# Contents

How to use this Learner’s Book .......................................................................................................................................... v

Term 1: LIFE AND LIVING ............................................................................................................................................. 1

**Topic 1: Photosynthesis and respiration** ................................................................. 1
   Unit 1 Photosynthesis ................................................................................................................. 2
   Unit 2 Respiration ...................................................................................................................... 10

**Topic 2: Interactions and interdependence within the environment** .............. 15
   Unit 1 Ecology and ecosystems ................................................................................................. 16
   Unit 2 Energy flow ..................................................................................................................... 32

**Topic 3: Micro-organisms** ................................................................................................................. 56
   Unit 1 The unseen world of micro-organisms .................................................................. 57

Careers that require knowledge of environmental studies, nature conservation, zoology, botany, entomology and the study of micro-organisms ................................................................. 79

Term 2: MATTER AND MATERIALS ......................................................................................................................... 82

**Topic 4: Atoms** ...................................................................................................................................................... 82
   Unit 1 Atoms - building blocks of matter ............................................................................ 83
   Unit 2 Pure substances ............................................................................................................. 87

**Topic 5: Particle model of matter** ......................................................................................................................... 96
   Unit 1 The concept of the particle model of matter ............................................................. 97

**Topic 6: Chemical reactions** ................................................................................................................................. 117
   Unit 1 Reactant and products ................................................................................................. 118

Careers in inorganic and organic chemistry, mining, engineering, materials development and in the bio-fuels industry ................................................................. 123

Term 3: ENERGY AND CHANGE .................................................................................................................................... 126

**Topic 7: Static electricity** ................................................................................................................................. 126
   Unit 1 Static electricity - electricity that does not flow ................................................... 127

**Topic 8: Energy transfer in electrical systems** ................................................................. 135
   Unit 1 Electrical systems ........................................................................................................ 136

**Topic 9: Series and parallel circuits** ....................................................................................................................... 152
   Unit 1 Circuits can be connected in series or in parallel ..................................................... 153
How to use this Learner’s Book

Welcome to the Solutions for all Natural Sciences Grade 8 Learner’s Book.

The content in the Solutions for all Natural Sciences Grade 8 Learner’s Book is organised according to topics and each topic is structured in the same way:

**Topic opener page:** The topic starts with a full colour photograph of something that is related to the content of the topic. What you will learn about in this topic lists the content to be covered in the topic. There is also a section called Let’s talk about … which gives you an opportunity to start thinking about new things you will learn about in the topic.

**Units and lessons:** Each topic is divided into units that are broken up into lessons. A lesson consists of content and then a classroom activity, sometimes there is a practical task. Some of the classroom activities might be started in class but completed at home. The lessons break the work up in little chunks of information. This helps you to make sure you know and understand a certain section of the work before moving on to the next section of work. One practical task per term is a suggested Formal Assessment Task. You could be assessed on these tasks, so watch out for them.

**Extra practice activity:** The extra practice activity at the end of each topic has been included as an additional activity. Use the questions for extra practice.

**Summary:** Each topic ends with a summary of the work covered in the topic. You could use these summaries as study notes, just to recap what you should now at the end of the topic.

**Other features to look out for are:**

**Word bank:** These contain difficult words that you may not understand or that you may have encountered for the first time. An explanation for the word is given to enable you to understand its meaning better. Always keep a dictionary handy because if you understand a word learning will be a lot easier.

**Illustrations and photos:** The illustrations and photos have been included to help you understand the written text. Use the illustrations and photos when working through the text. When you see something you will remember it a lot better.

The publisher and authors wish you all the best in your study of Natural Sciences Grade 8.

*Good luck!*
What you will learn about in this topic

- Photosynthesis
- Respiration

Let’s talk about photosynthesis and respiration

Look at the picture on this page. It shows the leaves of a plant in an ecosystem on a sunny day. Plants are the only living things in an ecosystem that can make their own food using energy from the Sun. The energy required by plants helps bring about variety of life on Earth. Discuss how plants make their own food. How do animals in an ecosystem get their food? In this topic you will see how energy drives interactions between the living organisms in an ecosystem, creating biodiversity. You will learn about photosynthesis, the process by which plants convert the Sun’s energy into stored energy within glucose. You will learn how plants and animals release energy that is stored in glucose by the process of respiration.
Unit 1 Photosynthesis

What you already know

In Grade 4 you learnt that living things need energy. Plants use energy from the Sun to make food for themselves. Energy is stored in food. Animals cannot make their own food and so they depend on plants for food. Energy is transferred from the Sun to plants to animals in a sequence known as an energy chain or food chain. In Grade 5 you learnt that plants and animals depend on each other and they also depend on the resources available in their own habitats. An example is seen in food chains, in which each organism depends on the previous organism in the chain for food. A food chain starts with a plant and shows the transfer of energy from the plant to the last animal in the food chain. In Grade 6 you learnt that during photosynthesis plants use energy from sunlight, carbon dioxide from the air and water from the soil to make glucose. Plants release oxygen into the air during this process. Animals and humans need this oxygen to breathe. You also learnt that plants change some of the glucose into starch for storage and how to test for the presence of starch.

1. What do plants need to produce their own food through photosynthesis?
2. Explain why all animals depend on plants for food.
3. Draw a food chain consisting of four components to show the flow of energy from the Sun to animals.
4. What is the test for the presence of starch?

Lesson 1
The role of energy in interactions and interdependencies in an ecosystem

An ecosystem consists of all the living things in an area and their relationships with each other and with their non-living environment. The living parts of an ecosystem include all the living organisms such as the plants and animals. The non-living factors of an ecosystem include sunlight, air, water, soil and rocks. The different parts of an ecosystem are connected through interactions and interdependence.

Word bank

interdependency: a relationship in which both parties depend on each other for something
interaction: a relationship in which two parties affect each other
Interactions in an ecosystem

The different parts of an ecosystem interact with each other. An interaction is a relationship in which the parties affect each other in some way. The interactions may be harmful or beneficial to the parties involved. Examples of interactions between the parts of an ecosystem are shown in Figure 1.1:

- Insects eat plants which is beneficial for the insect but harmful to the plant.
- A bee pollinates a flower which is beneficial for both the bee and the plant.

![Figure 1.1 Interactions in an ecosystem may be harmful or beneficial: a) A beetle eating a leaf harms the plant b) A bee is pollinating a flower benefits the plant.]

