



Module 3

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**Junior Secondary Science**

Living Organisms'  
Environment and Resources

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THE COMMONWEALTH *of* LEARNING

**Science, Technology and Mathematics Modules**  
**for Upper Primary and Junior Secondary School Teachers**  
**of Science, Technology and Mathematics by Distance**  
**in the Southern African Development Community (SADC)**

**Developed by**  
**The Southern African Development Community (SADC)**

**Ministries of Education in:**

- **Botswana**
- **Malawi**
- **Mozambique**
- **Namibia**
- **South Africa**
- **Tanzania**
- **Zambia**
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## SCIENCE, TECHNOLOGY AND MATHEMATICS MODULES

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This module is one of a series prepared under the auspices of the participating Southern African Development Community (SADC) and The Commonwealth of Learning as part of the Training of Upper Primary and Junior Secondary Science, Technology and Mathematics Teachers in Africa by Distance. These modules enable teachers to enhance their professional skills through distance and open learning. Many individuals and groups have been involved in writing and producing these modules. We trust that they will benefit not only the teachers who use them, but also, ultimately, their students and the communities and nations in which they live.

The twenty-eight Science, Technology and Mathematics modules are as follows:

### **Upper Primary Science**

- Module 1: *My Built Environment*
- Module 2: *Materials in my Environment*
- Module 3: *My Health*
- Module 4: *My Natural Environment*

### **Junior Secondary Science**

- Module 1: *Energy and Energy Transfer*
- Module 2: *Energy Use in Electronic Communication*
- Module 3: *Living Organisms' Environment and Resources*
- Module 4: *Scientific Processes*

### **Upper Primary Technology**

- Module 1: *Teaching Technology in the Primary School*
- Module 2: *Making Things Move*
- Module 3: *Structures*
- Module 4: *Materials*
- Module 5: *Processing*

### **Junior Secondary Technology**

- Module 1: *Introduction to Teaching Technology*
- Module 2: *Systems and Controls*
- Module 3: *Tools and Materials*
- Module 4: *Structures*

### **Upper Primary Mathematics**

- Module 1: *Number and Numeration*
- Module 2: *Fractions*
- Module 3: *Measures*
- Module 4: *Social Arithmetic*
- Module 5: *Geometry*

### **Junior Secondary Mathematics**

- Module 1: *Number Systems*
- Module 2: *Number Operations*
- Module 3: *Shapes and Sizes*
- Module 4: *Algebraic Processes*
- Module 5: *Solving Equations*
- Module 6: *Data Handling*

## A MESSAGE FROM THE COMMONWEALTH OF LEARNING

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*Dato' Professor Gajaraj Dhanarajan*  
President and Chief Executive Officer

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# JUNIOR SECONDARY SCIENCE PROGRAMME

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## Introduction

Welcome to the programme in Teaching Junior Secondary Science. This series of four modules is designed to help you to strengthen your knowledge of science topics and to acquire more instructional strategies for teaching science in the classroom.

Each of the four modules in the science series provides an opportunity to apply theory to practice. Learning about science entails the development of practical skills as well as theoretical knowledge. Each science topic includes an explanation of the theory behind the science, examples of how the science is used in practice, and suggestions for classroom activities that allow students to explore the science for themselves.

Each module also explores several instructional strategies that can be used in the science classroom and provides you with an opportunity to apply these strategies in practical classroom activities. Each module examines the reasons for using a particular strategy in the classroom and provides a guide for the best use of each strategy, given the topic, context and goals.

The guiding principles of these modules are to help make the connection between theory and practice, apply instructional theory to practice in the classroom situation and support you, as you in turn help your students to apply science theory to practical classroom work.

## Programme Goals

This programme is designed to help you to:

- strengthen your understanding of science topics
- expand the range of instructional strategies that you can use in the science classroom

## Programme Objectives

By the time you have completed this programme, you should be able to:

- develop and present lessons on energy and energy transfer; the use of energy in electronic communication; the needs of living organisms and their environmental resources; and the study of scientific processes. The topics on energy and the environment will focus on learning, through the scientific inquiry method, ways to achieve a sustainable environment
- guide students as they work in teams on practical projects in science, and help them to work effectively as a member of a group
- use questioning and explanation strategies to help students learn new concepts related to energy and to support students in their problem solving activities
- guide students in the use of investigative strategies to learn more about particular technologies, and to find out how tools and materials are used in science
- prepare your own portfolio about your teaching activities
- guide students as they prepare their portfolios about their project activities

### ***The relationship between this programme and the science curriculum***

The science content presented in these modules includes some of the topics most commonly covered in the science curricula in southern African countries. However, it is not intended to cover all topics in any one country's science curriculum comprehensively. For this, you will need to consult your national or regional curriculum guide. The curriculum content that is presented in these modules is intended to:

- provide an overview of the content in order to support the development of appropriate teaching strategies
- use selected parts of the curriculum as examples for application of specific teaching strategies
- explain those elements of the curriculum that provide essential background knowledge, or that address particularly complex or specialised concepts
- provide directions to additional resources on the curriculum content

### **How to Work on this Programme**

As is indicated in the programme goals and objectives, this programme provides for you to participate actively in each module by applying instructional strategies when exploring science with your students and by reflecting on that experience. There are several different ways of doing this.

#### ***Working on your own***

You may be the only teacher of science in your school, or you may choose to work on your own so you can accommodate this programme within your schedule. If this is the case, these are the recommended strategies for using this module:

1. Establish a schedule for working on the module: choose a date by which you plan to complete the first module, taking into account that each unit will require between six to eight hours of study time and about 2 hours of classroom time for implementing your lesson plan. For example, if you have 2 hours a week available for study, then each unit will take between 3 and 4 weeks to complete. If you have 4 hours a week for study, then each unit will take about 2 weeks to complete.
2. Choose a study space where you can work quietly without interruption, for example, a space in your school where you can work after hours.
3. If possible, identify someone who is interested in science or whose interests are relevant to science (for example, a math or science teacher in your school) with whom you can discuss the module and some of your ideas about teaching science. Even the most independent learner benefits from good dialogue with others: it helps us to formulate our ideas—or as one learner commented, “How do I know what I’m thinking until I hear what I have to say?”

### ***Working with colleagues***

If you are in a situation where there are other teachers of science in your school or in your immediate area, then it is possible for you to work together on this module. You may choose to do this informally, perhaps having a discussion group once a week or once every two weeks about a particular topic in one of the units. Or, you may choose to organise more formally, establishing a schedule so that everyone is working on the same units at the same time, and you can work in small groups or pairs on particular projects. If you and several colleagues plan to work together on these modules, these are the recommended steps:

1. Establish and agree on a schedule that allows sufficient time to work on each unit, but also maintains the momentum so that people don't lose interest. If all of you work together in the same location, meeting once a week and allocating two weeks for each unit, this plan should accommodate individual and group study time. If you work in different locations, and have to travel some distance to meet, then you may decide to meet once every two weeks, and agree to complete a unit every two weeks.
2. Develop and agree on group goals, so that everyone is clear about the intended achievements for each unit and for each group session.
3. Develop a plan for each session, outlining what topics will be covered and what activities will be undertaken by the group as a whole, in pairs or in small groups. It may be helpful for each member of the group to take a turn in planning a session.

Your group may also choose to call on the expertise of others, perhaps inviting someone with particular knowledge about teaching or about a specific science topic to speak with the group, as long as this is in keeping with the goals of the module and of the group.

Your group may also have the opportunity to consult with a mentor, or with other groups, by teleconference, audioconference, letter mail or e-mail. Check with the local coordinator of your programme about these possibilities so that you can arrange your group schedule to be compatible with these provisions.

### ***Colleagues as feedback/resource persons***

Even if your colleagues are not participating directly in this programme, they may be interested in hearing about it and about some of your ideas as a result of taking part. Your head teacher or the local area specialist in science may also be willing to take part in discussions with you about the programme.

### ***Working with a mentor***

As mentioned above, you may have the opportunity to work with a mentor, someone with expertise in science education who can provide you with feedback about your work. If you are working on your own, your communication with your mentor may be by letter mail, telephone or e-mail. If you are working as a group, you may have occasional group meetings, teleconferences or audioconferences with your mentor.

### ***Using a learning journal***

Whether you are working on your own or with a group, it is strongly recommended that you use a learning journal. The learning journal serves a number of different purposes, and you can divide your journal into compartments to accommodate these purposes. You can think of your journal as a "place" where you can think out loud by writing down your ideas and thoughts, and this "place" has several "rooms".

### *Ideas/Reflections/Questions*

In one part of your journal, you can keep notes and a running commentary about what you are reading in each unit, write down ideas that occur to you about something in the unit, and note questions about the content or anything with which you disagree. You can use this part to record general ideas about how to use some of the content and strategies in the classroom. If you consistently keep these notes as you work through each unit, then they will serve as a resource when you work on the unit activity, since you will have already put together some ideas about applying the material in the classroom. This is also the section of the journal for your notes from other resources, such as books or articles you read or conversations with colleagues.

