	% Germination	
	A: Normal atmospheric air	B: Exhaust fumes
1	80	27
2	74	31
3	91	45
Average	81	34

a. Formulate a possible hypothesis for the student's investigation.

b. Describe one way in which the student ensured reliable results in her proposed investigation.

c. Explain why the percentage of germinating seeds differs under the two air compositions.

d. Explain one practical use of the results of this investigation.

ANSWERS ON PAGE 124

How do invasive species destroy biodiversity?

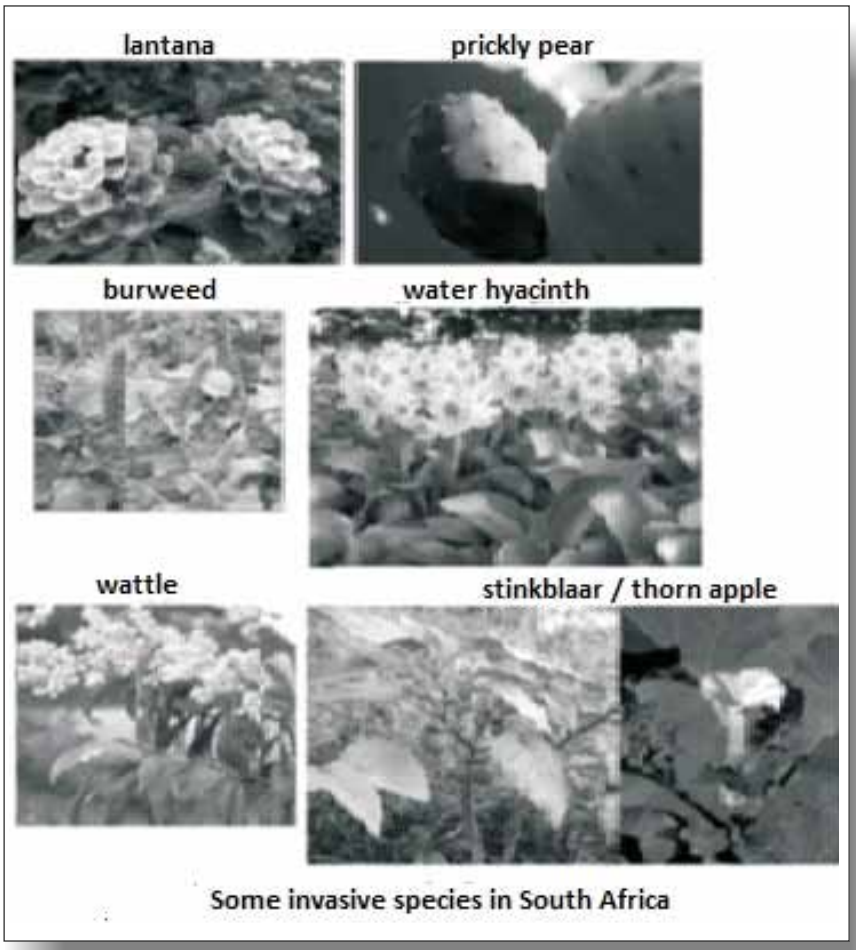
Invasive species are organisms that have been introduced to an ecosystem in which they do not naturally occur. This threatens the existing indigenous, or naturally occurring, species. We may think that certain plants look pretty, such as the jacarandas or wattle trees, but very quickly these plants take over from the indigenous species and displace them.

The alien or introduced species have few or no predators or animals that feed on them or parasitise them, so they grow strongly, while the indigenous species are often out-competed. This means that the alien species is able to survive better than the indigenous species. The indigenous species cannot compete with the alien species for resources. Some **invasive species**, such as eucalyptus gum trees absorb far more water from the soil than the indigenous trees, thus making it difficult for the indigenous trees to survive.

Invasive species are also sometimes called 'alien' species or 'exotic' organisms.

Invasive organisms are considered a major threat to biodiversity, human livelihoods and economic development.

They cost South Africans tens of billions of rand annually in lost agricultural productivity and resources spent on trying to remove them from the ecosystem.



Some invasive species in South Africa

Extinction

Extinction is the end of existence of a species. The moment of extinction is generally considered to be the death of the last individual of that species. Species which are not extinct are termed extant. **Endangered** means a species is seriously threatened, and unless efforts are applied, there is a very high danger of extinction in the near future.

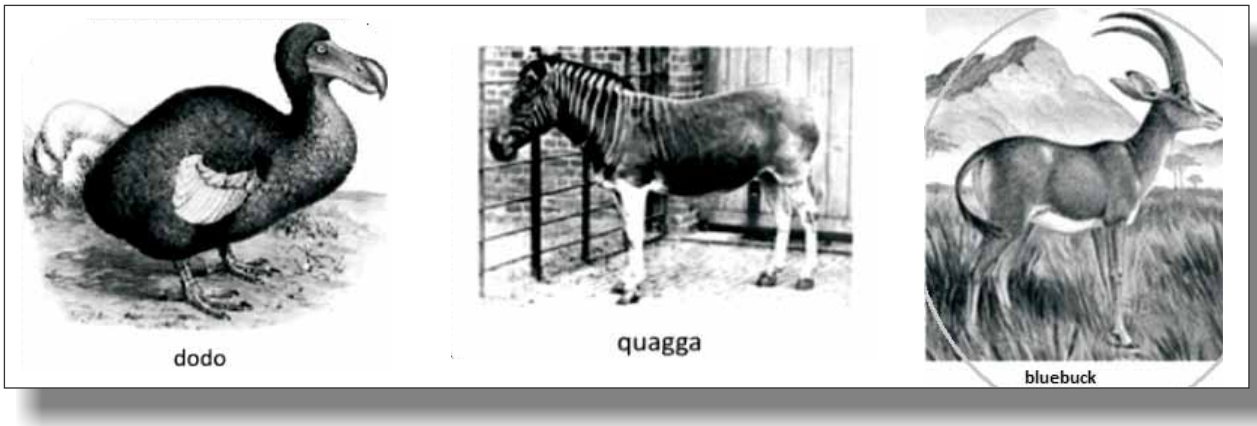
Historically, humans have not been concerned with the effects of hunting animals or removing a certain plant species to make way for crops or grazing land. Famous historical examples of animals that have been hunted to extinction in recent times are the dodo, a large pigeon-like bird found on the island of Mauritius, and the quagga, a sub-species of zebra found in the Cape.

It is only really in the 20th century that people started to recognise the dangers of extinction of plants and animals. The International Union for the Conservation of Nature and Natural Resources (or the IUCN) is the world's main authority on conservation. The IUCN Red List of Threatened Species, created in 1963, and also known as the IUCN Red List or Red Data List, is the world's most complete record of the global conservation status of plant and animal species, in other words, how endangered a certain plant or animal really is.

The Red Data List uses precise criteria to evaluate the extinction of thousands of species. The aim is to communicate the urgency of conservation issues to the public and policy makers, as well as help the international community to try to reduce species extinction.

The **Quagga** was a southern subspecies of the plains zebra. It differed from other zebras in being striped on the head, neck and front portion of its body only, and being brownish, rather than white in its upper parts. The name Quagga came from the indigenous people living in the area where the Quagga lived, and is an imitation of the animal's call. The Quagga became extinct because it was ruthlessly hunted down for meat and leather by farmers. Quagga were seen as competitors for grazing by the livestock farmers of sheep and goats. The last captive Quagga, a mare, died on 12 August 1883 in the Amsterdam Zoo, where she had lived since 9 May 1867. It was not realised that this Quagga mare was the very last of her kind. What a tragic thing to witness the death of the last individual of a particular species.

The **bluebuck** became extinct in 1799 in South Africa, also due to excessive hunting. It was a relative of the sable and roan antelope and was found in the south western coastal regions of South Africa. Unlike many other antelope species, it was heavily reliant on water. As human agricultural activity extended in this area, its habitat declined. Although it apparently wasn't very good to eat, the farmers killed it, nevertheless.



ACTIVITY 3

Read the passage below before writing the essay.

Exploitation of indigenous plants

There are many research projects in South Africa which use indigenous plants to reduce poverty. These projects create new ways of generating income.

As long as these projects continue without a plan that promotes sustainable use of resources, there is a high risk that indigenous plants may be overexploited for medicinal and nutritional purposes. The over-harvesting of the African potato is an example of a threat to indigenous plants.

Write a mini-essay in which you describe at least four ways in which overexploitation of indigenous plants impacts on the environment and explain four appropriate management strategies that can reduce such over-exploitation.

ANSWERS ON PAGE 125

COMMENT

Humans are the greatest threat to biodiversity. It is only recently that steps are being taken to ensure the sustainability of ecosystems and biodiversity for future generations.