Interdependence in an ecosystem

The different parts of an ecosystem are interdependent on each other. An interdependency is a relationship in which both parties depend on each other for something. Examples of interdependencies in an ecosystem are shown in Figure 1.2:

- Plants depend on the soil for water and nutrients. When they die, nutrients from their decaying bodies are returned to the soil.
- Animals depend on plants for food and shelter and plants depend on animals for pollination and seed dispersal.
- Animals depend on the soil for shelter. The urine and droppings of animals add nutrients to the soil. When animals die, nutrients from their decaying bodies are returned to the soil.
Energy drives interactions and interdependence in an ecosystem

Interactions and interdependence in an ecosystem are driven by the need for energy. All living organisms need energy to sustain life. Energy in an ecosystem is linked to food, because energy is stored in food compounds inside plants and animals. The Sun is the source of energy in an ecosystem. Energy flows from the Sun to plants and then to the animals of an ecosystem.

The Sun is the source of energy in ecosystems

The Sun provides energy to ecosystems in the form of light and heat. The Sun’s heat energy warms the air, soil, water, plants and animals in an ecosystem. Plants use the Sun’s light energy to produce food in the form of glucose (a type of sugar) through the process of photosynthesis.

The movement of energy through an ecosystem

Figure 1.3 shows how energy moves from one part of an ecosystem to another.

- Photosynthesis is the first step in the movement of energy in an ecosystem. During photosynthesis, energy from the Sun is stored in the glucose that the plant produces. The plants in an ecosystem break down some of the glucose to release the energy needed for life processes. The plants convert some of the glucose into starch for storage in their roots, stems, leaves, fruit and seeds.
• The energy stored in glucose and starch in the plants is passed on to herbivorous animals that feed on the plants. The glucose and starch are broken down inside the herbivore’s body to release the energy. The herbivores use some of the energy for life processes, but also stores some of the energy in energy-rich compounds such as carbohydrates, proteins and fats in their bodies.

• When a carnivorous animal eats another animal, it takes in the energy-rich compounds from that animal's body. The carbohydrates, proteins and fats are broken down inside the carnivore's body to release the energy they contain. The carnivore uses some of the energy for life processes and stores the rest in carbohydrates, proteins and fats in its body.

Classroom activity 1

1. Figure 1.4 shows an interaction in an ecosystem. Study the image and answer the following questions.

   a) Name the two parties that are involved in the interaction.
   b) Describe the interaction.
   c) Explain how the interaction could benefit or harm each party.
   d) Explain how this interaction is driven by the need for energy.
Lesson 2
The role of plants in capturing and storing energy in ecosystems

Plants use energy from the Sun to make glucose

Photosynthesis is a chemical process during which green plants use the energy in sunlight to convert carbon dioxide gas and water into glucose. Photosynthesis involves a series of chemical reactions. You do not need to know all the reactions, but the overall process of photosynthesis can be summarised with the following word equation:

\[
\text{carbon dioxide + water} \xrightarrow{\text{chlorophyll, sunlight}} \text{glucose + oxygen}
\]

The word equation shows that during photosynthesis carbon dioxide and water react to form glucose and oxygen. It also shows that chlorophyll and sunlight are needed for the reaction to occur. Chlorophyll is a green pigment that absorbs energy from sunlight.

Word bank

- **photosynthesis**: the process by which plants make their own food
- **chlorophyll**: the pigment that gives plants their green colour
- **pigment**: a substance that gives colour to something
- **by-product**: something produced in addition to the main product
Requirements for photosynthesis

Photosynthesis takes place mainly in the leaves of the plant. For photosynthesis plants need:

- **sunlight**, which provides the energy for the process
- **chlorophyll**, which absorbs sunlight energy
- **carbon dioxide gas**, which is absorbed from the air through small openings on the surface of the leaves
- **water**, which is absorbed from the soil and moves from the roots to the leaves.

Products of photosynthesis

Photosynthesis produces:

- **glucose**, which is a type of sugar molecule, as its main product
- **oxygen** as a by-product that is released into the air.

Figure 1.6 shows a summary of the requirements and products of photosynthesis.

Plants change glucose into other compounds

Plants use the glucose they produced during photosynthesis to help with their life processes. Some of the glucose is broken down to release energy, while the rest is changed into other compounds. These compounds include:

- **Sucrose**: Sucrose consists of two sugar molecules joined together. It is the form in which sugar is transported from one part of the plant to another.
- **Starch**: Starch is made up of spirals of long molecules branching chains of sugar molecules joined together. It is the main form in which plants store energy.
- **Cellulose**: Cellulose is made up of long linear chains of sugars. It is very strong and is used to provide structure and support in plants.
In Grade 6 you learnt that there is a simple test for the presence of starch in potatoes. Starch changes the colour of yellow-brown iodine solution to a blue-black colour. This test can also be used to show that plants produce starch in their leaves.

**Practical activity 1**

*Group*

**Investigate if plants produce starch in their leaves**

**Aim**

To test for the presence of starch in the leaves of plants

**You will need:**
- green leaf from a healthy plant that has been growing outside
- a glass beaker or container
- water
- bunsen burner or spirit burner
- tripod
- gauze
- test tube
- ethanol
- forceps
- white tile or other white surface
- iodine solution
- dropper
- timer

**Method**

1. Heat a beaker of water on the tripod stand with gauze over a Bunsen burner until the water boils.
2. Use the forceps to put the leaf in the boiling water for one minute.
3. Switch off the Bunsen burner.
4. Use the forceps to remove the leaf from the water and place it into a test tube filled with ethanol or methylated spirits.
5. Place the test tube in the beaker of hot water (the water must not be boiling). Do not let the water flow into the test tube. The ethanol will boil because it has a lower boiling point than water. This step removes the chlorophyll from the leaf so that it does not mask the colour of the iodine solution later in the test.
6. Use the forceps to take the leaf out of the test tube and rinse it in the hot water in the beaker.
7. Use the forceps to place the leaf gently on the white tile.
8. Use the dropper to add a drop of iodine solution to the surface of the leaf. Observe any changes.

Figure 1.7 Preparing a leaf to test for the presence of starch

Questions
1. What colour was the leaf when you:
   a) removed it from the boiling water?
   b) rinsed it after removing it from the ethanol?
2. What colour was the iodine solution:
   a) before it was placed on the leaf?
   b) when it came into contact with the leaf?
3. What does the change in colour in Question 2 indicate?

Results
Write a report on this investigation using the headings: Aim, Hypothesis, Method, Results, Discussion and Conclusion.
Classroom activity 2

*Individual/Pairs*

1. Describe the process of photosynthesis.
2. Write a word equation for photosynthesis.
3. Copy and complete the table to summarise the requirements for photosynthesis:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Source</th>
<th>Role in photosynthesis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon dioxide</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorophyll</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sunlight</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Name the main product of photosynthesis.
5. Plants can convert the main product of photosynthesis into other substances. Name two of these substances and describe the function of each.
7. Describe what happens to the by-product of photosynthesis.
8. Write a paragraph to describe how you would test for starch in a plant leaf.