### *Plans*

This is the section where you work on your activity for each unit. At the start of each unit, you should start considering what activity you will choose to do, and then develop your ideas as you go along. Each activity will also have specific guidelines.

### *Observations/Reflections*

This is the section where you record your observations about classroom experiences, how students seem to tackle various situations and how each instructional strategy works in practice. This is the place to record your notes after you implement the unit activity about what you feel worked well and what could be improved. If you are part of a group, you can keep your notes about good practice and effective group dynamics, based on the group experience, in this section.

### ***Resources available to you***

Although these modules can be completed without referring to additional resource materials, your experience and that of your students can be enriched if you use other resources as well. There is a list of some of the resource materials for each module provided at the end of that module.

### *Tips for selecting resources*

Working with locally available resources may require selecting those that are most appropriate from among materials that may not be complete or relevant. When reviewing materials to see if they will help you with the module, consider:

- Which module topics does this material address?
- Is it possible the ideas in this material are transferable to the science classroom?
- Is it possible the ideas in this material are transferable to the technologies included in the module?

# ICONS

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Throughout each module, you will find some or all of the following icons or symbols that alert you to a change in activity within the module.

Read the following explanations to discover what each icon prompts you to do.

	<b>Introduction</b>	Rationale or overview for this part of the course.
	<b>Learning Objectives</b>	What you should be able to do after completing this module or unit.
	<b>Text or Reading Material</b>	Course content for you to study.
	<b>Important—Take Note!</b>	Something to study carefully, or a possibly harmful action/substance.
	<b>Individual Activity</b>	An exercise or project for you to try by yourself and demonstrate your own grasp of the content.
	<b>Classroom Activity</b>	An exercise or project for you to do with or assign to your students.
	<b>Reflection</b>	A question or project for yourself— for deeper understanding of this concept, or of your use of it when teaching.
	<b>Summary</b>	
	<b>Unit or Module Assignment</b>	Exercise to assess your understanding of all the unit or module topics.
	<b>Suggested Answers to Activities</b>	
	<b>Equipment</b>	List or description of any apparatus or tools that this activity requires

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# Module 3: Living Organisms' Environment and Resources

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## Module 3 Overview

This module, like others in the Stamp 2000 series, is not a textbook, but is intended as support material to help you prepare and deliver learner-centred lessons in your science teaching.

Topics include the living organism's environment, the use of resources, population studies, and the need to conserve resources. As you work through the units in this module, keep the following points in mind:

- The activities will serve as a guide on how to apply a specific method for the selected content as well as give you a learning opportunity.
- For each activity, you will be asked to write out notes and lesson plans in your plan book/note book or Learning Journal. This work will constitute your teaching notes. You could divide this book into teacher activities and pupil activities.
- Include possible/expected answers where questions are used.
- If you change any of the activities, make a note of this and assess your progress after each unit. Keep a record of the change/assessment in your note book for future reference.
- Try applying the method(s) from one unit to an activity in another unit. This will help you gain confidence in applying different teaching methods to new material.
- Try to integrate the contents of this topic with other contents in your course. This will help your pupils broaden their understanding of the subject.
- Group work is strongly advised for all the activities, but try to reach each pupil in your class by assigning individual work as well.

In this module, the following teaching strategies are used:

- the mind map
- questioning techniques
- case studies
- role playing
- structured investigation

You are, of course, free to use other methods in addition to those proposed here.

## Module Objectives

The aim of this module is to make you aware of:

1. the damage that can occur in the environment as a result of living organisms extracting resources
2. possible conservation solutions to these problems



## Learning Outcomes

Once you have worked through the material in this module and carried out the activities with your pupils, you will:

- be able to identify the resources living organisms obtain from the environment
- have an understanding of the damage caused by living organisms in the environment
- be aware of the link between population size and environmental damage
- be able to describe conservation and restoration measures that can be taken to address and prevent environmental problems

# Unit 1: The Environment and Resource Use of Living Organisms

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## Introduction

The activities in this unit will help you deliver learner-centred lessons for this content. The natural environment is a very important teaching resource and you are advised to use it for the activities of this unit. The mind map and questioning techniques are used but you should try to use other methods as well. Where the activities do not fit your situation, try to modify them to suit your circumstances.



## Objectives

After completing this unit you should be able to:

- describe a living organism's environment
- list the resources required by living organisms
- identify how organisms use these different resources
- construct mind maps
- formulate appropriate questions to direct your pupils' investigation



## Content

### ***Living Organisms, Environment, and Resources***

All those things that occur around an organism form an environment for that particular organism. This environment is made up of natural and artificial components.

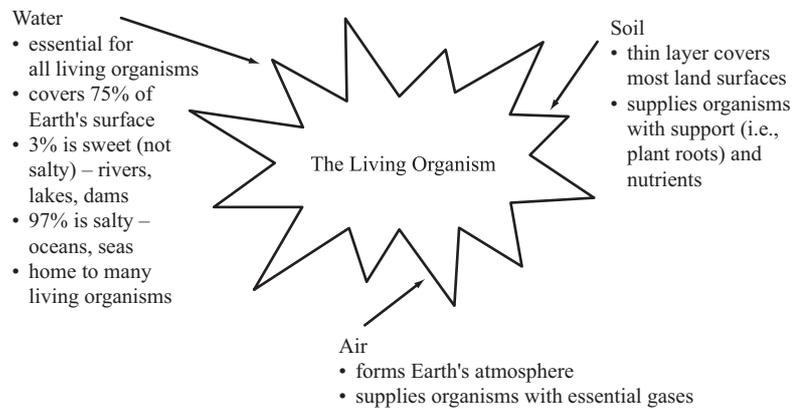
### ***Natural Environment***

The natural environment can be divided into physical and biological components. Examples of some of the physical components are soil, water, air, light, landforms, and energy. Some components are used by organisms for their livelihood.

The physical components of the environment are important resources on which living organisms, including human beings, depend directly or indirectly. Plants take up nutrients and water from the soil and carbon dioxide from the air and, using energy from the sun, produce compounds like carbohydrates. Herbivores consume plants for their livelihood. Through this process, plants take physical components from the environment and turn them into biological components.

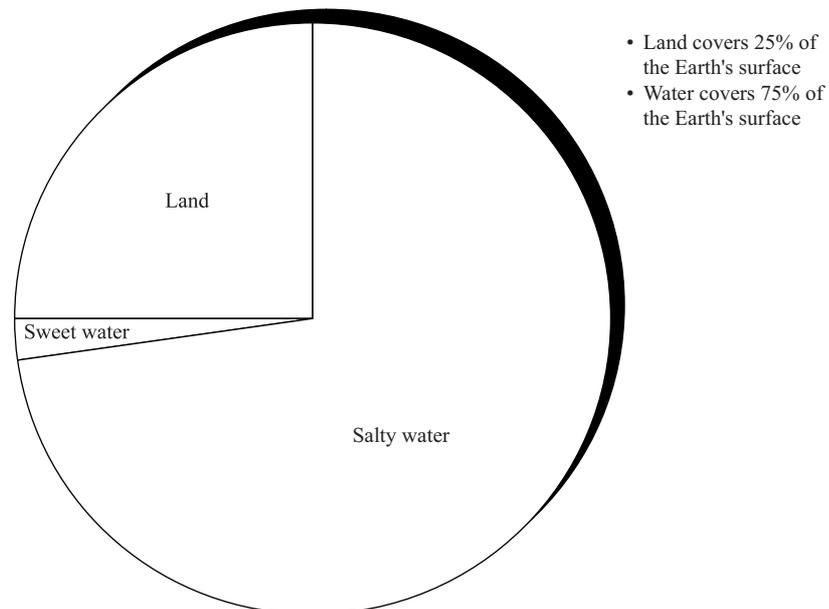
The biological components of the environment are represented by all living organisms, including plants, animals, fungi, bacteria, and viruses. Predators and parasites depend on other animals, especially herbivores, which in turn depend on plants. Therefore, plants and herbivorous animals form immediate resources for other living organisms, including humans.

### ***The Living Organism's Natural Environment***



*Figure 3.1*

### ***The Pie Chart for Soil and Water***



*Figure 3.2*

### ***Artificial Environment***

The artificial environment is comprised of manufactured objects and structures. Humans make machines and build houses, roads, bridges, etc., using resources from the natural environment. These manufactured items make up the artificial components of the overall environment.

## **Renewable and Non-Renewable Resources**

Some of the resources found in the natural physical environment are said to be renewable, meaning that they are replaced as they are used. A typical example is sunlight.

Other resources like soil and minerals, as well as coal and petroleum, are regarded as non-renewable. Topsoil can be washed into lakes, rivers, and eventually into the ocean, and it cannot be recovered. The process of forming fossil fuels (coal and petroleum) takes millions of years, an extremely long period of time. The rate at which these resources are replaced is too slow to match the rate at which they are being used, therefore they are regarded as non-renewable resources.

Humans must use non-renewable resources with extra care if we are to continue to have their benefit for a long time. This concept will be discussed in more detail in Unit Four.



## **Teaching Strategies**

The teaching and learning activities in this unit will centre mainly around mind mapping and questioning techniques.