CHECKLIST

Are you able to:

- ❒ explain how habitat destruction, pollution and the introduction of invasive alien species destroy biodiversity
- ❒ discuss the phenomenon of extinction of biodiversity

LESSON 7

Sustainable Living

About this lesson

In Lesson 6, you learnt that the greatest threat to biodiversity is human action. Humans tend to take away natural resources from other living organisms in an ecosystem, or poison the natural resources with human waste. The human population is increasing significantly. Unless humans can manage their negative impact on the environment and biodiversity, not only will biodiversity be threatened, but the survival of the human species also will be seriously threatened.

You will focus on some ways in which humans are trying to move towards sustainable living.

In this lesson you will:

- explain what is meant by sustainable living
- describe some steps being taken to ensure sustainability of ecosystems
- discuss how to undertake an Environmental Impact Assessment
- investigate conservation measures in South Africa

What can be done to stop land degradation and habitat destruction?

stakeholder:
a person or group of people who have an interest in something and will benefit from the correct management of something.

In Lesson 6, you learnt about the serious effects of land degradation and habitat destruction. Stopping land degradation is a task that involves many different **stakeholders**. It is not simply the job of scientists and ecologists to stop this process. Many levels of control need to get involved: government, scientists, farmers and ordinary people living on the land.

Education is a powerful tool in preventing land degradation. Once people understand the risks and consequences of land degradation, they are more likely to put in place strategies and plans to prevent this.

A number of solutions have been tried in order to reduce the rate of desertification and regain lost land; however, most measures treat symptoms of sand movement and do not address the root causes of land modification such as overgrazing and unsustainable farming.

- Stacking stones around the base of trees will collect morning dew and help retain soil moisture.
- Artificial grooves dug in the ground retain rainfall and trap wind-blown seeds.
- Using trees and bushes to make windbreaks will help to reduce soil erosion.
- Where local people are using trees for firewood adding to the desertification process, use solar ovens as a means of relieving some of this pressure upon the environment. Teach local people to recognise indigenous trees and alien trees. If they use alien trees for firewood, they are benefitting the environment by removing the alien species.
- Research new ways to use surface-water resources such as rain water harvesting or irrigating with seasonal runoff from neighbouring highlands. Investigate new ways to find groundwater resources and more effective ways of irrigating arid lands.
- Research on the reclamation of deserts focuses on discovering proper crop rotation procedures to protect the fragile soil. Plant sand-fixing plants which grow by spreading out long runners and holding sand down.
- Research ways of developing grazing lands and water resources without overusing these.

Have you noticed areas of land degradation where you live? Can this process be stopped in your local environment? Can you be instrumental in bringing about a change where you live?

What can be done to stop degradation of wetlands? What is an Environmental Impact Assessment?

People have previously not recognised the important role wetlands play in the ecology of an area. They have exploited and drained wetlands in order to “reclaim” this land. We now see that this is a foolish practise that has brought increasing land degradation. Let's look at an example of wetland degradation that has taken place in South Africa.

The iSimangaliso or Greater St Lucia Park, which is a World Heritage site, is also a wetland. At present, wetlands are among the world's most threatened ecosystems. Before studying the situation in the St Lucia wetland, let's take a closer look at wetlands themselves in order for you to appreciate the impact of degradation on this ecosystem.

A wetland is a terrestrial (or land) ecological area where water is the primary abiotic factor controlling plant and animal life. It occurs where the water table is near or at the surface of the land, so that shallow water covers the land. Unique types of soils and distinctive plants, amphibians and birdlife adapted to these waterlogged soils are characteristic of wetlands.

What is the value of wetlands?

- Wetlands support high concentrations of biodiversity.
- Wetlands can provide food, e.g. rice is grown in wetlands. Fish can be harvested from wetlands too.
- Wetlands slow down the rapid flow of water in a river and spread the volume out in a shallow basin. Water leaves a wetland flowing slowing. This reduces water erosion.
- Wetlands act as water purifiers. Pesticides and heavy metals become trapped in the wetland and the water that leaves the wetland is cleaner than the water entering it.
- Wetlands provide domestic use resources, such as reeds for thatching and basket and mat weaving.
- Wetlands have special religious and traditional significance in some local cultures.

Studies around South Africa show that up to 50% of the wetlands have already been destroyed or severely degraded.

Because of the enormous biodiversity associated with wetlands, the area provides a great opportunity for education and for ecotourism. With careful planning, these areas can be used to attract paying tourists who will be able to contribute to the economic and social development of the area.

The main causes of wetland destruction are:

- **Overgrazing** – local farmers allow their animals to overgraze the wetland leaving soils exposed to erosion.

- Similarly, **over-harvesting** of reeds for thatching or domestic use removes valuable habitats for biodiversity and can leave soils exposed if the reeds are pulled out by the roots.

- **Draining of wetlands** – farmers drain the wetland to provide soil to plant crops. Draining wetlands and using the land for commercial and housing development destroys the wetland, but is also now considered a risky and expensive option for building. As water re-accumulates in the natural catchment of the wetland, foundations of buildings can subside causing unstable constructions.

Possibly the most famous case of potential wetland destruction in South Africa occurred in what is now the World Heritage Site of St Lucia.

Fringing the 280 km coastline of this natural World Heritage Site are sand dunes exceeding 180m in height. These impressive dunes have been built by the wind over the past 25 000 to 30 000 years. Rising steeply from the waves of the Indian Ocean are the highest vegetated dunes in Africa.

The dunes are composed of windblown sand driven off the beach by north-easterly winds. Vegetation growing on the dunes forms a delicate ecosystem of plant life. These plants trap nutrients and stabilise the dunes. On the seaward side, the dunes have a stunted forest whereas on the land facing side a large forest can be found. Hardwood trees in the forest can exceed 20m. A variety of epiphytic plants, including orchids, ferns and lichen grow on these trees. A network of lianas and creepers complete this remarkable habitat. Within this unique habitat occurs a variety of birds, monkeys, reptiles, squirrels, antelope and insects.

Below this unique eco-system lies a huge mineral wealth. These dune minerals were eroded from the Drakensberg and transported hundreds of kilometres to the coast. When reaching the Indian Ocean they were washed north and blown on-shore by the prevailing on-shore winds. This phenomenon can still be witnessed today where black patches of sand pattern the beach. It is not oil, but mineral-rich sand.

Mining was proposed in the 1980's, resulting in a massive public outcry.

A mining company proposed to bulldoze and process the sand dunes along the shore of Lake St Lucia in order to mine titanium and other important metals. An urgent **environmental impact assessment study** showed that mining would damage the whole St Lucia wetland. The mining company also had a bad history of not restoring land it had mined in previous areas it had worked.

The impact analysis showed the enormous risk to the extensive biodiversity, including a number of endemic species found nowhere else, let alone the damage to 25 000 year old coastal dunes. The government used the study to prohibit mining in the area.

What is an environmental impact assessment study?

An **Environmental Impact Assessment** or **Analysis** (EIA) is a process that analyses the social, political and biophysical impact or effect that some event or development will have on the land.

According to the National Environmental Management Act of 1998, an Environmental Impact Assessment is required before any decisions are made concerning development of land. When properly conducted, an Environmental Impact Assessment is a powerful instrument which carries a great deal of influence among the decision-making authorities.

The aim of an Environmental Impact Assessment is not necessarily to shut down all development, but rather to reduce the negative impact on the environment and in particular where the environment may be fragile. An Environmental Impact Assessment will also consider marginalised and poor people in the community, and the impact the proposed development will have on them.

Sadly, sometimes, unprincipled and dishonest developers bribe local officials and the results of an Environmental Impact Assessment are hidden or only partially revealed, so that building may take place in a fragile environment.

Degradation can occur over huge areas of land, or over small patches of land. You should look around the area where you live very closely, in order to identify small patches of land which are degraded. If these small patches of land are not attended to, degradation can very quickly spread and soon large areas are suffering.

ACTIVITY 1

Benjamin was very concerned about the taxi rank just outside his village. He noticed that there were no places for people to throw their litter, so they were throwing papers, plastic bags, bottles and other litter on the ground. There were no toilets, so people were urinating in a stream that ran past the taxi rank and defecating in the bushes around the taxi rank. Taxi drivers would park their taxis off the road killing grass and other plants. If the taxi drivers stayed in the area overnight, they broke branches of trees to use for fires.

According to what Benjamin had learnt, this area was showing signs of serious degradation. He decided that he would do an Environmental Impact Assessment as a school project.

Benjamin followed three steps. You must answer the questions relating to each of the steps he followed:

1. **Assessment**
   The Environmental Impact Assessment begins with analysis and gathering of data.