Unit 2 Respiration

What you already know

In Grade 7 you learnt that energy that is stored in a system is called potential energy. There is potential energy in food. Moving bodies, such as when animals walk or run, have kinetic energy. Energy cannot be created or destroyed, but can be converted from one form to another or transferred from one part of a system to another. In a biological system such as an ecosystem, energy can be stored in food by plants and animals and passed along food chains.
A farmer has an ox. The ox eats grass in a large field on the farm. When it is planting season, the farmer uses the ox to pull a plough to till the soil.

1. What form of energy is present in the grass?
2. Where does the grass get this energy from?
3. How is the energy in the plant transferred to the ox?
4. What type of energy is evident when the ox pulls the plough?

Lesson 3
Respiration in plants and animals

Food contains potential energy

You have learnt that energy drives many interactions and interdependencies in ecosystems. You have also learnt that energy is linked to food because energy is stored in food compounds in plants and animals. Plants use energy from sunlight to make their own food through the process of photosynthesis. Animals get their energy by eating plants or other animals. The energy stored in food is an example of potential energy. Potential energy is energy that is stored in a system.

Respiration releases potential energy from food

Plants and animals need the energy that is stored in food for life processes such as growth and movement. To release the energy stored in food, the food must be broken down into simpler substances in a process called respiration. Respiration involves a series of chemical reactions, but you do not need to know all of them. The overall process of respiration can be summarised by the following word equation:

\[ \text{glucose} + \text{oxygen} \rightarrow \text{energy} + \text{carbon dioxide} + \text{water} \]

The word equation shows that during respiration, glucose and oxygen react to form carbon dioxide and water and that energy is released. The energy that is released is the potential energy that was stored in the glucose.

Requirements for respiration

Respiration takes place in the cells that make up the bodies of plants and animals.

Plants and animals need the following for respiration:

- **glucose**, which contains potential energy. Plants make glucose during photosynthesis. Animals get glucose from the food they eat.
oxygen, which is absorbed from the air. Plants absorb air through tiny openings in their leaves called stomata. Animals absorb oxygen through their lungs, skin or gills.

**Products of respiration**

Respiration produces the following products:
- **Carbon dioxide:** This gas is a by-product of respiration. Plants release carbon dioxide into the air through the stomata in their leaves. Animals release carbon dioxide into the air from their lungs, gills or skin.
- **Water:** This is also a by-product of respiration. Plants release water into the air in the form of water vapour through their stomata. Animals release water in the form of sweat, urine or water vapour in exhaled air.
- **Energy:** Glucose is broken down into energy-rich molecules that are used in all the life processes in plants and animals.

**Testing for a product of respiration**

One way to find out whether respiration has taken place is to test for one of the by-products of the process, namely carbon dioxide.

Too much carbon dioxide is toxic to cells and needs to be removed from the cells continuously. In our bodies, carbon dioxide dissolves into the blood. In the lungs, oxygen from inhaled air replaces the carbon dioxide in the blood. The carbon dioxide moves into the air and is then exhaled. Testing exhaled air for the presence of carbon dioxide is therefore a simple test for the process of respiration.

**Practical activity 2**

**Groups**

Test for the presence of carbon dioxide in exhaled air

**Aim**

To test for the presence of carbon dioxide in exhaled air

**You will need:**
- beaker or clear glass container
- clear limewater
- drinking straw

*Figure 1.8 Testing for the presence of carbon dioxide in exhaled air*
Method
1. Pour some of the clear limewater into the beaker.
2. Gently exhale air into the clear limewater using a drinking straw.
3. Observe any changes.

Results
What did you observe when you blew exhaled air into the clear limewater?

Conclusion
What conclusion can you draw from your results?

Questions
1. Name a process that occurs in the cells of living organisms that could produce the carbon dioxide in exhaled air.
2. Explain the importance of the process in Question 1.
3. Name another by-product that is produced in this process.
4. Suggest how you could test for the presence of the by-product in Question 3 in exhaled air.

Classroom activity 3

Individual/Pairs
1. Describe the process of respiration.
2. Write a word equation to represent the process of respiration.
3. Where does respiration take place?
4. What is the importance of respiration?
5. Write a paragraph about the requirements and products of respiration. Describe where each requirement comes from and what happens to each product.
6. Describe how you can test whether respiration has taken place.
7. Discuss how photosynthesis and respiration can be considered as the reverse of each other.

Extra practice

Individual
In a grassland ecosystem, a zebra grazes on the grass. Grass seeds stick on the zebra’s coat as it moves through the grass. A leopard kills the zebra and eats it.
1. What is the source of energy in the ecosystem? (1)
2. Name and describe the process by which the plants make their own food. (4)
3. Name and describe the process by which the zebra and the grass release the energy stored in glucose. (2)
4. Explain whether the interaction between the zebra and the leopard is beneficial or harmful to the animals. (4)
5. What drives the interaction in Question 4? (1)
6. Describe how the grass and the zebra are interdependent. (2)

Total: 14 marks

Summary

- The different parts of an ecosystem interact with one another.
- An interaction is a relationship in which two parties affect each other in some way.
- An interdependency is an interaction in which both parties depend on each other for something.
- Interactions and interdependencies in an ecosystem are driven by the need for energy. Energy flows from the Sun to plants and then to the animals of the ecosystem.
- Photosynthesis is the process during which plants use the energy in sunlight to convert carbon dioxide and water into glucose.
- Plants require sunlight, chlorophyll, carbon dioxide and water for photosynthesis.
- The main product of photosynthesis is glucose, which contains stored energy. Inside the plant, glucose may be changed into other compounds such as sucrose, starch or cellulose.
- Oxygen is a by-product of photosynthesis. Yellow-brown iodine solution turns blue-black when it comes into contact with starch. This reaction can be used to test whether plants produce starch in their leaves.
- Respiration is the process during which glucose is broken down to release its stored energy.
- Plants and animals require glucose and oxygen for respiration.
- The products of respiration are carbon dioxide, water and energy.
- Carbon dioxide turns clear limewater milky and can be used to test for the presence of carbon dioxide in exhaled air.
Interactions and interdependence within the environment

What you will learn about in this topic

- Introduction to ecology
- Ecosystems
- Feeding relationships
- Energy flow: food chains and food webs
- Balance in an ecosystem
- Adaptations
- Conservation of the ecosystem

Let’s talk about interactions and interdependence within the environment

The photograph above shows a typical African grassland. Name four living things that could be in the photograph including two herbivores. What do the animals eat? What would eat the animals? What would happen to the plants and animals if there was a drought? How can the area in which they live be protected from poachers?
Unit 1 Ecology and ecosystems

What you already know

In Grade 4 to 6 you learnt about habitats and ecosystems. A habitat provides all the necessary resources for an organism to live. In a habitat there are relationships not only between the living things but also between the living and non-living things. Plants depend on non-living things to make their own food and so serve as food for other living things in a habitat. The transfer of energy from one living thing to another is called a food chain. Plants are the first link in every food chain and are therefore called producers. Animals are called consumers because they feed on plants or other animals.