### ***Mind Map***

In Module One, you learned how to use a mind map in your classroom to encourage participatory learning by your pupils. You can also use a mind map at the lesson-development stage for solving problems, at the introductory stage of your lesson to brainstorm with your pupils, or to help your pupils review what they have just learned.

To draw a mind map, begin by writing the theme word at the centre of a page or chalk board. In place of the theme word, you can draw a picture or symbol using different colours. The use of colour can help categorise information, draw attention to important points, and to stimulate pupils' thinking.

Write or draw your pupils' ideas on main branching lines that are connected to the central theme word or image. You can then add facts by drawing smaller lines to the appropriate main branch lines, just like a tree. To link ideas and thoughts on different branches of the mind map, use arrows, colours, underlining, and boxes.

### ***Questioning Technique***

Question and answer is one of the teaching strategies used by teachers. The effectiveness of the questioning technique depends on the quality of questions:

- Are the questions clear and appropriate to the subject matter being covered?
- Are the questions at the level of development of the pupils?

It is important to balance low-order and higher-order questions. Low-order questions are those that require a one-word answer. An example of a low-order question would be:

*“What is the word that refers to the things in the environment that an organism uses for its livelihood?”*

Higher-order questions require the pupil to comprehend, apply, analyse, synthesise, and evaluate the learned information to answer the question. An example of a higher-order question would be:

*“Explain why coal and petroleum can be regarded as non-renewable resources.”*

The table below summarises the six kinds of questions based on Bloom’s Taxonomy.

Type of Question	Purpose	Words Used in Questions	
Knowledge	To remember specific facts.	who where define name	what when recall recognise
Comprehension	To organise facts to make sense of something.	describe compare construct	explain rephrase
Application	To apply information or rules to solve a problem or understand something.	apply solve how many which give an example	what is classify use choose
Analytical	Explain reasons, causes, or understand the nature of something.	what factors draw conclusions give evidence	
Synthesis	To see relationships or connections in order to create new ideas or predict outcomes.	predict produce develop what would happen if	
Evaluation	To choose from alternatives based on some stated value.	judge evaluate justify why do you agree which is better	decide assess

It is important to use follow-up questions to help pupils elaborate and improve on the quality of their answers and responses.

Remember the four Ps in questioning:

- pose a question
- pause for a moment
- pounce on a target pupil
- praise the pupil for making an effort to respond whether they give a correct response or not

Pausing after asking a question gives pupils time to reflect on the question before responding. The length of the waiting time depends on several factors, some of which might be the pupils' age or ability, degree of difficulty of the question, and the rapport between the teacher and the pupils. The topic of questioning techniques was covered in Module One. Please refer to the article found at the end of that module if you need to review this topic.



## Individual Activity

How you would teach the first lesson on the topic “Investigating the Living Organism’s Environment and Resources”? It might be useful to begin by determining what your pupils already know. Then try to work out the sequence for your lesson plan and write down all the points that come to mind. Write down your ideas as soon as they come to mind—you can rearrange them later.

Compare your ideas with those in the following list:

- Topic title
  - always give your lesson plan a title, and write it on the chalkboard during lesson delivery. This will keep your pupils focused on the topic
  - during their review, lesson titles will help pupils indicate which topics they have difficulty understanding
- Objectives—what your pupils have to learn for a given topic
  - check your syllabus to determine what activities you need to develop for your pupils
  - this forms the objectives of your lesson and should be expressed in a way that clearly states the abilities your pupils need to develop
- How will you teach this content?
  - think of the best method to use to teach this content
  - use questions and mind maps to find out what your pupils already know about this content and to stimulate discussion
- Use your note book or plan book to develop your lesson
  - copy the mind map diagram given in *Figure 3.3* into your note book
  - add your own ideas of what living organisms obtain from the environment
  - this exercise would be more interesting if done by more than one person
  - involve an interested friend or family member who has a basic understanding of this topic

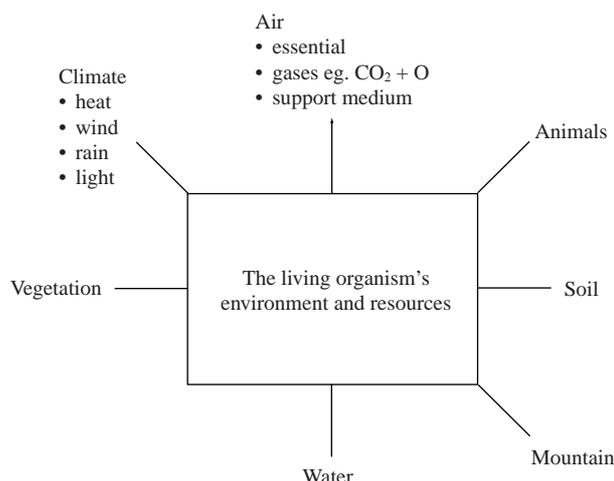


Figure 3.3

The words in the above mind map (*Figure 3.3*) represent components of the environment and the bulleted words below them (if any) indicate some of the resources a living organism might use or require. Note that this mind map is a generalised one, and does not refer to specific living organisms.

In your lesson delivery, you can ask your pupils to work on mind maps for specific organisms, e.g., one for a specific animal or plant. This could be given to them after the general mind map is explained. This type of activity will improve their understanding of the different ways plants and animals use resources from the environment.

Keep your notes and lesson plans in your note book and use them when you teach this lesson.



## Classroom Activity

### **Formulating Workshop Questions**

The natural environment is a rich teaching resource. In this activity, the investigation and questioning techniques will be used to determine the different ways that living organisms use resources from their environment.

As much as possible, science teaching should be practical rather than theoretical. In this activity, you will:

- design a worksheet that your pupils can use as they carry out an investigation on living organisms' resources and their uses
- formulate questions to guide your pupils to identify a living organism, its resources, and the different uses these resources have in the life of the organism
- lead your students in an investigation of an environment near your school

Refer back to the section on questioning techniques. You can begin to organise your ideas by making a list of points for which you will ask questions. These points might include:

- types of living organisms in the area of study
- type of environment surrounding the different organisms
- resources they obtain from the environment
- how they use these resources
- if these resources are used in such a way that they will last a long time
- if these resources are used in such a way that they will run out some day
- if these resources are renewable or non-renewable
- a general comment about the investigation findings

Refer to your lesson objectives so that your worksheet covers them completely. Once you have done this, it becomes easy to formulate your questions. The worksheet should have clear and complete instructions for your pupils. By doing this, you will avoid wasting time during the actual investigation.

Identify a place where you will carry out the investigation with your pupils. The questions you ask should be based on this place.

The worksheet questions for this unit activity should guide your students to discover what resources are found in the living organism's environment and what they are used for. The following worksheet gives examples of specific types of questions, but you do not have to follow the order, or limit yourself to these questions. You can ask low-order questions to establish the pupils' knowledge base, and combine comprehension, application, analysis, synthesis, and evaluation to form higher-order questions. By balancing your questions according to this classification, your worksheet will sharpen the thinking skills of your pupils.

### ***The Worksheet***

Aim: To investigate the living organism's environment and resources

Materials: Cardboard, pencil, worksheet, record sheet

Instructions:

- In groups of four or five, read through the questions in your worksheet and carry out the investigation of a given area using these questions.
- Record your answers on the record sheet.
- One member of the group will be selected at random and asked to give a report to the class.



Type of Question	Example(s) of Question
Knowledge	1. What components of the environment are found in your area of study?
Application	1. Classify these components into living and non-living. 2. Which type of living organism is most abundant in your area of study?
Comprehension	1. Explain how various living organisms benefit from the environment. 2. Compare the resources required by plants with those required by animals.
Analysis	1. For the most abundant organism, explain why it is the most abundant.
Synthesis	1. What relationship can you establish between the resources and the distribution of living organisms?
Evaluation	1. Is it important to study about living organisms in the environment and their resources? Why?

### ***The Record Sheet***

Structure your pupils' record sheets in a way that makes it easy for them to complete during their investigation. Here is an example:

Living Organisms	Nature of the Environment	Resources Obtained from the Environment	What are the Resources Used For?
Plants	Soil	Water, nutrients	Formation of Food
	Air	Carbon dioxide	Photosynthesis



### **Classroom Activity**

Identify another study area, different from the one you used for the above activity, such as a pond or a polluted river.

Design a worksheet to guide your pupils through an investigation on the living organisms and their resources in this environment. Your questions should include both high and low order questions.



## Summary

- Living organisms obtain vital materials, e.g., nutrients, food, essential gases and sunlight from their environment.
- The environment is made up of the things that surround the living organisms, e.g., water, soil, and land.
- The things that living organisms obtain from the environment are called resources.
- Some of these resource materials are renewable while others are not.
- Mind maps can be used to find out what the pupils already know.
- Good questions can be used to guide pupils to carry out an investigation on a living organism's environment and its resources.



## Reflection/Self Assessment

- Were your questions clearly understood by your pupils? Refer to the type of answers they gave.
- Were you able to formulate questions of different categories?
- Do you think the method you used successfully covered the content?
- What challenges did you encounter in using this method?
- Do you think you dealt successfully with these challenges?