   What is the current situation at Benjamin's taxi rank?

2. **Risk Analysis**
   Benjamin used the results of the assessment to list all the risks that might exist if the current situation continued. He projected what he thought the worst possible situation would be if the situation was not corrected.

   What kinds of things would you have listed as risks if you were Benjamin?

3. **Public Awareness**
   Benjamin decided to inform the public about the situation at the taxi rank.

   Who needs to be informed of the risks? How could he go about informing the public? How could he go about bringing about changes he thinks are necessary?

ANSWERS ON PAGE 126

How can conservation efforts preserve biodiversity?

South Africa has over 400 national parks and nature reserves. More than 90% of the region's birds, mammals, amphibians and reptiles occur in this network of protected areas.

However, only 34% of plants are protected. There is an urgent need to extend the network of conservation areas to include unprotected plants.

The conservation scientists at the South African Parks Board are actively involved in researching threats to biodiversity. They work in conjunction with other scientists at universities and other research organisations. Research and findings are pooled so that all sectors in South Africa and in neighbouring countries benefit from the conservation efforts of the South African National Parks Board.

What are some of the things these conservationists do?
They identify key research themes necessary for national parks to achieve their conservation objectives and then they conduct their research. They coordinate research projects that external scientific institutions conduct in national parks.

As a result of all the research activity they integrate the best available biodiversity data into park management through interactions with external researchers and research institutions. Game rangers and game management specialists implement management strategies in the parks.

They keep inventories or lists of biodiversity in national parks, including species checklists for vertebrates and higher plants, and they map landscapes, geology, soil and vegetation.

A very important part of what they do is to identify and prevent threats to biodiversity in national parks, including overabundance of certain wildlife populations, identifying and eradicating invasive alien plant and animal species, pollutants, excessive resource exploitation, climate change or other factors.

Although tourism in the National and other parks brings in vital funding from the public, the research scientists ensure that development within parks takes place in a manner that does not compromise biodiversity conservation.

What are World Heritage Sites?

An example of international and national partnership to create public awareness about land, resources and conservation is the development of World Heritage Sites.

In 1972, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) adopted a programme to identify heritage sites all over the world.

The World Heritage Committee seeks to encourage the identification, protection and preservation of cultural and natural heritage considered to be of outstanding value to humanity.

Some of South Africa's World Heritage Sites that are active in conservation of biodiversity are:

1. **The Greater St Lucia Wetland Park/iSimangaliso Wetland Park**

   The wetland is situated on the coast of KwaZulu-Natal and is one of the largest estuary systems in Africa. It is also comprises the continent's southernmost coral reefs. Its varied landforms include wide submarine canyons, sandy beaches, forested dune, wetlands, grasslands, forests, lakes and savannah.

   What organisms will you find here?

   Biodiversity includes large numbers of nesting turtles on the beaches; the migration of whales, dolphins and whale-sharks offshore; some 521 bird species including large breeding colonies of pelicans and other water birds.

2. **Cradle of Humankind**

   Sterkfontein, Swartkrans, Kromdraai and vicinity situated in Gauteng and North West has one of the world's richest concentrations (more than 950 specimens) of hominid fossils and evidence of human evolution over the last 3.5-million years. The remains of ancient forms of animals, plants and hominids are fossilised in dolomite rock.

   Recently, a fossilised skeleton of an early human, Australopithecus sediba was discovered by a young boy, Matthew Berger.

   This world heritage site is of great significance in terms of the prehistory of the human species as well as other species.

3. **The uKhahlamba Drakensberg Park**

   In the west of KwaZulu-Natal on the Lesotho border is Africa's highest mountain range south of Kilimanjaro. It is an area of outstanding natural beauty and is home to the largest series of rock art paintings in Africa, created by the indigenous San people who lived there for more than 4000 years.

uKhahlamba:
barrier of spears
Drakensburg:
dragon mountains

High altitude grasslands, steep-sided river valleys and rocky gorges provide a diversity of habitats which protect many endemic and globally threatened species, especially birds and plants. The Bearded vulture or lammergeyer is endemic to this area. Parts of this world heritage site belong to the Afro-Alpine biome, one of the smallest biomes on the planet.

4. **The Cape Floral Region**

   This famous biome stretches from the Cape Peninsula to the Eastern Cape including Table Mountain; it takes up only 0.04% of the world's land area, yet contains 3% percent of its plant species. Of the 9 600 species of plants found here, 70% are endemic, occurring nowhere else on earth. It is also home to 11 000 marine animals and 560 vertebrates.

We are very fortunate in South Africa to have so many world heritage sites where both cultural and natural diversity are preserved.

ACTIVITY 2

This activity focuses on recycling something you can do to ensure sustainability of your environment.

Urban waste mismanagement has become a serious environmental and health concern. There is a great potential for the majority of wastes to be **recycled**, yet this does not happen in South Africa. Wastes are indiscriminately thrown into **landfill sites**. These dumps are sometimes not fenced in and are dangerous. They are in urban areas and result in pests and disease and bad smells in the urban areas. The waste management is poor at these sites. Many of the landfills and dumps that exist are illegal.

1. Make a list of the effects a landfill site may have on the community. (Think of the kinds of wastes that are normally part of household and business waste. What effect will throwing these wastes into landfills have?)

2. Make a list of the effects a landfill site can have on the environment.

3. What opportunities are there in your community for recycling waste? How are wastes recycled? Do you have a place in your community where wastes can be collected and recycled according to the material they are made of such as paper, glass, tin, or plastic?

ANSWERS ON PAGE 127

COMMENT

Land is one of the most important resources held in common heritage by all human beings. The biodiversity that exists on that land is vitally important. Humans need to practise sustainable land and biodiversity management, so that future generations are able to enjoy the biodiversity you take for granted today.

CHECKLIST

Are you able to:

- ❒ explain what is meant by sustainable living
- ❒ describe some steps being taken to ensure sustainability of ecosystems
- ❒ discuss how to undertake an Environmental Impact Assessment
- ❒ investigate conservation measures in South Africa.

LESSON 8

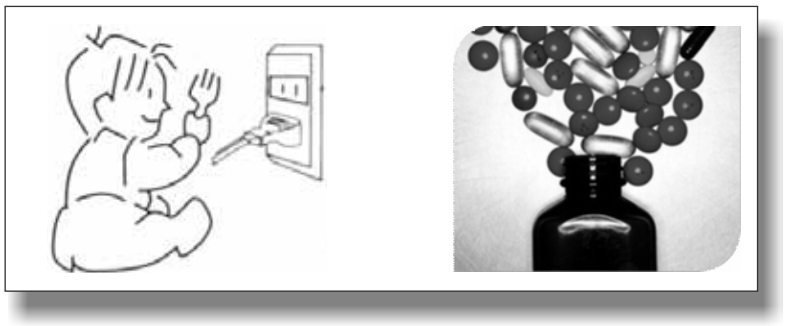
Living safely

About this lesson

When you were younger, parents and teachers often cautioned you and warned you about safety issues around the house, at school and when you were out in the world interacting with strangers in a wide range of activities. You did what your parents and teachers advised, because you didn't want to get hurt and were possibly afraid of the consequences if you did not take their advice! Sometimes you may have ignored their advice and you did suffer the consequences, by hurting yourself or breaking something at home.

As you grow older, you learn from your mistakes and you also learn to take greater responsibility for your own safety. You may even begin to take responsibility for other, younger people, or for people who do not have your knowledge of safety matters.

If you are going to take responsibility for the safety of others, you need to be able to communicate your knowledge to them.



In this lesson you will:

- focus on essay writing skills
- discuss issues of safety relating to
  - healthy living
  - chemicals in the home
  - safety with electricity
- write an essay based on safe living.

What are the different types of essays?

Essays are important ways to communicate ideas in any subject, and science is no exception. There are different kinds of essays that you may have to write in science:

- Discursive essays discuss an issue or a process. They may describe how something happens. For instance, a topic for a discursive essay might be 'How does Photosynthesis Work?' In her essay the writer would explain what photosynthesis is, and how it works. Discursive essays help define scientific ideas. Learners may be asked to write discursive essays to determine their knowledge of a particular scientific topic.

- A scientific review is similar to a discursive essay, but it requires the writer to understand scientific research, rather than a scientific process. A review essay will usually summarise major theories or research in a particular area of science. For example, a great deal of scientific research has taken place in an effort to find a way to cure cancer. A scientific review on this issue might summarise theories and current experiments being performed to determine how to cure cancer. The writer of a scientific review does not need to draw conclusions about which theory is best or what the ultimate answer to the question is, he or she simply needs to research and understand the science being explored in the area.