An ecosystem is an area where living and non-living things depend on one another in many different ways. An ecosystem often consists of many different habitats and therefore many different living things. In an ecosystem plants and animals are connected by their feeding relationships, which are called food webs. Food webs consist of producers, consumers and decomposers. The different components all depend on one another to keep the ecosystem functioning.

In Grade 7 you learnt that the biosphere refers to the part of the Earth where all living things live. The biosphere includes all the different ecosystems on Earth. To sustain life on Earth there is a delicate balance between land, water, air and living things in the biosphere.

Check myself

1. Below is a list of things that may be found in a habitat. Sort them into living and non-living things.
   sunlight, bacteria, birds, wind, carbon dioxide, fungi, rock, soil, grass, water

2. What is meant by the interdependence of plants and animals?
3. What is an ecosystem?
4. Describe the feeding relationships between the different kinds of living things in an ecosystem.
5. What is the biosphere?
Lesson 1
Introduction to Ecology

Ecology is the study of living things and their relationships to one another and the environment. Living things interact with one another as well as with non-living things. We refer to the living things in an ecosystem as biotic factors, while non-living things are called abiotic factors. The abiotic factors in an ecosystem contribute to both the physical and the chemical environment in an ecosystem.

Ecologists generally study ecological interactions at any of four levels, organised from small to big:

- A **population** is a group of organisms of the same **species** that live in a defined area and are able to breed freely.
- A **community** is a group of different populations living in a defined area.

---

**Word bank**

- **ecology**: the study of the relationships in an ecosystem
- **ecological interactions**: the relationship in an ecosystem
- **population**: a group of organisms of the same species that live in a defined area and are able to breed freely
- **species**: a group of similar organisms that produce fertile offspring when breeding with each other
- **community**: a group of different populations living in a defined area
- **ecosystem**: an integrated system of biotic and abiotic factors
- **biosphere**: the largest ecological unit on Earth
An ecosystem includes biotic and abiotic factors in the area and the relationships between them. Many communities form part of an ecosystem.

The biosphere consists of all the ecosystems on Earth. It is the largest ecological unit on Earth.

Classroom activity 1

**Individual**

1. Consider a grassland habitat where 150 lions live. The lions feed on plant-eating animals such as kudu, zebras and wildebeest. The plant-eaters feed on the leaves of Acacia trees and grasses.
   a) What is the size of the population of lions?
   b) Describe the community that lives in this ecosystem.
   c) Describe the habitat of the lions.
   c) Give the name of the ecosystem the lions live in.

*Figure 2.2 Lions form part of the community in grasslands.*
2. The following terms and their definitions do not match. Re-write the list to match each term with the correct definitions.

<table>
<thead>
<tr>
<th>Biological term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Community</td>
<td>A living thing</td>
</tr>
<tr>
<td>Biosphere</td>
<td>A thin layer around the Earth where living things exist</td>
</tr>
<tr>
<td>Environment</td>
<td>A group of organisms of a single species living in a specific habitat</td>
</tr>
<tr>
<td>Habitat</td>
<td>A group of different organisms living in the same area</td>
</tr>
<tr>
<td>Ecosystem</td>
<td>The thin layer around the Earth where living things exist</td>
</tr>
<tr>
<td>Ecologist</td>
<td>The surroundings of an organism</td>
</tr>
<tr>
<td>Population</td>
<td>The area in which living and non-living things interact with each other</td>
</tr>
<tr>
<td>Organism</td>
<td>The place where an organism lives and gets all the things it needs to survive</td>
</tr>
<tr>
<td>Abiotic</td>
<td>A scientist who studies the relationships between the living and non-living things in an ecosystem</td>
</tr>
</tbody>
</table>

**Lesson 2**

**Ecosystems**

**Introduction to ecosystems**

The biosphere is the thin ‘blanket’ of life within which all living things live. Life is found mainly around the edges between land (lithosphere), air (atmosphere), and water (hydrosphere). The biosphere does not penetrate very far below the land surface, very high into the atmosphere, or very deep under the ocean. The biosphere can be divided into several biomes such as forests, deserts and grasslands and these biomes have many different ecosystems. All the ecosystems combined make up the biosphere.

Ecosystems are complex integrated systems where biotic and abiotic factors interact. An ecosystem may be quite large, such as grassland, a forest, a lake, or even an ocean or it could be more restricted, such as a riverbank or tree stump. Because the parts of an ecosystem depend on one another, damaging one part of the ecosystem may have a disastrous effect on the other parts.
Abiotic components of an ecosystem

Abiotic factors play a vital role in providing organisms with a suitable habitat. A particular habitat provides an environment that suits some kinds of plants and animals better than others.

Abiotic factors include:
- light
- water
- air
- climate
- soil and humus
- physiographic factors.

Light
Sunlight is the main source of energy for all organisms. This light energy is converted to sugars and oxygen during photosynthesis. Oxygen is a by-product that is used by all organisms during respiration.

Water
Water is a life-giving resource. It serves as medium for most of the chemical reactions in organisms. Water is also needed for photosynthesis and therefore is an important input to food chains. Many plants and animals also depend on water to provide them with a suitable habitat.

A healthy, functional ecosystem requires an adequate supply of water. In a water-scarce country such as South Africa it is particularly important that we protect our water resources. This means not only that we should use water sparingly and avoid wastage but also that we should prevent pollution. Littering, chemicals and sewage pollute water, which negatively affects the surrounding environment and the health of people in the area.

Everyone should contribute to protecting our water resources. Always close taps properly after use and report leaks or burst pipes to the municipality. You can also volunteer to participate in conservation programmes such as Working for Water.

Figure 2.3 Do not waste water by letting it run. Water is a scarce resource.
Air
Air consists of a mixture of gases, which are all important in an ecosystem.
- Oxygen ($O_2$): About 21% of the air consists of oxygen. Oxygen is important in the process of respiration during which energy is produced so that organisms can carry out the life processes.
- Carbon dioxide ($CO_2$): The proportion of carbon dioxide in the air is very small (about 0.04%). In plants, carbon dioxide and water are converted by the energy of sunlight into sugar through the process of photosynthesis.
- Nitrogen ($N_2$): Most of the air (about 78%) consists of nitrogen. Nitrogen in the air is unreactive and must be converted by bacteria into a usable form for plants to make proteins.
- Water vapour ($H_2O$): The amount of water in the air is variable. Clouds, mist and fog are all caused by water vapour in the air. Air also contains small amounts of gases such as methane and ozone. Although these gases are found only in small quantities they have a powerful ecological effect because they help to regulate the Earth’s temperature.