## Unit Assignment

1. List two examples for the following:
  - a. things that form part of a living organism's natural environment
  - b. things that form part of a living organism's artificial environment
  - c. resources that are obtained by all living organisms from the environment
2. What are the features of:
  - a. low order questions
  - b. high order questions
3. When is it best to use a mind map?

## Unit 2:

# The Environmental Implications of Using Resources

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### Introduction

This unit focuses on the problems that occur in the environment as a result of living organisms using the resources. Environmental issues covered here include pollution, deforestation, and soil erosion. In this unit, case studies are used as the main strategy supported by the questioning technique.

It is important to know how different methods are used as this will give you a broader choice in selecting methods to use for different content. As much as possible, try to adapt these methods to new situations. Remember—first teach and review the general things that pupils might already know, then teach the new material. You should keep this approach in mind for other content that you teach.



### Objectives

After going through this unit you should be able to:

- Identify signs of environmental damage resulting from the use of resources by living organisms.
- State how organisms damage the environment.
- Describe how the use of resources affects living organisms and the environment.
- Use a case study to investigate environmental damage caused by living organisms.
- Formulate questions for pupils to work with in a case study.



### Content

#### ***Environmental Damage***

Anything that destroys or causes harm to the natural environment is a source of environmental damage. Most of this damage comes from human activities. To a lesser extent, other living organisms also cause damage to the environment.

Pollution is the contamination of a resource by harmful or poisonous substances. Contamination can take place in water, soil, or air, which are the main components of the environment surrounding living organisms.

Water can be polluted by chemical waste, agricultural waste, and domestic waste. Can you list some industrial waste that might have found its way into a river in your area?

The land/soil can be polluted by agricultural chemicals and by the dumping of rubbish and domestic waste.

The air is mainly polluted by gases produced from burning fuel in industries and vehicles.

Pollution is the result of industry making goods that maintain our standard of living and can come in different ways. The pictures below show examples of different types of pollution.

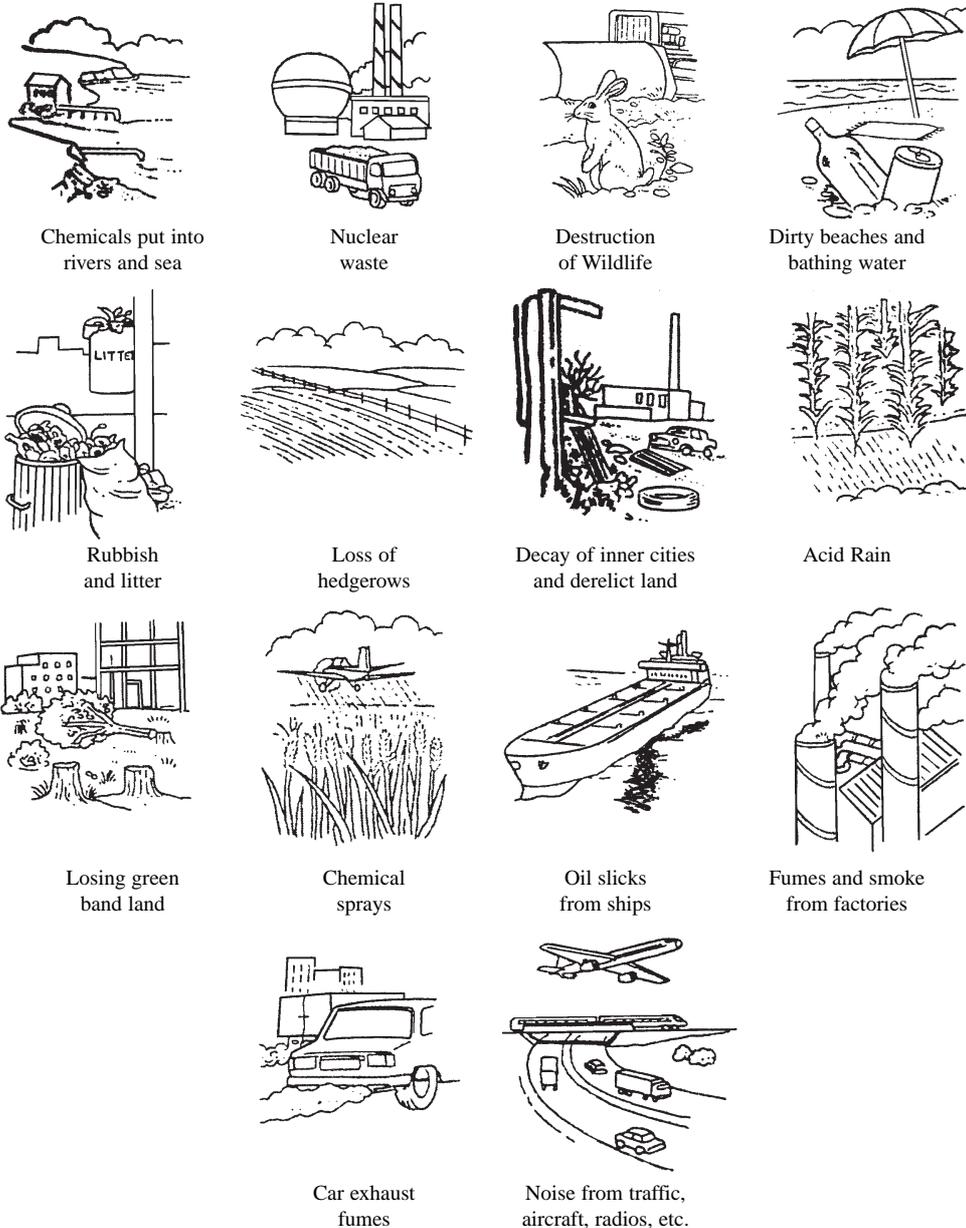


Figure 3.4: Adapted from Applin, D., Buzan, T. (Revised GCS Biology)

Deforestation occurs when forests are destroyed, intentionally or unintentionally, by living organisms. Human activity is the main cause of this environmental damage, arising from the demands for wood for the construction industry and for fuel, and from clearing forests for agricultural use.

When rich, fertile soil is lost from the land due to various causes, this is referred to as soil erosion. The main causes are poor farming methods, including over-stocking domestic livestock (cattle, goats, etc.) and the cultivation of slopes. Poor farming methods expose the soil to environmental forces leading to soil erosion and the formation of gullies.

Eventually, the products of erosion are transported into rivers, lakes, and reservoirs and deposited. This process is called siltation. It reduces the depth of lakes and reservoirs, inhibits plant and aquatic life, and can even affect the quality of drinking water.



## Teaching Strategy

The teaching strategy for this unit is the case study supported by the questioning technique. Refer to Unit One of this module for details on the questioning technique.

### Case Study

A case study is an attempt to interpret a specific problem or problems relating to an event or situation, and can be based on a real or a hypothetical situation. The purpose and objectives of the case study should be clearly stated. The content of a case study is usually a narrative account that describes the problem, the methods used to analyse it, and the observations that were made. This analysis is based on collected information, and usually includes how the situation was created as well as the various stages of development leading up to the state of the situation at the time of evaluation. The situation should be solvable but complicated enough so the solution is not obvious, and observations should be realistic and believable. The issues in the case study should generate discussion.

A case study should:

- stimulate reflection and discussion by learners in order to analyse a problem
- encourage learners to be open to suggestions, new view points, and the feelings of others
- provide an opportunity to practise dealing with a situation before actually encountering it
- allow participants to analyse and solve real-life dilemmas without having to leave the classroom
- allow each member of a group to participate fully and make decisions about solving the problem
- give participants the opportunity to overcome shyness, share their views, practise negotiation and communication skills, respect the thinking of others, and be unbiased in viewpoint and judgement
- help develop analytical and problem solving skills

A significant amount of time is required to develop and implement the case study. Emphasise to your pupils that no definite solutions exist for the case study problems. This will encourage them to take part in and contribute to the discussion.



## Classroom Activity – A Case Study

In this activity, your pupils will investigate environmental damage caused by living organisms. Using a case study about a hypothetical game park, formulate questions to help your pupils learn about wildlife management principles.

The Gomba villagers were indiscriminately hunting animals for meat. Some of the animal populations dwindled to such low levels that if nothing was done, some species would be eliminated from that area.

To protect the remaining animals, the Department of Wildlife Management decided to create a game sanctuary. They did this by choosing a heavily vegetated area of land measuring 20 kilometres wide and 20 kilometres long, which had a small river through it. The area was enclosed with a high, diamond wire fence. Some of the animals in the enclosed area included: ten impalas, four kudus, two giraffes, two bush bucks, eight hares, two elephants, and three wildebeests. To provide drinking water for the animals, the small river was dammed to create a reservoir. The sanctuary was guarded by six game rangers who kept potential poachers away.

For the first ten years, everything appeared to go well with the various animal populations increasing steadily. By the fifteenth year of the project, land that was once thickly forested was showing signs of deforestation. Most large trees had lost their branches and the bush had virtually disappeared. Almost three-quarters of the land remained bare for much of the year.