- Argumentative essays usually present two sides of an argument and come to a conclusion based on the evidence presented. An argumentative essay attempts to prove a scientific point. It may use previous research as evidence. An argumentative essay is often like a scientific debate with different viewpoints. An example of an argumentative essay topic could be 'Is genetic engineering an ethical practice?'

- Source based essays are written in response to an analysis of a variety of sources. Often, in examinations at school, you are presented with a number of sources that present evidence of some issue. The writer is expected to analyse the sources and then answer a related question in an essay. You can see how a source based essay can also be argumentative or discursive, depending on the question that is asked after you have read the sources.

ACTIVITY 1

Sort the following essay topics into the categories:

- discursive essay
- scientific review
- argumentative essay
- source based essay

1. Read the following news and media articles, as well as the statistics on rhino poaching. What is the current state of the rhino population in South Africa?

2. Write an essay in which you describe the process of DNA replication and explain how mutations can occur during this process.

3. Contraceptives should be supplied routinely and free of charge to all girls over the age of 14. Do you agree with this statement? Write an essay in which you debate this matter.

4. What is the best way to cultivate tomatoes in glasshouses? Write an essay in which you present all the current information on successfully growing tomatoes under cover.

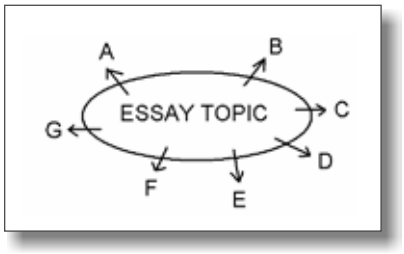
ANSWERS ON PAGE 128

What can I do to write a really good essay?

Essays require careful planning. An essay is not simply a collection of recalled facts written in whichever order the recalled facts come to mind. You need to put the facts in a logical sequence. The whole essay must have focus, structure and must be simply, but well written.

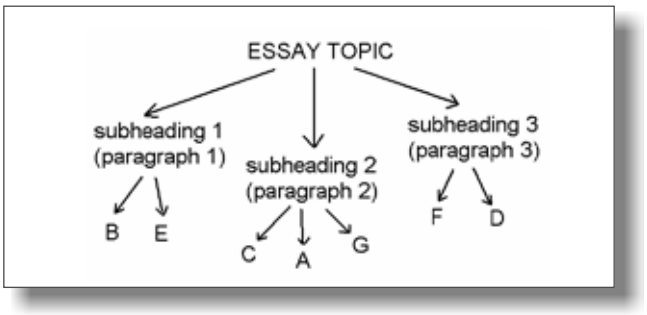
These are some steps you could work through when writing a good essay.

1. Determine the purpose of your essay. This will be related to the type of essay you are asked to write. Is a discussion required? Must you write a review? Are you being asked to present an argumentative essay? Are there sources that you need to read and incorporate in your essay?



2. Brainstorm all your ideas relating to the essay topic, using key words, order does not matter.

3. Organise the key words under subheadings. Each subheading will become a separate paragraph in the essay.



4. Structuring the essay:

   Introduction:
   State your intentions both as to the content you will cover and the type of essay you will write whether it be a review, discursive or argumentative essay.

   Body:
   You need to work from your plan to write separate paragraphs which are logically organised. Each paragraph contains a complete idea. Paragraphs must be linked to make a cohesive and organised essay.

   Conclusion:
   Pull together the main points that have been discussed and make any final deductions/statements regarding the topic.

5. Edit the essay:

   plan the essay → write a draft → **edit** → rewrite

What can I do to edit my work well?

Any writing you do needs to be edited. Whether you are writing a paragraph, or an essay, or a report, you need to make sure that what you have written makes sense and is accurate. The process of checking your work is called **editing**.

Editing involves reading a draft of the work, correcting any errors and generally improving the work. Editing is an essential stage of writing, because it enables you to evaluate critically what you have written and improve your work. You should always plan ahead so that you leave sufficient time for editing and rewriting. The ideal situation is for you to edit and rewrite and then to pass your work on to someone else to read and edit your work for you.

Use the checklist below whenever you produce written work, in order to make sure that the work you hand in is of the highest possible standard:

Content:

- Has all the relevant information been included?
- Does the written work address the topic/answer the question/fulfil the aims?
- Have any irrelevancies been left out?
- Have you supported facts and opinions with evidence?

Language and Writing Style:

- Are the sentences grammatically correct?
- Are sentences short and simple to read?
- Have spelling errors been corrected?
- Has terminology been used correctly?

Synthesis and Logical Flow:

- Is there an introduction which clearly states your intentions?
- Are there paragraphs which are logically connected and which flow in sequence?
- Is there a conclusion which sums up the essay and makes the final point?
- If the work is descriptive, does it fully describe what it is meant to describe?
- If the work is comparative, does it actually compare, point for point, what it is meant to compare?
- If the work is discursive, does it discuss the issues logically?

Other aspects:

- Does the work have a suitable title?
- Have you included references?

Remember that writing is a process. It involves continual reviewing and revising. It is only by editing and rewriting drafts that you will improve your end-product and become skilled at writing. Writing is a skill that requires lots of practise and critical self-evaluation. And if that isn't enough you can generally increase your marks by 5 - 10% simply by using a rigorous editing process!

ACTIVITY 2

Choose one of the following essay topics and write an essay of approximately 600 words. Make sure you use the planning and editing tools you have just learnt about.

Essay topic 1:
Read the information in the source below. Research other sources that will add to your knowledge of the issues mentioned in this source. Write an essay in which you explore the ways in which young people can live healthier lifestyles.

This information was taken from the internet site:
http://www.seattlecca.org/healthy-living-choices.cfm

People who live healthy lives have a better chance of avoiding cancer and other diseases. Research shows that the majority of all cancers and other diseases such as heart disease, may be prevented with healthy lifestyle choices that should begin as early as childhood. These healthy lifestyle choices may reduce your risk of becoming ill during your lifetime.

Research shows that people who begin smoking as teenagers suffer more damage than those who begin smoking as adults. The best idea is to never smoke. Various cancers and increased risk of heart disease are directly related to smoking.
Children and babies should avoid exposure to second-hand smoke. Smokers should smoke outdoors and away from children.

Regular exercise may help decrease the risk of several types of cancer, including colorectal and prostate cancer as well as heart disease and your likelihood of developing Type 2 diabetes. Get involved in activities. Turn off the TV and spend time outdoors, doing something physical. Choose activities that you can do together with your family and friends, like bike riding, walking, hiking, or swimming.

Eat at least five servings of fruits and vegetables every day Research shows that eating at least five servings of fruit and vegetables every day can reduce your risk of many different cancers, heart disease and Type 2 diabetes. Eat a well balanced, low fat, high-fibre diet. Maintain a healthy weight being overweight causes heart disease, stroke, and diabetes.

But it's also associated and certain cancers. Health-care professionals are concerned that so many of today's children are obese that they will actually have a shorter life span than their parents. By incorporating a healthy diet and a regular exercise programme into your life, you can lose weight, keep it off, and improve your overall health and chances of getting ill.

Limit your time in direct sun skin damage occurs over time. Studies show that children tend to get 80 percent of their lifetime sun exposure by age 18. Use sunscreen with a Sun Protection Factor (SPF) of 15 or higher. SPF indicates how long skin can be in the sun and maintain a low risk for sunburn. The higher the SPF number, the longer it protects a person from burning rays. SPF of 8 protects twice as long as an SPF of 4. Most sunburn can be prevented by using a sunscreen with an SPF of 15. Wear sunglasses or a hat with a visor to avoid damaging your eyes. Consider wearing a hat that shades your face, ears, and neck.

Limit the amount of alcohol you drink. Smoking, combined with alcohol, has proven to greatly increase the risk for some types of cancer and heart disease. However, the dangers of alcohol consumption go further than increasing risk of illness. Many social problems arise from the excessive consumption of alcohol, such as abuse of others, poor family relationships and inability work productively. Alcohol has caused the tragic deaths of many on the roads when drivers drive cars under the influence of alcohol. Alcohol is often called a 'gateway drug'. This means that taking alcohol can often lead to the use and abuse of other drugs such as dagga, cocaine, heroin, cat and tik. It is well researched that use of these drugs damages many systems in your body, including the brain. Drug addiction causes social problems and many addicts have recognised that drugs lead to jail and ultimately, death.

Protect yourself from sexually transmitted diseases. Safe sexual practices will greatly reduce risks of sexually transmitted diseases. Being aware of contraceptive options as well as the risks associated with unsafe sex is not enough. People need to put into practise what they have been taught and what they know to be sensible options. Often use of alcohol and drugs can lower inhibitions and people make poor sexual choices as a result.