Climate
The climate of a region has an enormous influence on the type of plants and animals that live in an area. Climatic conditions include temperature, wind, rainfall and humidity.

Temperature has a notable influence on the distribution of plants and animals. Organisms have special adaptations to suit certain conditions. For example, aloes are adapted to hot arid conditions by having thick fleshy leaves to store water.

Wind is the movement of air, which is caused by temperature differences. Wind affects the rate of evaporation, which affects the quantity of available water. It is also an important factor in plant pollination and seed dispersal.

Rain perhaps has the greatest influence on the diversity and distribution of organisms. The combination of rainfall and temperature causes different climatic conditions, for example hot and dry, cold and dry, cold and wet and hot and wet.

Soil and humus
Soils are made by the decomposition (weathering) of rocks by water, wind, temperature and other mechanical processes. The size of the soil particles determines the type of soil. The main types of soil and their properties can be compared in Table 2.1.
Table 2.1: Properties of soil

<table>
<thead>
<tr>
<th></th>
<th>Clay</th>
<th>Silt</th>
<th>Sand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Particle Size</td>
<td>&lt; 0,002 mm</td>
<td>0,002–0,05 mm</td>
<td>0,05–2,0 mm</td>
</tr>
<tr>
<td>Air Spaces</td>
<td>None</td>
<td>Very small</td>
<td>Large</td>
</tr>
<tr>
<td>Drainage</td>
<td>None</td>
<td>Poor</td>
<td>Good</td>
</tr>
<tr>
<td>Mineral salt content</td>
<td>Good</td>
<td>Good</td>
<td>Poor</td>
</tr>
</tbody>
</table>

Loam is a combination of the different soil types and usually contains humus. Humus is organic matter that forms when the remains of dead plants and animals break down. Water content and pH are inorganic factors that contribute to soil quality.

Animals such as earthworms, moles and dung beetles aerate the soil and return nutrients to the soil. Animals depend on soil for food, protection and shelter. Plants depend on soil for water, support and mineral salts.

South African soils develop at an average rate of 2,5 mm per 100 years. Soil loss exceeds soil formation. The loss of soil may be due to natural causes such as climatic changes, but human activity can greatly accelerate erosion. Erosion may be worsened by cultivating crops on steep slopes, poor irrigation and agricultural practices, overgrazing and habitat destruction.

The management of soils is essential to the protection maintenance of an ecosystem. It is important that the soil types are classified and recorded with the potential problems that affect particularly sensitive systems.

Physiographic factors
Physiographic factors are the physical characteristics of the land. These characteristics include slope, aspect and altitude.

Slope
Slope is the angle of the ground relative to the horizontal. A flat terrain has no slope. As the angle from the horizontal increases, the slope becomes steeper. A cliff can be considered as a vertical slope. The slope of an area affects factors such as erosion.
Aspect
The aspect is the direction the slope faces. In the southern hemisphere, north-facing slopes (northern aspect) are warmer and drier than south-facing slopes (southern aspect). This affects the type of plants that grow.

For example, in the Umdloti Valley in KwaZulu-Natal the dominant plants on the northern aspect are adapted to dry conditions. Examples include the cactus-like *Euphorbia* and thorn trees. On the southern aspect forest trees such as white stinkwood and Natal mahogany are the dominant plants.

Altitude
*Altitude* is the height above sea level. High altitudes such as the Drakensberg are colder than the low-lying areas such as Pietermaritzburg. This influences the types of plants that grow there.

Biotic components of an ecosystem
Living organisms are referred to as the biotic factors of an ecosystem. Biotic factors include plants, animals, fungi, algae and small unicellular organisms such as bacteria. Their survival depends on their ability to adapt to changes in their habitat or in the ecosystem.

Practical activity 1

*Group*
Selecting and marking off an ecosystem for study

*Aim*
To study an ecosystem in a selected area

*You will need:*
- four dowel sticks of 50 cm each
- string
- scissors
- measuring tape or trundle wheel
- flour
- notebook
- pen and pencil
- eraser
- field guide
- camera (optional)
- sieve
- hand lens
- paper towel
Part A: Make a quadrat

A quadrat is a sampling square used to estimate the number of living things in an ecosystem. The quadrat is placed at random spots in the study area to sample the organisms within the square. The more samples that are taken, the more reliable the estimated population sizes in the ecosystem would be.

Method
1. Place the end of one dowel stick over the end of another at a right angle.
2. Thread some string over the two ends in a criss-cross manner. Tie the string tightly when the two sticks are joined securely.
3. Join the other dowel sticks in the same way to finally form a rigid square frame.

Part B: Study an ecosystem

Method
1. Find a big open area at or close to your school, for example a soccer ground or park.
2. Use the measuring tape or trundle wheel to measure out a square of 5 m × 5 m.
3. Mark the corners with tent pegs and pour some flour along the outline of the square.
4. Place your quadrat at a randomly selected position in the outlined area.
5. Record all the different plants and animals you see in the quadrat in your notebook. Use your field guide to identify any plants or animals you do not know. You can also take pictures of make drawings for later reference.
6. Count the number of each type of living thing you have identified. Include organisms at the edge of the square only if it is more than halfway into the square.
7. Repeat steps 1–5 another seven times.
8. Tally the counts to find the size of all the different populations in the studied ecosystem.
9. Record all the abiotic factors you observe in the selected ecosystem.
10. Record any human interferences (e.g. fences, pathways, litter, etc.) you can see in the selected ecosystem.

Do not count this plant; it is less than halfway into the quadrat.

Count this plant; it is more than halfway into the quadrat.

Figure 2.4 Working with quadrats.
Part C: Study a soil sample from an ecosystem
1. Spread a spade full of soil out on the paper towel.
2. Record the colour of the soil.
3. Rub some soil between your fingers and describe the texture.
4. Transfer some of the soil to the sieve. Observe what sifts out and what is left behind in the sieve. Use the hand lens to examine any organic matter, if necessary.
5. Describe the size of the soil particles as small, medium or large.

Questions
1. Draw a sketch of the study area in your notebook.
2. a) Calculate the number animals per square metre.
   b) Calculate the number of plants per square metre.
3. Explain how the abiotic factors in the ecosystem affect the biotic factors.
4. Give two examples to describe the relationships between different biotic factors in the ecosystem.
5. a) Give an example of a human interference you observed in the studied ecosystem.
   b) Describe how this human interference could affect the biotic factors in the ecosystem.
6. a) Using your knowledge about soil types, what type of soil did you find in the studied ecosystem?
   b) How does the soil type affect the biotic factors in the ecosystem?
Classroom activity 2

Individual
1. Redraw the Venn diagram below and sort the following organisms into communities. Note some organisms may live in both ecosystems.
   Crocodile, buffalo grass, kingfisher, fig tree, yellow fish, earth worm, frog, kudu, waterlily, waterboatman, mole, otter, termite, crab, chameleon, Cape robin

   ![Venn diagram](image)
   River
   Grass bank

2. Redraw the grid below and fill in the answers to the questions. The blocks in grey will reveal a term related to this lesson.