The trails the animals used to go to the reservoir for water had developed into deep gullies and each time it rained, the water in the dam would remain muddy for a long time. In addition, the depth of the water in the reservoir had been drastically reduced.

The following questions will help to lead your pupils in a thought-provoking discussion about the case study. Can you think of other questions?

1. Why was it necessary to build a wildlife sanctuary?
2. Identify the special characteristics of the sanctuary that made it ideal.
3. Study the number of animals that were initially in the sanctuary and discuss why:
  - the numbers were right to start with
  - only these animals were allowed in the sanctuary
4. Why did it take as long as ten years for the sanctuary to show signs of environmental destruction?
5. What do you think will happen if the sanctuary is allowed to continue as it is for another five years?
6. Suggest at least two intervention measures that should be undertaken to improve the sanctuary. One of these suggestions should simulate a natural situation.
7. Is a sanctuary a good way to manage resources? Explain your answer.



### ***Comments and Possible Responses to the Classroom Activity Case Study Questions***

1. The answer to this question can be obtained from paragraph one. It is a relatively easy question and getting an answer will encourage the learner to continue.
2. Although the answer is contained in paragraph two, the learner is required to think beyond the case study.
3. The learner has to analyse the situation and work on drawing conclusions:
  - Only herbivores (vegetation eaters) were allowed in the sanctuary. Carnivores (meat eaters) were not placed in the sanctuary because they would have eaten the herbivores.
  - The numbers were low so that the environment would not be damaged beyond repair and would have a chance to recover.
4. The learner evaluates and assesses the situation to give reasons why something happens. The animal numbers built up steadily to reach a population size that exceeded the environmental carrying capacity of the sanctuary.
5. The learners are required to take a current situation, bring in a possible future situation for comparison, and predict possible outcomes.
  - The reservoir will become shallower, leading to a shortage of water.
  - Ground cover will continue to diminish, leading to food shortages.
  - There is a possibility that animals will die due to starvation and dehydration.
6. Making use of previous knowledge, learners are expected to suggest possible solutions to the problems they are faced with:
  - Introduce a carnivore(s) into the sanctuary.
  - Transport some of the animals to another area.
  - Systematically kill some of the animals, reducing their numbers to meet the carrying capacity of the environment.
7. Encourage your pupils to use their knowledge and experience to arrive at a solution(s) to the problem of wildlife management. For example,
  - If the sanctuary is properly managed, the environment remains stable because the carrying capacity of the environment is not be exceeded.



## Individual Activity

Identify a suitable case study and write out questions for your pupils to investigate environmental damage at this place. The questions should help your pupils focus on:

- the nature of damage to the environment
- how the problem developed
- possible solutions for the problem(s)
- what your pupils can do to help solve the problem



## Summary

- Living organisms sometimes use resources in such a way that the resources are not in a good state for other organisms to use.
- Human activity is a main contributor to the destruction of the environment.
- Major indicators of environmental damage are deforestation, formation of gullies, siltation of rivers and lakes, and air and water pollution.
- Living organisms, especially humans and large animals, can destroy the ground cover and expose the land to soil erosion.
- Industrial activities are a major source of air and water pollution.
- Well-chosen teaching strategies contribute to pupils' positive learning.
- It is important to choose case study content carefully for it to be effective.
- Well-constructed questions help pupils focus on issues.



## Reflection/Self Assessment

1. In your opinion do you think you used the case study effectively?
2. How well did your pupils participate in the case study?
  - What improvements can you suggest to help your pupils understand better?
  - Do you think the activities in this unit helped your pupils understand that the environment is destroyed by organisms using the resources in the environment?
  - Are there any disadvantages to using a case study?



## Unit Assignment

1. What are the signs of damage to the following resources:
  - a. soil
  - b. water
  - c. vegetation
2. Which two animals are the main destroyers of the environment in your region?
3. What are the advantages of using a case study?

## Unit 3: Population Studies

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### Introduction

Environmental issues can never make complete sense unless a study of the population of living organisms is carried out. It is important to know the relationship between the resources in the environment and the numbers of organisms using these resources. From this relationship, a number of things can be established about the ability of the environment to support these living organisms.

- Can the environment support the population?
- How long will the resources last?
- Can all the organisms continue to survive?

In this unit, the investigation method is used to determine factors that control the size of a population.



### Objectives

After completing this unit you should be able to:

- define a population of living organisms
- identify populations of different living organisms at a given place
- carry out population counts
- design investigation activities to study populations



### Content

#### ***Population***

A population is a group of living organisms of the same species found in a particular place at the same time.

## **Population Size**

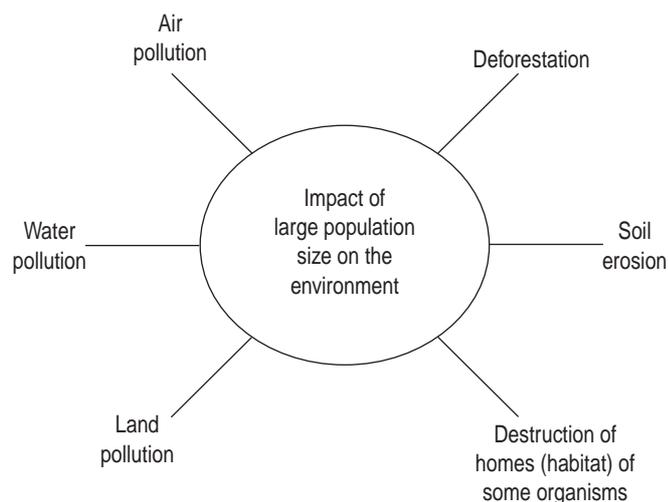
The size of a population can be affected by a number of factors:

- births and immigrations, which increase the size of a population
- deaths and emigrations, which decrease the size of a population
- limiting factors that prevent populations from growing indefinitely:
  - food
  - water
  - oxygen
  - light
  - shelter
  - disease
  - drought
  - flooding

## **Population Counts**

Large populations can create a strain on natural resources and might cause serious problems in the natural environment, including:

- damage to the environment by removing ground cover and exposing soil to erosion
- a shortage of nutrients and other resources
- disturbances of feeding relationships and a reduction of the space available for other organisms

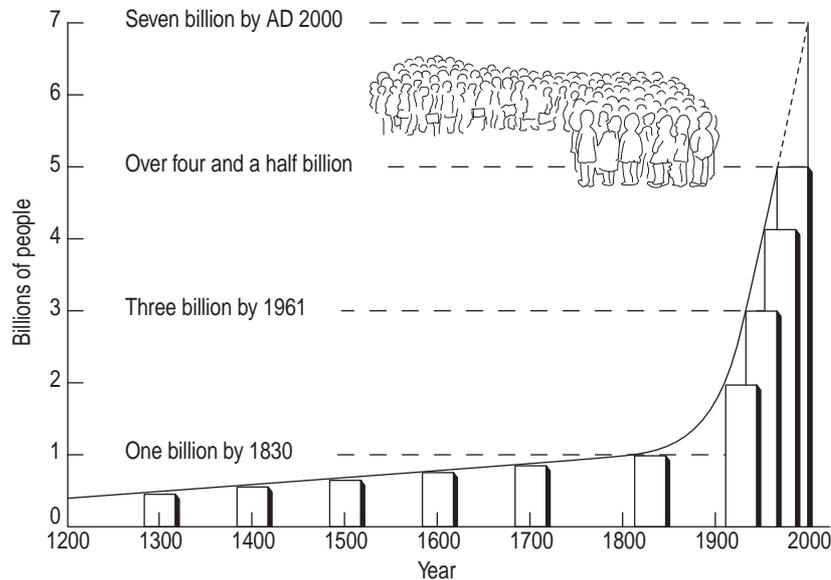


*Figure 3.5*

The human population has grown rapidly over the past years. To monitor this growth, the United Nations Population Fund provides money to all countries in the world to take a population count every ten years. Such studies help in planning and delivering social services.

We also conduct population counts of various animals that can cause environmental damage (e.g., elephants) and those whose numbers are low (e.g., rhinoceros).

Below (*Figure 3.6*) is a human population growth curve between the years 1200 and 2000.