Essay topic 2:
Every year, we hear of tragic deaths caused by children who accidentally consumed dangerous chemicals found in their homes. Could these deaths have been prevented? Are adults guilty of causing these deaths because they behaved irresponsibly? Read the source material below and then answer the questions posed in an essay.

Potentially dangerous chemicals can be found in every room in your home. If not properly stored or used, these products could end up causing minor to serious and even life-threatening health problems. What are these every day household chemicals? Keep in mind that most household cleaning products and pesticides are reasonably safe when used as directed, and that the level of toxicity of a product is dependent on the dose of the product used (never use more than the amount listed on the label) and the length of exposure to the product.

The following table was produced after consulting http://my.clevelandclinic.org/healthy_living/safety/hic_household_chemicals_chart_whats_in_my_house.aspx

Product	Hazardous Ingredient	Possible Effects
In the garage		
Antifreeze	Ethylene glycol	Poisonous if swallowed -- can cause severe damage to heart, kidneys, brain. Inhalation can cause dizziness.
Motor oil	Heavy metals	Can cause nerve and kidney damage; is thought to cause cancer
	Hydrocarbons	Some forms thought to cause cancer.
Batteries (car, boat, tractor)	Sulphuric acid	Can cause severe skin burns, and blindness
	Lead	Can cause nerve and kidney damage; is thought to cause cancer
Paint	Organic solvents	Can irritate eyes and skin; cause cracking of skin. Inhaling paint fumes can result in headaches, nausea, dizziness, and fatigue

In the kitchen		
Laundry detergent	Cationic, anionic, or non-ionic solutions	If swallowed, cationic detergents can cause nausea, vomiting, shock, convulsions, and coma. Non-ionic detergents can irritate skin and eyes
All-purpose cleaners	Ammonia	Fumes can irritate eyes and lungs; can cause burns or rashes on skin; can produce deadly chloramine gas if mixed with chlorine containing products
Bleach	Sodium hypochlorite solution	Corrosive to skin and lining of nose mouth and throat; fumes irritating to eyes and respiratory tract
Never *mix bleach with other cleaners – especially ammonia – and also toilet bowl cleaners and drain cleaners. A gas can be produced that can cause serious breathing problems and even death*		
Dishwashing detergents	Cationic, anionic, or non-ionic solutions plus phosphates (automatic dishwasher detergents)	Automatic products can cause skin irritation or burns; hand dishwashing products are milder, though can cause irritation to mouth, throat, and GI tract
Oven cleaners	Lye (consisting of either sodium hydroxide or potassium hydroxide)	Extremely corrosive, burns skin and eyes; can be fatal if swallowed; aerosols disperse chemicals, increasing inhalation dangers
In the bathroom		
Toilet bowel cleaners	Sodium bisulphate	Forms sulphuric acid, which is corrosive, burns skin
	Oxalic acid	Can damage kidney and liver; irritate eyes and respiratory tract; corrodes mouth and stomach
	5-dimethyldantoin	Forms hypochlorite in water, which is corrosive to skin and mucous membranes
	Hydrochloric acid	Fumes are extremely corrosive; burns skin
	Phenol	Can cause central nervous system depression; severely affect circulatory system; corrosive to skin; suspected of causing cancer
Mould and mildew removers	Chlorine and alkyl ammonium chlorides	Can cause breathing problems; if swallowed, can burn throat
Drain cleaners	Lye and sulphuric acid	Can cause burns to skin and in severe cases, blindness if splashed in eye
In the living room		
Rug, carpet, upholstery cleaners	Perchloroethylene	Fumes cause dizziness, sleepiness, nausea, loss of appetite and disorientation; can cause cancer with long-term exposure
	Naphthalene	Can damage liver; prolonged vapour exposure has led to cataract formation
Furniture polish	Ammonia, naphtha, nitrobenzene, petroleum distillates, and phenol	Can irritate your skin, eyes, throat, lungs and windpipe; if swallowed, furniture polish can cause nausea and vomiting
Air fresheners	Formaldehyde	A strong irritant to the eyes, throat, skin and lungs; thought to cause cancer
	Petroleum distillates	Can irritate skin, eyes, respiratory tract; may cause fatal pulmonary oedema; flammable
	P-Dichlorobenzene	Fumes can be irritating to skin, eyes and throat
	Aerosol propellants	Fumes associated with brain damage or highly flammable

In the bedroom		
Mothballs	Naphthalene, P-Dichlorobenzene	Can cause headaches, dizziness, and irritate the skin, eyes, and throat; cataract formation and liver damage can results from prolonged exposure
In the backyard, pool and garden shed		
Swimming pool chloride tablets	Sodium (or calcium) hypochlorite	Corrosive to skin and lining of nose mouth and throat; fumes irritating to eyes and respiratory tract
Insect repellents	Butopyronoxyl	Can cause mild necrosis in liver and kidney –in animals
	Cimethyl phthalate	Can cause central nervous system depression if swallowed
	Diethyltoluamide (DEET)	Can irritate sensitive skin and respiratory tract tissues as well as loss of coordination, anxiety, behavioral changes, and mental confusion
Weed killers	diquat, 2,4-D, and glyphosate	Can irritate the eyes and skin; can cause abdominal pain, nausea, vomiting, and diarrhea
Rodent control	Warfarin	Causes internal bleeding if ingested in large amounts

Essay topic 3:

Electricity is a familiar and necessary part of everyday life, but electricity can kill or severely injure people and cause damage to property. There are simple precautions that you can take when working with, or near electricity that can reduce the risk of injury to you and others around you.

A 19-year-old man was electrocuted and killed when he touched a refrigerated display cabinet in a café. Investigation showed that the plug had been incorrectly refitted to the cabinet's main lead. This meant the metalwork of the cabinet, which should have been safe to touch, was dangerously live at mains voltage. The man's sister received two shocks from the cabinet before realising what had happened to her brother.

Write an essay entitled 'What the experts say about avoiding electric shock.' Consult a number of references and find out what the major hazards are when working with electricity. Your essay should also include first aid and what to do in the event of an electrical shock. Finally, conclude your essay with some information about electricity theft and illegal electrical connections.

ANSWERS ON PAGE 128

COMMENT

Our lives and the lives of our family members are very precious. With just a little more knowledge and a conscious decision to 'do the right thing', we can avoid illness, accidents and even death. Our homes should be safe places. Often they are not. Why don't you take a look around your home? Is it a safe place to live? Are children safe in your home? Do you lead a healthy lifestyle? It's never too late to start making changes!

CHECKLIST

Are you able to:

- ❒ use excellent essay writing skills when you write an essay
- ❒ discuss issues of safety relating to healthy living, chemicals in the home and safety with electricity

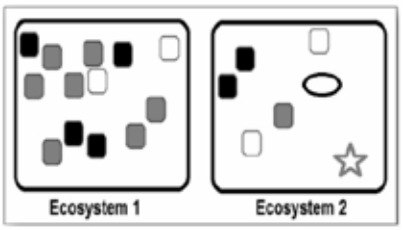
NOTES

Answer section

Lesson 1

Activity 1

You will be surprised at the number of different organisms you can find if you take time to observe your area. Did you remember to look for birds and insects flying over your area too? When you compared your areas, were you able to use terms such as **species diversity** and **ecosystem diversity** accurately? Remember this diagram from your notes: were you able to say which area had the greater biodiversity? Remember that it is not the total number of organisms that you recorded that is important but rather the total number of **different** species that you observed in your area that is important.