   ![Crossword puzzle](image)
   a) The place where an organism lives.
   b) All the ecosystems combined.
   c) All the different populations of organisms in an ecosystem.
   d) An area in which all the living and non-living things interact.
   e) A term that describes all the living things in an ecosystem.
   f) A non-living factor.
   g) The study of ecosystems.
3. Some people keep tropical fish at home in a fish tank. The environmental conditions of the fish tank have to be carefully controlled in order to keep the fish alive.

   a) The following pieces of equipment represent abiotic factors that are important in the fish tank. Explain what each of the following pieces of equipment is needed for:
      i) light
      ii) heater
      iii) pump

   b) Suggest two reasons why it is important to have plants in the fish tank.

   c) What natural ecosystem is represented by the water filter?

   d) Imagine that you were setting up a tropical fish tank at home.
      i) What resources would you have to provide to keep your fish alive and healthy?
      ii) Name five organisms that you might put into your tank. What component of the ecosystem do they represent?

---

Lesson 3
Feeding relationships

In an ecosystem organisms are **interdependent**. Interdependence refers to the way in which organisms interact with and depend on each other to obtain food, grow and reproduce. For example, bees depend on flowers for their food (pollen and nectar), and flowers, in turn, depend on bees for pollination. Bees and flowers are, therefore, interdependent.
When one organism consumes another organism, or parts thereof, there is a flow of energy from one organism to the other. The Sun is the primary source of the energy within an ecosystem.

**Producers**

Plants use light energy from the Sun to produce carbohydrates (sugar). Since green plants are able to make their own food by photosynthesis they are called producers in an ecosystem.

**Consumers**

Organisms that are unable to produce their own food and are called consumers. They feed on other organisms to obtain energy. Consumers are classified according to the type of food that they eat.

**Herbivores**

Animals that eat plants are called herbivores. They are the primary consumers. Large herbivorous animals often have special digestive systems that allow them to break down tough plant material. Kudu and zebra are examples of herbivores in a grassland ecosystem such as the African savannah. Kudu eat mainly leaves of trees and shrubs, while zebra prefer to eat grasses.
Carnivores
Animals that eat other animals are called carnivores. They may be secondary or tertiary consumers depending on how high up on the food chain they are. There are two different types of carnivores:

- **Predators** actively hunt and kill other animals. The animal that is killed is called the prey. Snakes such as the black mamba are true predators because they actively hunt and eat live prey.

- **Scavengers** are animals that eat other animals that are already dead. Vultures are true scavengers because they will eat only carrion (meat on the carcass of a dead animal).
There are very few true predators or scavengers. Most carnivores will both hunt and scavenge for food. Lions are both predators and scavengers, and so are hyenas.

- **Insectivores** are organisms that feed on insects. Examples include the Southern African hedgehog and the Venus flytrap.
Omnivores
Animals that eat both plants and animals are called **omnivores**. Humans, monkeys, rodents and bushpigs are examples of omnivores.

*Figure 2.14 The endangered Samango monkey is an omnivore.*

**Decomposers**
Decomposers breakdown dead plant and animal material and return nutrients to the soil. These nutrients can then be taken up by plants when they produce food. Bacteria, fungi and earthworms are examples of decomposers.

*Figure 2.15 Fungi are decomposers.  Figure 2.16 Earthworms are detrivores.*

The continuous input of energy from the Sun keeps nutrients flowing and the ecosystem functioning. This movement of energy from one organism to another can be illustrated by food chains and food webs.
Classroom activity 3

Individual
1. Provide definitions for the following terms:
   a) Predator  
   b) Scavenger  
   c) Producer  
   d) Omnivore  
   e) Herbivore  
   f) Carnivore  
   g) Decomposer  
   h) Insectivore  

2. a) Draw a mind map to show the feeding relationships between the organisms listed in Question 1.
   
   b) Choose examples of each type of organism from the following list to include in your mind map.

   - hagfish
   - warthog
   - giraffe
   - marabou stork
   - african rock python
   - maroela tree
   - aardvark
   - great white shark
   - mushroom
   - blue duiker
   - baboon spider
   - baboon
   - woodlice
   - king protea

Unit 2 Energy flow

What you already know

In Grade 4 you learnt about habitats and how each animal in a habitat is suited to live there because it knows how to find food and shelter in that area. You also learnt that animals need food because it contains the energy that they need to live and that all energy in a habitat is provided by plants that trap the energy from the Sun.

In Grades 5 and 6 you learnt that many organisms can live in the same habitat at one time and that one organism depends on another for its survival. This is known as the interdependence. Often this interdependence is that one organism needs the other organism for food as a supply of energy. The interdependence of organisms in terms of food can be shown using food chains and food webs.
Say whether the following statements are true or false. If the statement is false, rephrase it so that it is true.

1. All of the energy in an ecosystem comes from moonlight.
2. Energy from the Sun is trapped by animals.
3. A habitat can only have one type of organism in it.
4. If an animal needs another animal to survive it is said to be independent.
5. Food chains show how many types of animals there are in a habitat.

Lesson 4
Food chains and food webs

The flow of energy
The primary source of energy on Earth is sunlight. This light energy is absorbed by plants and converted into chemical energy in the form of sugar so that it can be stored or used as energy for life processes. The continuous input of energy from the Sun is a renewable resource and keeps nutrients flowing and the ecosystem functioning. It must be remembered that whilst nutrients are recycled, energy cannot be recycled and is changed from one form of energy into another to be used in a different way.

The movement of energy from one organism to another can be illustrated by the use of food chains and food webs. We are also able to show how animals interact with each other by using food chains and food webs.

Food chains
A food chain shows how the energy provided by one organism is passed on to another organism though feeding. Although the Sun is the primary source of energy, a food chain always begins with a producer. The chain may have many links with the arrows showing the direction in which the energy flows.

As energy flows through the environment it passes through a series of ‘feeding levels’ called trophic levels. The producers form the first trophic level and are called autotrophs because they make their own food. The consumers are heterotrophs and form each consecutive trophic level.
Food webs

When there are many food chains with common links, they can be joined to form a food web. A food web shows the interactions one organism may have with many other organisms.

Classroom activity 4

Individual

Figure 2.17 represents a food web for a game farm. Look carefully at the food web and answer the questions.