*Figure 3.6*

## Teaching Strategies

Investigation consists of practical activities carried out to identify problems and search for solutions. This method, if used well, helps pupils to develop skills in:

- observation
- experimentation
- data collection and analysis
- critical thinking
- problem solving

Procedure for the investigation method:

- identify an issue for investigation
- design an investigation instrument, e.g., worksheet, questionnaire, etc.
- collect and analyse data
- explain your findings

Characteristics of the investigation method:

- pupil-centred
- conceptual rather than factual
- interactive—the pupil is directly involved in an activity and encouraged to co-operate with others

Advantages of the investigation method:

- develops problem-solving skills
- helps pupils to independently acquire and critically examine information, with less dependence on the teacher
- pupils learn through doing
- encourages the application of learned information to new situations

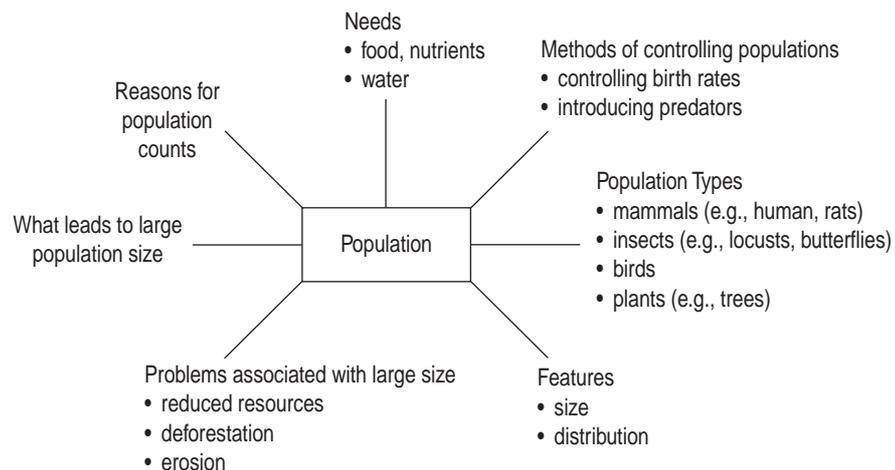
Limitations of the investigation method:

- success of the investigation phase is dependent on the planning phase—if not well-planned, the investigation might not be successful



## Individual Activity

Try using a mind map to define population. As part of your preparation for this activity, construct a mind map for the world population. This will help to identify issues related to population. On a new page in your plan book, copy the mind map given in this activity (*Figure 3.7*) with as many words or phrases that you associate with the term population under each sub-heading. To make the activity more interesting, invite a colleague to help you.



*Figure 3.7*

Did you like this activity? Try to apply it to new situations. First, establish sub-headings for the main idea you are dealing with, then list words or terms that apply. If you came up with words or ideas but were not sure where to place them, discuss these with a colleague who teaches the same subject. You might find solutions as well as new ideas.

In the above mind map (*Figure 3.7*), notice that the sub-heading can be used as sub-topics in the study of population. When beginning a new topic of study with your pupils, this kind of activity lays the foundation for other lessons. To help you think of as many words as possible for a given sub-heading, look up the topic in your textbooks.

From this information, try to build a general idea about a population of living organisms. Three things should be present in your definition:

- kind of organism (species) forming the population
- location of the population
- time period over which you refer to this population



## Classroom Activity

In this activity, you will lead your pupils in an investigation of the distribution of a grass genus or species on a given piece of land.

In the activity described here, the selected environment consists of dry land next to a swamp area. You could choose a grassland area with a stream passing through it, a lowland, or a depression with a lot of vegetation, etc.



### Materials

- 1 m × 1 m wooden square structure called a quadrant or long string and nails to mark some quadrants on a piece of land
- pencil
- record sheet
- tape measure or a 40 m long string

### Procedure

- Place your quadrant in a suitable place, i.e., with a lot of vegetation near the swamp.
- Identify the types of organisms inside your quadrant. You do not have to know the name of each organism. Use the letters of the alphabet to name those organisms you do not know.
- Carry out a population count of these organisms and enter them on your record sheet. The names you use in this quadrant must be maintained in other quadrants if the same kind of organism is found there.
- Remove the quadrant and place it 40 m from the first point. Identify and count the numbers of organisms in this quadrant and note them on your record sheet.

- Repeat the above procedure at 80 m, 120 m, 160 m and 200 m from the position of the first quadrant. Each time you move the quadrant, it should be further from the swamp. Record the data in a chart.

RECORD SHEET		
Distance from the Swamp	Types of Organisms	Population Size
0 m	Species A Species B Species C	
40 m		
80 m		
120 m		
160 m		
200 m		

- Draw a bar graph to show the distribution of a specific grass population. Comment on the distribution of this population.
- Explain the observed distribution pattern in relation to:
  - nutrients
  - water
  - sunlight
  - soil type

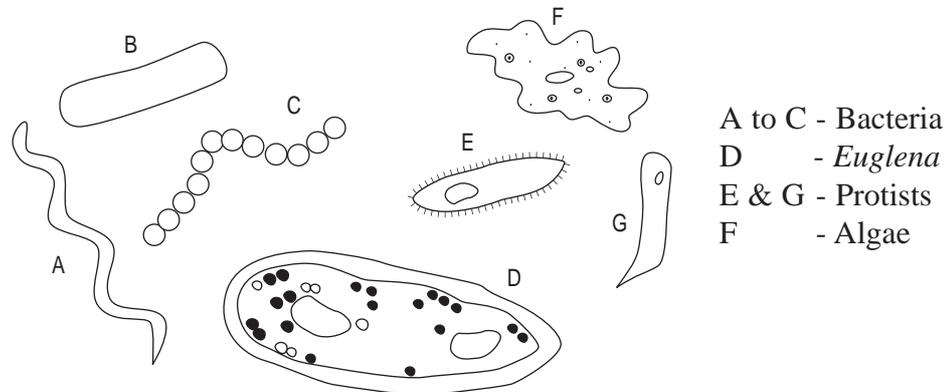


Conducting a population count can be labour-intensive and time-consuming. Use your judgement with this activity. If you feel your pupils have the necessary skills, have them carry out the population count as described above. You can also ask your pupils to identify and count the members of only one species in all the quadrants, or even have them make general observations about the types of vegetation in each quadrant and how the relative numbers of each species changes as they move away from the swamp.



## Classroom Activity

Prepare a lesson plan that uses the investigation method to teach your pupils how pollution affects population growth of living organisms in a pond. Most of these organisms are microscopic and so have to be observed using a magnifying glass or microscope. Below (*Figure 3.8*) is a picture of some of the organisms you might find in pond water.



*Figure 3.8*

For pollutants, use such things as oil, fertilisers, disinfectants, and pesticides which normally find their way into water.

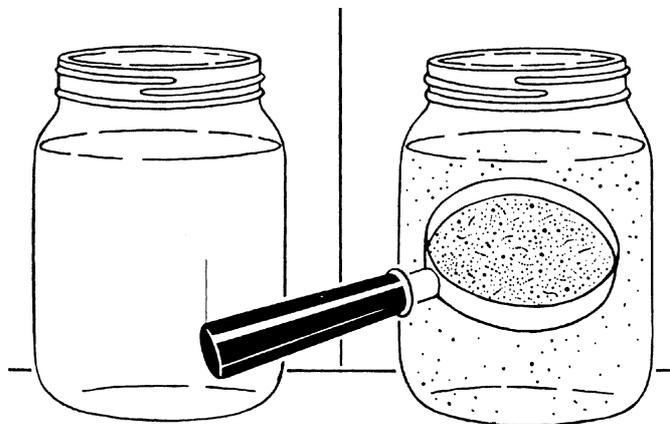


Caution: Many of these substances are toxic and might even be carcinogenic. They should be handled with extreme care and direct contact should be avoided.



Use the following method to grow algae for this kind of investigation:

1. Decide how many pollutants you want to test.
2. For each pollutant you plan to investigate, place an open jar of pond water in the sun for ten days. You can use plastic bottles or jam jars (which have been washed) as containers.
2. Add more water as the water level in the jar falls due to evaporation.
3. Over time, a green or brown growth will appear in the jar. This growth is the algae that you can then expose to the substances listed above.



*Figure 3.9*

As part of the investigation for this lesson:

- Have your pupils observe the amount of algae—if possible, have them study it with a magnifying glass.
- Add a small quantity of the pollutant to each jar and label it.
- Every day, for the next five days, ask your pupils to examine the algae in each jar.
- Have your pupils write out their observations.
  - how did each pollutant affect the algae population?
  - which pollutant had the least effect?
  - which pollutant had the greatest effect?
  - which pollutant had the most rapid effect?
  - which pollutant was the slowest?



## Summary

A population is a group of living organisms of a given type found at a specific place at a given time. The size of a population of living things is determined by the following things:

- immigration
- emigration
- deaths
- births
- availability or non-availability of resources, e.g., food, shelter, nutrients, etc.

Knowledge about the population size of living organisms helps in the management of the resources in the environment. These sizes are determined through population counts.

The investigation method can be used to teach pupils about population distribution patterns.



## Reflection/Self Assessment

1. Were the methods used in this unit suitable for the content?
2. If you had to change anything, what would it be?
3. How were these methods received by your students?
4. Did the method match well with what you intended to teach your pupils?
5. Were your pupils able to understand the variables in a population of living organisms?
6.
  - a. What did you find challenging during your preparation for this activity?
  - b. How did you deal with the challenges?



## Unit Assignment

1. List the things that can affect a population of living organisms.
2. For each of the things listed above, say how it affects the population.
3. Why is it important to take human population counts every ten years?
4. How would large populations of large animals affect the environment?
5. Draw a histogram for the following populations of living organisms found on a piece of land:
  - a. grass plants    100
  - b. ants            50
  - c. butterflies    10
  - d. spiders         3

# Unit 4: Conservation of Natural Resources

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## Introduction

The natural environment supplies living organism with the resources required to sustain life. Unfortunately, in using these resources, the living organism might harm the environment.