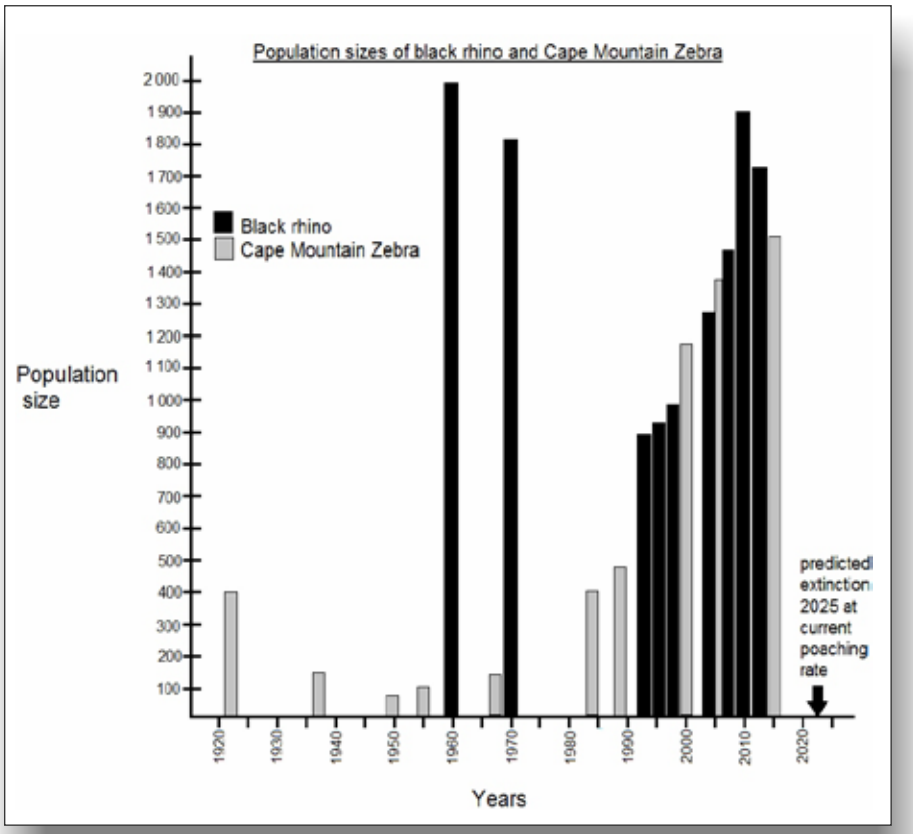


Some fun South African biodiversity facts!
The animal in South Africa that is:

- the world's largest land mammal? African elephant
- the world's fastest mammal? Cheetah
- the world's tallest mammal? Giraffe
- the world's smallest mammal by mass? pygmy shrew
- the world's heaviest reptile? leatherback turtle
- the world's smallest turtle? speckled padloper turtle
- the world's largest antelope? Eland
- the world's largest bird? Ostrich
- the world's heaviest flying bird? kori bustard

Activity 2

1. Check that your graph has a heading; axes correctly chosen and labelled; scaling correctly chosen for the years and population sizes your scale might not be identical to the one given here, but it should be regular; bars show a similar trend to that shown here; a key is provided.



2. Conservation measures such as breeding programmes have been successful. This is clearly evident by the increased numbers of both species. However, it seems that in spite of conservation programmes, the black rhino population is in trouble again, due to poaching.

3. a. 20 696 rhino in total.

   b. The number of white rhino increased but since 2009 the numbers have dropped. The number of black rhinos did not increase as much as the white rhino and only showed a decrease after 2010.

4. An excellent reference on the website is the Business Day investigative report

   http://www.businessday.co.za/articles/Content.aspx?id=162979.

Other references will show that poaching of rhinos is on the increase and it is predicted that by 2025, at the current rate of poaching, rhinos will be extinct. At present rhinos are extinct in many countries in Africa, where previously they were plentiful. It seems that unless South Africa can end the poaching of rhinos, South African rhinos will follow this tragic route for the species.

Lesson 2

Activity 1

1. phylum = largest; species = smallest

2. Family

3. 3

4. Wolf. Domestic dogs and African Wild dogs belong to different genera, however, wolves and dogs belong to the same genus.

5. Jackals are more closely related to Wild dogs than Wild cats. This is because although jackals and wild dogs belong to separate genera, they belong to the same family, Canidae, and wild cats belong to the family Felidae.

6. Ask someone else to use your classification system and see if the organisation you have invented works for them.

Activity 2

1. Animals

2. Plants

3. Fungi

4. Carolus Linnaeus

5. Archaea

6. Genus

7. Species

8. Monera

9. Eukaryotic

10. The three domain system

Activity 3

1. Cellulose cell wall, chloroplasts, storage of starch, large vacuoles

2. Algae are unicellular; if multicellular, they have no differentiation of specialised tissues, no roots, stems or leaves.

3. Like bacteria in that they are unicellular, unlike bacteria in that they are eukaryotic while bacteria are prokaryotic; algae have cellulose cell walls while bacterial cell walls are made of peptidoglycan; algae are all photosynthetic autotrophs while bacteria can be autotrophic, heterotrophic or chemotrophic.

4. Red and brown algae do contain chlorophyll, but it is masked or hidden by other pigments which colour the cells red or brown. They do photosynthesise.

5. This is still a puzzle to Life Scientists so there is no correct answer! You need to substantiate your answers with evidence and reasons.

Activity 4

1. You should observe patches of green where the holes were indicating the presence of photosynthetic protista.

2. To demonstrate that photosynthetic protista can move to areas of light / Show the presence of green organisms in pond water / Light has an effect on the behaviour of protista etc. Any reasonable ideas.

3. This will depend on the hypothesis that you state and what, in your opinion, the focus is of the investigation is. Light is a variable.

4. Heat, for example is another variable. It is very difficult to control this variable as the windowsill is likely to be warm-hot. Use of a fan to keep the heat down could be one way you could control the variable.

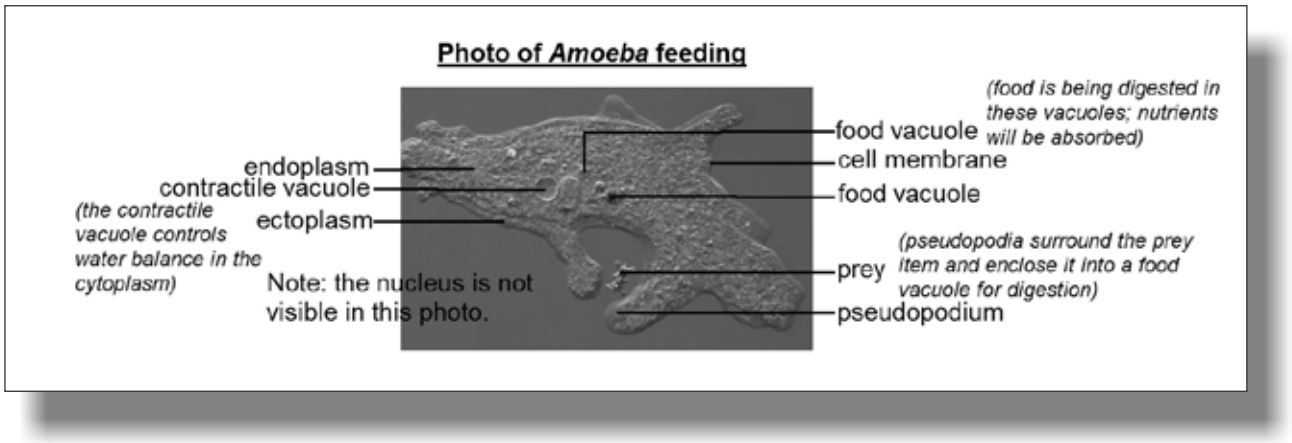
5. Does not demonstrate the behaviour of non-photosynthetic or heterotrophic protistans; it focuses only on the autotrophic algae.

6. The protista moved to the areas where the holes were in the black paper i.e. to areas where sunlight was allowed through to shine into the water. The protista moved to the patches of sunlight so they could photosynthesise.

7. Protista are able to move in the water. This is shown by the fact that there were no patches of green initially and after the exposure of limited areas of sunlight, the protista moved to these patches of sunlight.

Activity 5

You may have labelled your diagram differently, but this is an idea of what you may have done. Did you remember to give your diagram a heading?



Activity 6

Thinking about Fungi

Fungi are similar to plants in that:
- they have cell walls
- they are most often found attached to a substrate with rhizoids or root-like structures

Fungi are similar to animals in that:
- they are heterotrophic
- their cell walls are made from chitin which is found in the exoskeletons of animals such as insects
- they do not store food as starch but as oil droplets and glycogen, which is how animals store energy.

Because they have characteristics of both plants and animals, they are placed in their own kingdom.

Did you :
- make diagrams of what you saw?
- measure the size of the mycelia growth?
- describe the way the fungi spread?
- describe colour changes?
- compare the growth of the fungi on the different foods?

Do you think you grew more than one type of fungus?
Reasons?

Activity 7

Members of the Plant Kingdom are multicellular organisms. They all carry out the process of photosynthesis which means they use energy from the sun to make food for themselves. Mosses are very simple plants that lack true roots and stems. Both mosses and ferns use spores for reproduction. They are very reliant on the presence of water to assist in their reproduction. Ferns have simple support tissues, which mosses lack. Gymnosperms are characterised by the presence of seeds that develop inside cones. Conifers are a group of gymnosperms that have needle-like leaves. In the group of plants known as the flowering plants, or Angiosperms, the flower protects the seeds before fertilisation, while the fruit protects the seeds after fertilisation.

If you discovered a plant that had true tissues that could support the plant, as well as roots and stems, but reproduced with spores, you would have discovered a member of the group known as ferns.