1. How many components does the longest food chain in this food web have?
2. Use the food web to identify one example of a:
   a) predator
   b) consumer
   c) producer
   d) tertiary consumer
   e) herbivore
   f) carnivore
   g) secondary consumer.

3. If the red grass were removed from the habit, explain how the food web would be affected.

4. Suggest why the number of black mamba might decrease if the guinea fowl all died from a disease. Explain your reasoning.

**Ecological pyramid of energy**
An energy pyramid is another way to represent the trophic structure of an ecosystem. Such pyramids are based on the energy losses at each transfer to a different trophic level. Plants use less than 1% of the total radiant energy available and only about 10% of the energy entering one trophic level becomes available to organisms at the next level. The rest is lost as heat or *excreta*.

In an energy pyramid we see that locusts feed on plants and that it takes many locusts to provide enough food for a mouse. The base of the pyramid is wider than the top and represents the number of producers. The next layer represents the number of consumers at that trophic level. As you move towards the top of the pyramid, you will find the number of consumers decrease.

*Figure 2.19 An energy pyramid represents the trophic structure of an ecosystem.*
Classroom activity 5

**Individual**

Consider the following food chains:

A. grass → rabbit → cat
B. wheat → mouse → cat
C. wheat → mouse → grass snake

1. Represent the trophic levels in food chain A as an energy pyramid.
2. a) Use all three food chains to draw a food web.
   b) Name one producer in the food web.
   c) Name a primary consumer in the food web.
   d) Name a secondary consumer in the food web.
3. If the mice died, explain what would happen to the number of:
   a) grass snakes
   b) rabbits.

Practical activity 2

**Groups**

**Identifying a food chain or food web**

**Aim**
To study the interactions between organisms in an ecosystem

**Note:** You will have to complete this activity over several days. If you struggle to find an ecosystem with suitable interactions, use the example given in the alternative task to complete the activity.

**You will need:**
- notebook and pen
- camera (optional)

**Method**
1. Choose a small ecosystem near your school or home to study.
2. Sit quietly and observe the animals and plants around you for at least 15 minutes.
3. Note the time of day and the environmental conditions (for example temperature, cloud cover, rain, wind, etc.).
4. Record the type and number of different organisms you observe. Take photographs or draw pictures to refer to later.
5. Record how the organisms in the area interact with one another. Make notes about:
   a) the role of each organism in its food chain (for example, producers and the level of consumers)
   b) feeding relationships and behaviour (for example, herbivore, carnivore, predator, prey, etc.)

Results
Write a brief report about the food chains and the food webs you observed during your study. Refer to the feeding relationships and the relative numbers of the organisms to describe the energy flow in the ecosystem. Include simple diagrams to illustrate the food chains and food webs you observed.

Alternative task
An ecologist has been studying a forest community for a week. She has noted which plants and animals she has seen and what the interactions in the ecosystem. Use her notes to write your report.

Forest feeding relationships: observation notes

Monday: I saw a red duiker eating some green leaves from a black stinkwood tree. A vervet monkey was eating some figs from a fig tree and then started catching some termites that were repairing their mud nest that was damaged with the short downpour of rain. I got thoroughly wet.

Tuesday: Trumpeter hornbills are eating the fruit from a wild plum. A large-spotted genet jumped down from a branch and caught a striped tree squirrel.

Wednesday: I have found fresh water shrimps in a small stream that seem to be eating all the time. They are eating microscopic plants and animals called plankton. I saw a fish, most likely a tilapia, eating shrimp and dragonfly nymphs in a rock pool. There was also a fresh-water crab that was filtering the plankton from the water. After a while I heard a splash and a water mongoose had caught the crab.

Thursday: I returned to the stream and observed the crabs more closely today. One was eating a shrimp it had caught. Unbelievably I saw a very large praying mantis was eating a very small fish, but I did not see it catch the fish.
**Friday:** Today I heard a loud screeching and ran quickly to see a **large crowned eagle** tearing the flesh off a baby **vervet monkey** with its hooked beak whilst it held the monkey in its sharp talons. Further away there was a **paradise flycatcher** catching the flies that were buzzing around the midden (toilet site) of a **black rhino**. A **green boomslang** had just caught a **chameleon**.

Use the rubric to help you compile your report:

<table>
<thead>
<tr>
<th>IN MY REPORT I HAVE:</th>
<th>LEVEL OF ACHIEVEMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level</strong></td>
<td><strong>Grade</strong></td>
</tr>
<tr>
<td>Drawn a simple food web that links at least three food chains.</td>
<td>Low</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td><strong>High</strong></td>
<td></td>
</tr>
<tr>
<td>Used applicable key words to describe feeding behaviour of the organisms (e.g. producer, herbicore, carnivore).</td>
<td>Medium</td>
</tr>
<tr>
<td><strong>Described and explained at least one adaptation each that helps a predator and its prey to survive.</strong></td>
<td>Low</td>
</tr>
<tr>
<td><strong>Medium</strong></td>
<td><strong>2</strong></td>
</tr>
<tr>
<td><strong>Described one daily change that affects the organisms.</strong></td>
<td>Low</td>
</tr>
</tbody>
</table>
The balance between organisms and resources in an ecosystem

As you have already learnt, ecosystems consist of communities of organisms that interact with one another and with their environment. The resources available to organisms include food, water and shelter. These can be considered limiting factors because they regulate the number of organisms within an ecosystem.

The number of individuals of a population that an ecosystem can sustain without damage to the environment is termed its carrying capacity. For example, if there is an excessive amount of resources such as food, a population of animals will thrive and its size will increase greatly. But as the population increases, the amount of food available to each individual decreases.

Once a resource is being used quicker than it can be replaced the environment becomes damaged. This is called unsustainable use of a resource. If the number of organisms using that resource is not reduced, the environment may not recover and the specific organisms will become extinct in that area.

Factors that affect the balance within an ecosystem

Disturbances within an ecosystem cause disruptions in the recycling of nutrients, availability of resources and interactions between organisms in the community. These disturbances may be natural or caused by human interference.

Word bank

resources: things in an environment that organisms can use to help them survive

carrying capacity: the maximum number of individuals of a species the area’s resources can support continuously

epidemic: when many individuals become ill with a disease at the same time

Lesson 5
Balance in an ecosystem

The balance between organisms and resources in an ecosystem

As you have already learnt, ecosystems consist of communities of organisms that interact with one another and with their environment. The resources available to organisms include food, water and shelter. These can be considered limiting factors because they regulate the number of organisms within an ecosystem.