This unit focuses on the possible solutions to the problems that have been discussed in the previous units of this module. The activities are designed to help you teach the crucial issue of conservation to your pupils in a way that is interesting and straightforward. Try to put your pupils at the centre of their learning and involve them as much as possible.

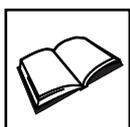
The unit activity shows you how to involve your pupils in dramatising a conservation play taking roles of different people. This is only one way to involve pupils in their own learning. Make use of the activities given here, and try to think of other interesting ways to teach this content.



## Objectives

After completing this unit you should be able to:

- define conservation
- identify environmental damage to a given area of study
- suggest possible solutions to the problem of environmental damage
- design pupil activities to show how to use role playing to teach conservation



## Content

### **Conservation**

In using natural resources, care must be taken to ensure that they do not run out or reach a state in which they can no longer be used. **Conservation** is the planned use and management of resources.

If these resources are not conserved, the balance of nature can be disturbed and this could upset a lot of processes in the natural environment. Many things can be done to ensure that these resources last longer. The following table summarises some measures that can be used to conserve the resources. This list is not exhaustive, and you and your pupils can add your own ideas.

<b>Resource</b>	<b>Conservation Measures</b>
Soil	Maintain ground cover by reforestation, avoid overgrazing, prevent veldt fires. Construct contour ridges on sloping ground as well as not ploughing along the slopes.
Water	Collect water in reservoirs. Avoid water pollution by oil, chemicals, and sewage.
Air	Avoid pollution by using environmental friendly energy resources such as solar energy. Plant more trees to absorb carbon dioxide.
Wildlife	Create game parks and reserves. Have good wildlife management laws. Avoid veldt fires. Avoid pollution of all kinds.

Once non-renewable resources have been used, there is no way to replace them. However, many situations in which environmental damage has occurred can be reversed. **Restoration** is an important part of conservation, and involves finding solutions to environmental problems and putting them into practice.

## Teaching Strategy

The key strategy for this unit is role play. The mind map and questioning technique are used to support role play. Refer to Unit One and/or Module One if you feel you need to review them.

### **What is Role Play?**

Role play involves “acting out” a real life situation. Participants improvise parts using descriptions of the characters and settings provided by the trainer. This technique enables participants to develop an understanding of how people act in real life situations and allows them to test solutions to problems in a non-threatening environment.

### ***When to Use Role Play***

You should use role play when you want your participants to:

- explore reactions and feelings when discussing an experience
- practice handling problem situations in a safe environment
- illustrate the points of view of other characters
- practice decision making, problem solving, and interpersonal communication skills
- generate material for discussion

### ***Procedure/Role of Participants***

1. Prepare the concept for the role play in advance. The role play situation should have conflict and variety and offer the opportunity to demonstrate effective behaviour. Simulated, rather than real, organisational problems should be used.
2. Briefly describe the situation and the characters to the entire group.
3. Participants can volunteer or be selected by the teacher for the role play. Brief the players on their roles. The setting and role descriptions can be written for the players or described verbally by the trainer.
4. Let the participants act out the situation, making up their lines as they go along. Direct only if absolutely necessary. Stop the action when it illustrates the problem or when a natural end-point is reached, usually after a few minutes.
5. Encourage all your pupils to discuss what occurred in the role play. What strategy was used to solve the problem? Did it work? What strategy could have been used? What underlying values and/or feelings caused cast members to act as they did? Ask these questions for each role.
6. Evaluate and summarise the points learned. Can any of these points be applied to other similar situations?
7. The role play can be repeated with the same cast in new roles or with a new cast.

### ***Advantages of Role Play***

1. A “real” situation is created in a non-threatening atmosphere, in which participants can try out new approaches or behaviours through anonymous identity.
2. Participants can increase their awareness about the effect of feelings on social behaviour.
3. If well-planned, role play has high credibility, thereby reducing resistance to learning relevant attitudes and skills.
4. Role plays are flexible and permit the teacher to respond to a broad range of training problems.
5. The complexity of real life situations is played out within a simulation.

### **Limitation/Constraints of Role Play**

1. If the situation is not consistent with the overall learning objective of the training programme, the pupils will not learn the necessary skills.
2. A carefully prepared introduction is required.
3. Role play must be followed by discussion to permit participants to analyse and reflect on what occurred.
4. Role players need to be carefully selected to ensure they are capable of playing their roles adequately.

### **Uses-at-Glance**

- explore and change attitudes
- stimulate discussion and generate ideas
- analyse and solve problems



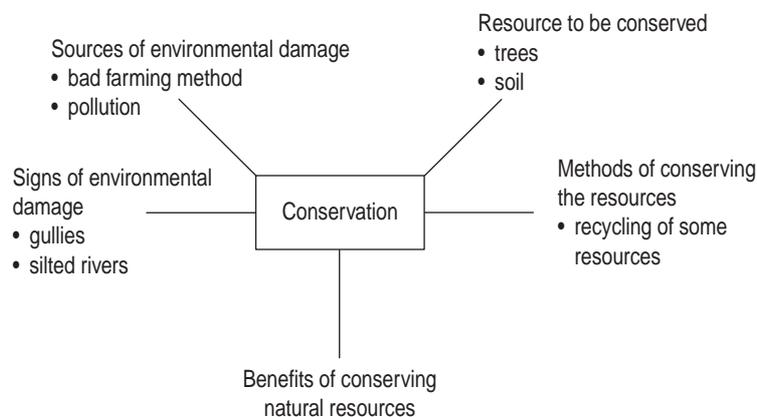
### **Individual Activity**

#### **Using a Mind Map to Define Conservation**

You need to find out what your pupils already know about natural resources and their conservation. Go over the exercises yourself through the use of a mind map. Begin a new page in your plan book and list words that will form the subheadings of your mind map. Here are a few ideas:

- resources to conserve
- methods of conservation
- causes of environmental damage
- signs of environmental damage

With the subheadings, you can now start writing or pooling your ideas.



*Figure 3.11: Some ideas about conservation*

More subheadings can be added to the mind map and the format could be changed. Invite one of your colleagues to help you.

Now try to come up with a definition of conservation. Your definition should be clear enough to dispel the thinking that conservation means not to use a resource. Emphasis should be placed on the management of resources to avoid a situation where they become depleted or remain in a state in which they cannot be used. Keep this preparation until the day you do the activity with your pupils.



## Individual Activity

From the previous units, your pupils should be clear about the kinds of environmental problems that occur as a result of the misuse of natural resources. In this activity, you will help your pupils use role play to come up with possible solutions to the problems they have studied..

Look around your own locality. Identify an environmental problem which is known to your pupils. This can include issues such as water pollution in a river passing through the village/city, air pollution, river siltation, deforestation, etc. Design a role play that involves a study of the causes and effects of these problems and possible solutions.

To introduce content on dealing with environmental problems, show your pupils charts and illustrations that demonstrate environmental damage and ask questions that focus on the issue. To develop this further, bring up the circumstances which might have led to such a situation and consider the alternatives that could solve the problem.

Think of a role play design and take note of the following:

- The design should clearly show an environmental problem and its source, and the need to conserve natural resources.
- The situation should be familiar to your pupils.
- The setting should be clearly defined.
- Pupil roles and tasks should be clearly outlined.

Study the example given below, then either plan one to suit your situation or enrich this one if it is appropriate.

## **The Play Setting**

Imagine the local authority of a certain rural district has sent its district administration to address the members of one of the villages on its intention to take away part of their land. This land is to be set aside for a conservation project. The land to be given up by the village includes part of the main river along which they practice stream bank cultivation and a highly deforested area that forms part of their stock grazing land. The villagers are being asked to participate in the following ways:

- lose part of their land
- reduce the numbers of their livestock
- lose their gardens along the river
- take part in planting trees
- look after the trees
- share the proceeds from the forests (long term)

The characters:

- district administrator (DA) and his team
- small farmers
- village chief
- head pupil of a local school
- agricultural advisor

In preparation for this role play, the following things have to be thought out and written down.

- the questions which each group of people is likely to ask the district administrator about their involvement in the project
- possible answers the DA can give
- the DA's speech (The speech should be good enough to convince the people to go along with this idea.)
- give the selected children their roles and allow them to practice

Where you have to come up with other characters, ask your pupils to help you prepare what they would do.

### *The District Administrator*

The district administrator is a government agent who has to negotiate with the villagers for the land. This area has suffered serious environmental damage and is to be used for a conservation project which, in the long run, will reclaim the land. He has to be a good negotiator in order to convince the villagers. Here are things he is likely to say:

- Communicate the government's intention to take the land which is highly deforested and the portion of the river that passes through the village.
- If the situation is not dealt with, further damage will occur, including siltation of the river due to high erosion, death of livestock due to absence of food and water, gully formation.
- Causes of the damage which have prompted the government to take action—cutting down of trees for construction of houses, firewood, fencing, and fields. This has increased the population and livestock in the area.
- Benefits of the project to the community:
  - providing poles for construction of houses and other structures
  - providing wind breaks
  - soil protection
  - food for animals in the long run
  - income generation to be used for improvement of social services, e.g., buying of medicine
- Project Activities
  - planting and care of trees
  - building contour ridges across sloping land
  - reducing the number of livestock
  - designing a work timetable for the community

Community members who cannot help with the work can pay a fixed fee to be used to hire other people to do the job. Under normal circumstances no one will be paid for the project.