If you discovered a plant that carried its seeds exposed on a cone-like structure, you could classify this plant as a member of the Gymnosperms.

Activity 8

1. A radially symmetrical animal can sense its environment from all sides. Movement is slow, however. Many radially symmetrical organisms are sessile which means they are attached to a surface, such as corals and anemones.

   Bilaterally symmetrical organisms co-ordinate sense and movement. Movement tends to be more efficient when it is bilaterally co-ordinated. Complex sense organs are located at the anterior of the animal. Cephalisation (development of a head with brain and sense organs clustered in this head) leads to rapid response to predators and food and location of mates.

   Bilaterally symmetrical animals with cephalisation are evolutionally successful.

2. The terms that apply to a human are:

   multicellular, coelomate, chordata.

   The terms that need to be changed are:

   radially symmetrical to bilaterally symmetrical; diploblastic to triploblastic; protostome to deuterostome.

3.

A Comparison of Structural Differences between Different Animal Groups						
Characteristic	Porifera	Cnideria	Platyhelminthes	Annelids	Arthropods	Chordates
Presence or absence of tissues	no true tissues	tissues present	tissues present	tissues present	tissues present	tissues present
Symmetry	asymmetrical	radial symmetry	bilateral symmetry	bilateral symmetry	bilateral symmetry	bilateral symmetry
Body layers	one	two – diploblastic	three - triploblastic	three – triploblastic	three - triploblastic	three - triploblastic
Body cavities in body wall	None	none – acoelomate	none - acoelomate	pseudo-coelomate	coelomate	coelomate

Lesson 3

Activity 1

a. Yes, because a few populations of different species are mentioned as living in one area the farm.

b. Yes, because although both deserts are at different ends of the continent of Africa, and may have different animals and plants living in them, they support similar ecosystems and they both have similar climatic conditions.

c. No, because ecosystem refers to the living organisms as well as the non-living factors mentioned in this statement.

d. No, because in South Africa cheetahs live in many isolated areas that do not have free access to each other so random interbreeding cannot happen.

e. No, because the forest has many different species of trees and populations consist of one species.

f. Yes, because the elephants are all one species, living in one particular area.

Activity 2

There are no model answers to this activity, as your answers will vary depending on the ecosystem you chose. Remember to record your observations carefully and accurately.

Activity 3

a. Soil B

b. Soil B has the smallest soil particles and therefore will have the smallest pores/spaces between its soil particles. As a result, water drains very slowly through the soil pores in Soil B

c. Soil C

d. Soil C has the largest soil particles and will therefore have the largest soil pores/spaces between the soil particles. As a result, the soil can hold lots of air in its soil pores

e. Soil C.

f. Soil C has large soil particles about 0.05 mm in size. Sandy soils are classified as soils with relatively large soil particles between 0.02 and 2.0 mm in diameter.

g. Plants growing in Soil C could struggle to get enough water.

Activity 4

a. i. Slope A: North facing . Slope B: South-facing .
ii. Slope A: Moderate/steep. Slope B: Gentle.

b. i. Slope A.
ii. Slope A is north-facing. In the Southern hemisphere, north-facing slopes receive more direct rays of the sun than south-facing slopes. This makes north-facing slopes warmer than south-facing slopes.

c. Slope B - Slope B is South facing and therefore cooler than Slope A, which means evaporation from the soil will be lower on Slope B. Slope B also has a gentler slope than Slope A, which means there will be less runoff and more infiltration of water into the soil of Slope B.

Activity 5

a. Grassland or savannah, open grassland or riverine ecosystem with trees

b. i. acacia, grass
ii. caterpillar, hare, locust (not the baboon or rat as they are omnivores)
iii. rat, baboon, leopard, francolin, meercat (some organisms are secondary consumers in some food chains whilst they are tertiary consumers in other chains)
iv. owl, meercat, leopard

c. The sun

Lesson 4

Activity 1

Alpine biomes are found in mountain regions worldwide, including the Andes, Alps and Rocky Mountains. The highest mountains in Ethiopia, as well as the highest peaks in the Drakensberg also have belts of vegetation that is classified as alpine. Generally, as the altitude increases, the temperature gets colder. Temperatures in the alpine biome are dynamic and can also change from warm to freezing in one day. The alpine biome is a tough place for plants to live. It's windy, cold, and the sunlight at these high altitudes is very strong. There are only about 200 species of alpine plants. At the high altitudes where these plants live, there is very little carbon dioxide, which is necessary for plants to carry on photosynthesis. Because of the blustery weather, most plants are small groundcover plants, which grow and reproduce slowly. They protect themselves from the cold and wind by hugging close to the ground. Most alpine plants are adapted to grow in sandy and rocky soil. Animals that live in the alpine biome must have special adaptations to survive the cold, snowy conditions. They also have to deal with high UV light exposure from the sun and thin atmosphere. Mostly warm-blooded animals live here, but a few types of insects also make the alpine biome home. Alpine animals adapt to the cold by hibernating, migrating to warmer areas, or insulating their bodies with layers of fat and fur. Some animals in the alpine biome are mountain goats, sheep, elk, many birds and insects.

Most temperate, deciduous (leaf-shedding) forests are located in the eastern United States, Canada, Europe, and parts of Russia. This biome has four changing seasons and quite a wet environment. Following rainforests, temperate deciduous forests are the second-rainiest biome. Rain falls throughout the year, but in the winter it snows. Summers are mild while winter temperatures are often well below freezing. Deciduous trees dominate temperate forests. As the seasons change each year, so do the leaves. Each year deciduous trees lose their leaves, and grow them back. Animals in temperate deciduous forests have to adapt to changing seasons. They must be able to cope with cold winters and hot summers. Some animals hibernate or migrate during the winter to escape the cold. The black bear is found in this biome, together with foxes, rabbits, deer, many birds and insects.

The desert biome covers about a fifth of the earth's surface. Weather is not the same in all deserts. The seasons in deserts are usually very hot during the summer and hot during the rest of the year. During winter these deserts get little rainfall. Rain is often light, or in short concentrated bursts. Deserts plants have many adaptations to survive in such a dry environment. They are good at storing and finding water.

Some plants have seeds that can stay dormant in the sand for a long time, until there is enough rain for them to grow. These plants must adapt to minimal rainfall by having extensive root systems that come up to the surface to absorb any possible rainfall, and go far down to absorb any water saturated in the ground. They also have very thick leaves that can store water whenever it is available. Some animals that live in the hot desert are cold-blooded, like snakes, insects, and lizards. Mammals that live in the desert are usually small, such as the kangaroo rat and kit fox.

Activity 2

a. True

b. False - In warm water the water molecules are moving faster. Heated water "excites" the oxygen molecules forcing them to escape from the body of water.

c. False Wetlands actually “absorb” water in times of floods and form reservoirs of excess water.

d. False Sandy shores are located above the high tide mark
.

e. True

f. True

g. False Although sandy shores may appear barren, plants do grow along dunes and animal life moves over the surface of the sandy shore constantly. Animal life is found under the sand too.

h. True

i. False The benthic biome is formed by the sea bed.

j. True

Activity 3

a. The rainfall is 400-800mm per annum in the summer months. The summers are hot. The winters are very cold.

b. The vegetation consists of grasses and small herbaceous plants. There are no/very few trees, except along riverbanks.

c. There are hardly any trees in the grassland biome because there is too little rainfall to support trees.

d. Grasses improve the soil in the following ways:
reduce soil erosion by holding the soil in place
reduce drought by soaking up rainwater like a sponge
add organic matter to the soil

e. a number of options could be drawn up:
grass ---> antelope ---> lion
grass ---> antelope ---> leopard
grass ---> zebra ---> lion
grass ---> zebra ---> leopard
grass ---> wildebeest ---> lion
grass ---> wildebeest ---> leopard

f. Farming of cereal crops and grazing of domestic animals

If you answered “Farming of cereal crops” in (f), then the answers are:
destroys the vegetation (placing the plants at risk of extinction)
destroys habitats of animals that occur naturally in the grassland (placing them at risk of extinction)
leads to soil erosion
leads to reduced water holding capacity of soil
leads to reduced soil organic matter.

If you answered “Grazing of domesticated animals” in (f), then the answers are:
leads to overgrazing (placing the plants at risk of extinction)
competition for grazing with wild animals (placing them at risk of extinction)
leads to bare areas of soil and soil erosion
leads to compacted areas of soil and therefore soil erosion
leads to soil erosion
leads to reduced water holding capacity of soil
leads to reduced soil organic matter .

g. Ecotourism is tourism based on the local wildlife and culture of an area.

h. It provides habitats for many plants and animals
It improves soil conditions
It provides an opportunity for ecotourism

Lesson 5

Activity 1

There are no model answers for this activity. You need to describe the impact of humans on your chosen ecosystem in depth, thinking about implications of the human impact.