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Factors that affect the balance within an ecosystem

Disturbances within an ecosystem cause disruptions in the recycling of nutrients, availability of resources and interactions between organisms in the community. These disturbances may be natural or caused by human interference.
If the balance in an ecosystem is disrupted, organisms must adapt to those changes. Disruptions caused by natural factors are usually temporary or occur gradually, giving communities a chance to adapt or recover. The disturbances caused by human interference are usually more permanent and occur so suddenly that communities are not able to adapt and recover.

**Natural factors that disrupt the balance in ecosystems**

Natural disruptions to the environment have occurred since life on Earth began. In fact this has been the driving force behind the great diversity of life on Earth. Extreme changes in the climate have the greatest influence on the environment.

Droughts occur when ecosystems experience little or no rain for unusually long periods of time. This causes plant communities to die and animals are forced to emigrate from the area affected by the drought. However, when the rain returns, plant communities are able to recover quite quickly because of their ability to produce seeds that can remain dormant for long periods of time. Similarly, floods and extreme and sudden changes in temperature put a strain on the biotic community of an ecosystem but recovery is quite rapid.

Disease is another factor that will influence the balance within an ecosystem. An epidemic may cause a large drop in numbers of a specific population. This has a knock-on effect, causing other populations to either decrease or increase. Ultimately though, as with climatic changes, this disturbance is temporary and communities are able to recover. Sometimes a natural disaster such as volcanic activity may, however, cause an ecosystem to change permanently.

**Human factors that disrupt the balance in ecosystems**

The influence of people on ecosystems is enormous. The demand for resources to provide food for a rapidly increasing population has caused, in many cases, irreversible damage to ecosystems. The effect is so great that the entire biosphere is in danger of a global catastrophe. The extinction of species due to human activities is so great that the term ‘The Sixth Mass Extinction’ has been coined.

Habitat loss is the largest cause of damage to ecosystems. Habitat loss can be caused mainly by:

- poor agricultural practices leading to the permanent damage of the drier ecosystems (desertification)
- cutting down natural forests (deforestation)
• introducing invasive alien plants into areas
• draining wetlands
• ploughing and cultivation of natural areas to grow timber and cereal crops (monoculture)
• opencast mining
• water pollution
• increasing urbanisation.

Other human influences such as poaching may affect a specific organism. Poaching can be classified into two categories:

• **subsistence poaching**, where people poach because they need the food to survive. This type of poaching very rarely causes a disruption to the ecosystem.

• **organised poaching**, when animals are captured to sell to wildlife traders or killed for specific body parts. These parts are sold to people who use them for cultural or medicinal purposes. Gambling also threatens species such as the oribi. For example, people use hunting dogs and gamble to see which dog can kill a buck first. Quite often influential people are involved with this type of poaching.

In South Africa, animals that are endangered because of organised poaching are the black rhino, the ground hornbill and the Cape wild dog, amongst others. Plants endangered because of poaching include the pepper bark tree and the black stinkwood. The indigenous wild ginger is critically endangered and may soon become extinct in the wild.

**The impact on the ecosystem**

The impact of human activity on ecosystems can be varied. For example, a natural area is cleared to grow wheat. The possible consequences of this disruption can include:

• loss of biodiversity, as only one species of plant now grows in the area; this means that there is no food for insects that eat fruits, which will, in turn, cause many of the insectivorous organisms to move to other areas

• populations of rodents may increase attracting larger numbers of top predators such as snakes and raptors like hawks

• pesticides may kill off most insects; these poisons may be passed on to other species that eat the poisoned insects and subsequently cause the death of organisms that are not the target of these poisons

• the soils become more exposed leading to erosion and loss of nutrients; fertilisers are used to replace the nutrients, fertilisers may wash into rivers and pollute the water.
There are many other examples of how human activities affect the environment. Human interference in the environment is, however, inevitable. This means that we need to adapt the practices that support our lifestyle to ensure that we use our environmental resources in a sustainable way.

**Classroom activity 6**

*Individual*

![A savannah food web diagram](image)

*Figure 2.20 A savannah food web.*
Use the food web in Figure 2.20 to answer the questions that follow.
1. Use the food web to name:
   a) two consumers
   b) one omnivore
   c) one producer
   d) one tertiary consumer.
2. Draw two food chains with four trophic levels each. Each must start with a different producer.
3. Because of drought and many veld fires during the past year, the number of shrubs creased dramatically.
   a) Suggest how this will affect the numbers of other members of the food web.
   b) Is this disruption caused by natural or human factors? Explain your reasoning.
4. Caracals are often killed by poisoning. More caracals have been killed this past year, and numbers are very low.
   a) Suggest how this will affect the numbers of the other members of the food web.
   b) Is this disruption caused by natural or human factors? Explain your reasoning.
5. Because of a mysterious disease the number of baboons has dropped dramatically.
   a) Suggest how this will affect the numbers of other members of the food web.
   b) Is this disruption caused by natural or human factors? Explain your reasoning.
6. Good rains have caused large numbers of locust to arrive in the habitat.
   a) Suggest how this will affect the number of shrike.
   b) Farmers began spraying pesticides air to kill the locusts. Suggest how this will affect the numbers of other members of the food web.
   c) Are these disruptions caused by natural or human factors? Explain your reasoning.
Lesson 6

Adaptations

What is an adaptation?
The organisms living in any habitat must be able to survive the environmental conditions within that habitat. To be able to survive they must have features that will give them an advantage over other organisms with respect to getting resources such as food, water and shelter. This ecological advantage is the driving force of evolution. Members of the same community may have similar adaptations to cope with the problems of their habitat. For example, many small animals and plants that live in fast-flowing rivers are streamlined to stop them being swept away.

Adaptations can include any of the following:

- Structural – A giraffe has a long neck to enable it to reach food higher up. The structure of the neck gives it an advantage over other species that browse on trees as there is no competition for the leaves at the top of the tree.

- Functional – When you talk about the wings of birds, you normally associate them with flight. That is their function. However the wings of a jackass penguin have been adapted to swim: same structure but a different function.

- Behavioural – The African bullfrog is found in southern African savannah, grassland and even desert habitats. To survive the dry season it burrows underground. Here, the frog can remain fairly cool and moist, but it cannot feed. Without food, it slows down its metabolism and enters a dormant state. This is called aestivation. During the short rainy season, the frog emerges from the burrow to feed in and around pools of water.

Mammalian predators and prey have many adaptations to help them find food or protect themselves from being eaten. Carnivores have eyes in the front of their head so that they can judge distances accurately. Predators also tend to have better-developed brains than their prey. This is because they need to select their victim and plan their method of capture. Prey tends to have better-developed sense organs such as sense of smell in order to detect predators early.

Examples of adaptation strategies

Mimicry
Mimicry is when a harmless animal (the mimic) copies the characteristics of a dangerous animal (the model) to trick a predator so that it does not eat the harmless animal. The monarch and viceroy butterflies are examples of species that display this type of mimicry.