The district administrator will have to listen to different views and questions from the various people in the community and give answers on behalf of the government. Different pupils can be selected to give answers to the villagers since the district administrator would have a team with him.

### ***The Small Farmers***

The farmers in the village will raise their concerns about the project, which could include the following:

- compensation for lost land and gardens by the river
- who will be responsible for reducing the livestock herds?
- the time to be put into project work would take time away from their daily routine
- punishment for those who would not come to work
- will they have a say in how the income generated from the project will be used?

### ***District Administrator's Response to the Small Farmers***

- The district administrator should make it clear that no compensation will be given for loss of gardens along the river as it was illegal for the villagers to establish these. Compensation for loss of farm land could be discussed.
- The government would decide on the maximum size of livestock herds for each villager. Those with large herds will have to reduce their numbers by selling some of their livestock.
- Villagers are to establish a work plan in which they decide what work needs to be done and how much time each villager will invest in the project.
- No payment will be made to anyone as this is a community project, not a government one.
- Income generated from the project will finance other projects and services approved by the villagers and/or the village development committee.

### ***The Chief***

The Chief is the liaison (go-between person) for the government and the villagers. He will call meetings at different stages of the project. The first meeting will be to tell the villagers of the coming of the district administrator and his team. This is what he is likely to say:

- Tell the people that the district administrator and his team are coming to the village.
- Give the villagers the agenda of the meeting and tell them:
  - about the government's intention to run a conservation project in their village
  - how the project will affect them (having to reduce livestock and give up garden land along the river)
  - about the benefits of reclaiming the land and generation of revenue
  - to think about all of this in preparation for the meeting with the district administrator

The second meeting will be between the villagers and the district administrator. At this meeting the Chief will be the chairperson, and should make sure that each side is given a chance to communicate its views to the other.

### ***Head Pupil at the Local School***

The head pupil at the local school will represent all the children in the community and will express the concern that they could be used as child labour for this project if no rules are put in place to protect them. The head pupil will point out that the children already work in their parents' crop fields and look after livestock.

### ***District Administrator's Response to the Head Pupil***

The district administrator should give assurance that all measures will be taken to ensure that no child labour is used for the project and that the villagers will not be overworked. The villagers will be responsible for drawing up a suitable work schedule for everyone. Children will not be completely excluded from the project as this will provide an excellent opportunity for them to learn about and develop positive attitudes towards the care and protection of the environment.

### ***Agricultural Advisor***

The agricultural advisor is to support the district administrator in order to get the villagers to see the value of the project and is likely to talk about the following issues:

- How large livestock herds have overgrazed and destroyed ground cover, exposing the soil to erosion.
- How the river has become silted from stream bank cultivation and is not holding water as long as it did in the past.
- Warn the villagers that if they do not carry out the project, they will face future losses of livestock, soil, and water.

After the role play, ask your pupils some questions to see if they understood the message being put forward in the play. Here are some examples of questions you could ask:

1. Would you agree with the government plan if you were part of this community? Ask the pupils to explain why they agree or disagree.
2. Would you be satisfied with the responses given by the district administrator if you were one of the villagers? Ask the pupils to explain why they are satisfied or unsatisfied.

These questions will reveal your pupils' understanding of real life problems and the need for a conservation solution for some of them. Give the class time to discuss these questions before they respond. Group work can be used to enrich the answers for these.



## Individual Activity

In the unit activity, you have been shown how role play can be used in the teaching of science. Look around your environment and identify a place which shows signs of environmental damage and requires conservation solutions. For this situation, design a role play with different people to play roles in it.

An example could be an environment such as a polluted river. Choose characters who can be used in role play to discuss how to reclaim (restore) the environment. For the river, role play characters could include:

- a person from a company which contributes to the river pollution
- a person representing fisheries people who are affected by the pollution
- a local authority
- an environmentalist
- a person representing fish consumers

Write down questions that each of the characters will use to argue their point. Identify the characters to lead the discussion, and help your pupils act them out.



## Summary

Conservation is the wise or planned use of the living organisms' resources so that they do not become polluted or depleted. Different measures can be taken to avoid or address environmental problems caused by different forces. If these problems are not addressed, they affect the lives of most living organisms in the environment as well as certain processes which maintain the balance of nature. In order to successfully deal with these problems, solutions must be worked out on the basis of the causes of these problems.

A role play can be used to teach the content on conservation. This method has an advantage of capturing the pupils' attention and maintaining it much longer, because learning is linked with entertainment.



## Reflection/Self Assessment

1. Do you think role play is a good method to use for this content?
2. What do you consider to be the challenges of this method?
3. How well did the pupils participate in the role play?
4. Do you think your pupils fully understood the roles they played?
5. Did the message on conservation come out clearly in the play?
6. Were the problems clearly matched with the solutions in the play?

Discuss this activity with your pupils. What are their opinions?



## Unit Assignment

1. How would you address the following environmental problems?
  - a landscape with gullies starting to form
  - a landscape supporting a lot of livestock but with little ground cover
  - a river bank being eroded due to stream bank cultivation
2. What are the benefits of using role play to teach science?
3. Why is it important to conserve natural resources?

## Module 3: Suggested Answers for Activities

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### Unit One

#### *Possible Answers to Unit Assignment*

1.
  - a. water, air, land forms, soil
  - b. manufactured structures, e.g., roads, bridges, buildings
  - c. water, air (essential gases)
2.
  - a. does not require the respondent to think deeply, requires a one-word recall type of answer
  - b. requires the respondent to think deeply and to apply, analyse, synthesise, or evaluate something
3. To introduce new content.

### Unit Two

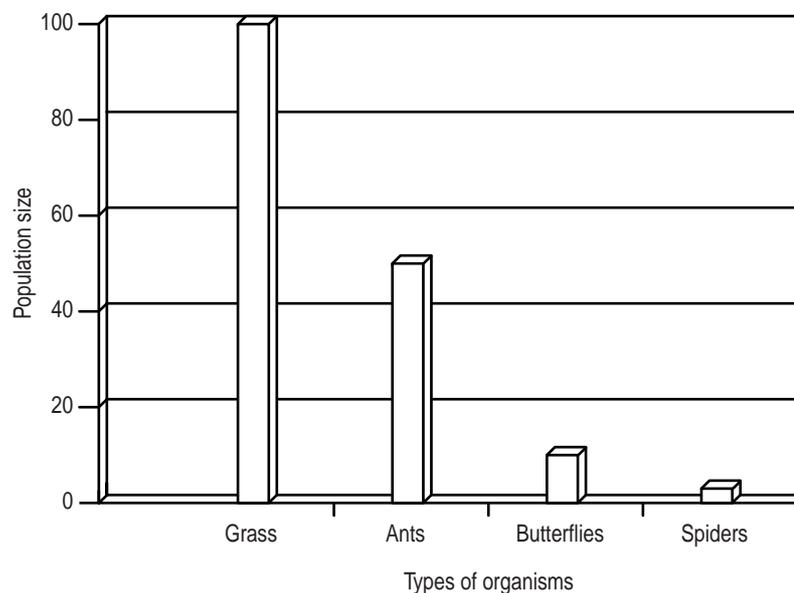
#### *Possible Answers to Unit Assignment*

1.
  - a. Soil—poor vegetation growth, formation of gullies, poor water absorption
  - b. Water—bad smell, unusual colour, unusual viscosity
  - c. Vegetation—no ground cover, uprooted trees, tree stumps
2. Humans and elephants
3.
  - develops analytical and problem solving skills
  - provides reflection and discussion
  - practise negotiation skills
  - provides practice with a situation before encountering it
  - become open to suggestions, new points of view, etc.

## Unit Three

### **Possible Answers to Unit Assignment**

1. Availability of food, shelter, water, wars and natural disasters, water pollution, air pollution, etc.
2. Unavailability of food, shelter, and water reduces population sizes while an abundance of these leads to increased population sizes.
3. Population counts are done in order to ensure that resources are planned and managed to meet the needs of living organisms. For people, the planning could be for schools, hospitals, houses, food, etc.
4. Destroy ground cover and expose soil to forces of erosion and formation of gullies. Destroy trees which are home to small animals and also help in the formation of rain.
- 5.



*Figure 3.10*

## Unit Four

### **Possible Answers to Unit Assignment**

1.
  - a. fence the area to arrest further damage, plant trees
  - b. reduce the size of herds, move livestock to another grazing area
  - c. reduce or eliminate cultivation on stream banks, construct contour ridges on slopes to prevent further erosion
2. It can help people to understand a difficult situation. Due to its entertainment value and flexibility, it can help hold the attention of participants and views for a longer time and can increase the awareness of the topic or issue being studied.
3. So they will last longer and be available for future generations of living things. It will also help maintain the balance of nature.

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