Lesson 6

Activity 1

1. biodiversity

2. desertification

3. overgrazing and desertification

4. Farmers removed natural forests or vegetation from an area to make space for their crops. The forest / natural vegetation is high in biodiversity. The farmers planted only one kind of crop. This means that the biodiversity of the area decreased from a wide variety, to one species.

5 a. deforestation removal of large tracts of indigenous forest; forests are areas of great biodiversity which is lost once the forest is removed

b. soil erosion removal of vegetation (loss of biodiversity) allows wind and water to blow/wash away topsoil; so preventing other vegetation from growing in the area

c. overgrazing too many herds in a limited area which is naturally arid or has sparse or scrubby vegetation decrease the vegetation as they eat; their hooves compact the ground preventing vegetation from growing; erosion often sets in

d. monoculture one single species of plant (most usually an alien / exotic species) replaces diverse plant life in an area

e. overfishing similar to overgrazing; irresponsible removal of fish from an area of the ocean can result in the food webs in that area being destroyed and the habitat can be destroyed.

Activity 2

1. a. nitrogen

b.
- Run-off of nitrates and phosphates from excess use of fertilisers has greatly increased the nitrate and phosphate in rivers and lakes
- Leads to eutrophication: overgrowth of microscopic algae / algal bloom
- Many algae and other organisms die as the oxygen is used up and their bodies are broken down by bacteria which need oxygen

- Therefore oxygen levels in water get further depleted and lack of oxygen causes animals in the water to die

2. a. Province A

   b. 450 - 375/75 x 100 = 20%
   375

   c. Pollution and contamination of water and soil sources; toxic substances affect biodiversity and can cause disease if the waste is contaminated with infectious substances; decomposition of waste produces bad smell/odours; nuclear waste from radiation therapies; unattractive; causes eutrophication.

3. a. Exhaust gases have a negative effect/positive effect/no effect on the percentage of seeds that germinate.

   b. She replicated the investigation three times and then found the average

   c. Oxygen is required for germination. Car exhaust fumes contains carbon monoxide that negatively affects the percentage of seeds that germinate.

   d. It could help farmers or other people intending to grow plants near roads: Do not germinate seeds near roads/where it is exposed to carbon monoxide.

Activity 3

Impact on environment

- Plants can become extinct/lead to loss in biodiversity
- Food chains/webs can be destroyed
- Shortage of food
- Could lead to degradation of the environment
- Erosion of ground surface if too many plants are removed
- Increase run-off of water
- Destroy habitats of many organisms
- Alien plant invasion
- Upset the balance of oxygen and carbon dioxide/global warming

Management practices to reduce over-exploitation

- Sustainable harvesting – over-exploitation must not be allowed

- Research – done to look at reproductive cycle/alternative source of active ingredient /cloning
- Legislation – control harvesting
- Penalties for breaking legislation
- Education/campaign – impact and consequences of over-exploitation
- Establish nurseries/seed banks – to replace plants harvested
- Establish more nature reserves – to conserve indigenous plants
- Controlling exploitation – of indigenous plants by international companies
- Provision of free/cheaper food – to reduce dependence on indigenous plants

Lesson 7

Activity 1

There are no model answers here – you will have to interpret the situation in your own way, however, some guidance is given below:

1. Littering, possible spread of disease due to wastes, land degradation could result in loss of biodiversity and soil erosion, the stream could carry pollutants into the water sources for the village.

2. Erosion, water and soil pollution, spread of disease. Plants, animals and humans will be negatively affected.

3. This needs to be done sensitively so that people do not feel they are being attacked but they need to see that with small changes, they can still run a business, but not harm the environment and other humans. Maybe he needs to have a meeting with the taxi owners. They can then work on ways of parking the taxis and not causing damage to the soil and plants. Maybe local businesses can be approached to pave the area and place rubbish bins and toilets on the land. Posters can be made by local school children to advertise how the area is being protected and the benefits of the conservation project to the public.

Activity 2

Continue on next page.

Activity 2

Effects on the community
Smells, surface pollution and unsightly piles of rubbish are unpleasant. When the wind blows, the community around the dump often has an increase in surface litter as plastic bags and papers blow from the landfill back into the urban areas. Landfills are very unattractive landmarks in an urban area. The prices of homes and property close to a landfill site are often much lower than that of sites that cannot see the landfill directly.
People working in or around the sites (including children playing) are exposed to health hazards. Very often, it is too costly for businesses to use the correct disposal method for hazardous wastes and these wastes are disposed of illegally in an urban landfill. However, even legal wastes, as they decompose, form poisons and hazardous substances which can affect the health of those living in the area. Vagrants tend to frequent landfill sites, looking for food and items that have been discarded, but that they can possibly use. Children play near or even on the landfill sites. These people are exposing themselves to serious health hazards.
Sites attract pests and are sources of disease. Rats, dogs and other vermin are attracted to the waste at landfills. These pests carry disease and will spread the disease back into the urban areas when they leave the landfills.
Respiratory disorders result from the toxic gases formed during burning of wastes. Other disorders result from drinking polluted water or eating crops grown in polluted soil. At times, landfill management will burn some of the wastes. Toxic gases can be released into the atmosphere and blow over the urban area, affecting the people who live there. You must also remember that when it rains, the run-off from the landfill can carry toxins and pollutants which can get into the drinking water supplies. The run-off can also affect agricultural croplands close by. The implications are serious as many of the poisons, especially heavy metals such as lead, can remain in the water and soil for many, many years, affecting the community adversely.
Effects on the environment
Surfaces are polluted and wind blows lighter refuse away from site, polluting surrounding areas. Plastic bags are a serious environmental threat. They are not biodegradable and often get caught in water ways, blocking the route of birds and fish. They can get tangled around animals' feet and in their mouths, causing starvation and death.
The soil is degraded as trucks continuously bring waste to the sites. Soil at the site is contaminated and degraded for centuries. The degradation effect on the soil at landfill sites is well known. The soil quality is poor and filled with toxins.
Burning waste causes air pollution. If wastes are burned, the air is polluted with toxic gases and smoke. This can add to the acid rain problem in certain areas.
Toxic wastes leak into the ground, poisoning the soil. The build up of heavy metals and other toxic substances can poison animals and plants living in the affected soil. These poisons can then be passed down food chains, ultimately harming humans and other sensitive organisms in the food chain.
Toxic wastes can leach into the ground water and lakes, dams, rivers etc. Water sources are polluted and bacterial growth kills all the other living organisms in the water source. This is of course, aside from the poisoning by organic and inorganic substances added to the water.

Lesson 8

Activity 1

1. source based discursive essay
2. discursive essay
3. argumentative essay
4. review essay

Activity 2

Depending on the essay chosen, the content will obviously be very specific. However, in order to check whether your essay would meet requirements in an examination or for continuous assessment purposes during the year, you can refer to this rubric and assess your own essay.

RUBRIC – ESSAY				
CRITERION	4 MARKS	3 MARKS	2 MARKS	1 MARK
TITLE	suitable	fair	Inadequate	none
INTRODUCTION	introduced content and intention	content and intention fairly introduced	inadequate introduction	none
CONCLUSION	summed up well and made final comments	summed up adequately	inadequate conclusion	none
PARAGRAPHING	logically connected; well constructed	fairly well connected; fair construction	inadequately connected and constructed	none
LOGICAL DEVELOPMENT OF IDEAS	ideas developed logically, focus and flow	attempt at logical flow	faulty logic, lack of focus and flow	essay does not make sense, ideas do not flow
READABILITY	spelling and grammar correct	spelling and grammar mostly correct	a number of spelling and grammar errors	numerous errors
INTEREST AND CREATIVITY	original and interesting to read	some good points	ordinary and predictable	boring!
CONTENT:	discussed in depth & intelligently with relevant examples	a good discussion, most of the relevant points covered	discussion is superficial, omissions	inadequate discussion, much omitted
ABILITY TO SEE BOTH SIDES OF AN ARGUMENT AND COME TO A CONCLUSION/OFFER OWN OPINION	excellent ability to describe both sides of an argument	a good ability to describe both sides of an argument	not able to competently describe both sides of an argument	unable to describe both sides of an argument at all
EVIDENCE OF RESEARCH AND APPLICATION OF THE EVIDENCE IN WRITING	excellent ability to substantiate opinions with evidence from science	a good ability to substantiate opinions with evidence from science	not able to competently substantiate opinions with evidence from science	no evidence for opinions from science