Food and Agriculture Organization of the United Nations

United Republic of Tanzania

Forests for a sustainable future

EDUCATION MODULES FOR PRIMA RY SCHOOLS

Teacher's book

MODULE 2

FORESTS, HEALTH AND WELL-BEING

Forests for a sustainable future

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Foreword

Teaching young people about protecting and sustainably managing forests is vital for our future.

Forests play important roles in our daily lives – they are a source of food, wood, medicines and energy for billions of people worldwide, and they host more than three-quarters of the world's terrestrial biodiversity. By sequestering carbon and influencing microclimates, forests help mitigate climate change; moreover, forests help communities adapt to climate change and increase their resilience to climate-related shocks.

The key to maintaining forests and their benefits over time is to manage them sustainably – this means ensuring that what is harvested in a forest is allowed to grow back and that the many values of forests are maintained over time. Today, however, people are increasingly disconnected from nature and lack awareness of forests and their benefits.

Forest education builds the knowledge, skills and shared values that underpin sustainable forestry and its contributions to sustainable development goals, such as those set out in the 2030 Agenda for Sustainable Development. In recent years, however, international forums have expressed concern that, in most countries, forest-related education is insufficient and outdated. The net result in a lack of awareness and understanding among people of all ages of the importance of forests.

Providing children with an understanding of the vital roles of forests is crucial for safeguarding natural resources for future generations. But the Global Assessment of Forest Education, published by the Food and Agriculture Organization of the United Nations (FAO) in 2022, reported that, in Africa, resources and learning materials for forest education in primary schools are absent or available to only a limited extent. The assessment also found that a lack of awareness-raising about nature in primary schools has contributed to a low level of interest in forest education.

It is essential that children in primary schools today learn about forests so they know why forests matter and how they can be used sustainably and thereby protected and maintained over time. Moreover, inspiring children from an early age about forests can help open new horizons and influence career pathways. When young people have a clear picture of forestry and the sector's role in solving sustainable development challenges, they are more likely to consider forestry as a viable career choice.

The education modules presented here are designed for children aged 9–12 in grades 3–5. They will increase the forest literacy of the children and, in the long term, enhance their capacity to make decisions in favour of sustainable forest use. The modules are inspired by the principles of the "education for sustainable development" (ESD) approach, which is based on learning methods that motivate and empower learners to make informed decisions, change their behaviour, and take responsible action for the benefit of the present and future generations. They use a more hands-on and interactive approach than standardized education methods.

The modules have been developed by the Ministry of Natural Resources and Tourism of the United Republic of Tanzania in the framework of the project, "Forests for a Sustainable Future: Educating Children", with technical contributions by FAO and the support of the German Federal Ministry for Food and Agriculture.

Nyabenyi Tito Tipo

FAO Representative in the
United Republic of Tanzania

November, 2023

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The modules are the result of an extensive revision and validation process involving the following Tanzanian organizations: Ministry of Education and Vocational Training; Sokoine University of Agriculture; Mtemi Mazengo Primary School; College of African Wildlife Management – Mweka; Tanzania Forest Industries Training Institute; Beekeeping Training Institute; Mji Mpya Secondary School; Mhonda Teachers College; Kikunyu Secondary School; University of Dodoma; Tanzania Institute of Education; Jordan University; Mazimbu A Primary School; Ministry of Higher Education, Science and Technology; Vocational Education and Training Authority; Forestry Training Institute Olmotonyi; National College of Tourism; and Tanzania Forestry Research Institute.

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Introduction

The method: encouraging children to be problem solvers

The ESD approach emphasizes skills, abilities and values such as empathy, self-reflection, critical thinking, collaborative decision-making, and taking responsibility for present and future generations. This requires a shift towards active, participative and experiential learning methods that engage the learner and make a real difference to their understanding, thinking and ability to act. Using this approach, teachers help pupils develop their abilities to recognize, analyse and assess the sustainability of processes and practices. This should enable them to adopt sustainable practices in their own lives and to play an active part in sustainable development, locally and globally.

Through ESD activities, teachers motivate pupils to be open to different perspectives and new information. The ESD approach aims to develop the ability of pupils to solve problems and use fact-based knowledge in taking action. The box sets out key aspects of the ESD approach.

The "education for sustainable development" teaching approach

Teacher's role and approach

- The teacher acts as a partner for self-reflection.
- The teacher encourages pupils to come up with solutions rather than demanding answers.
- The teacher provides prompts and guidance rather than definitions.
- The teacher's instructions purposefully lack context to encourage a pupil's ability to infer it autonomously.
- The teacher trusts pupils' capabilities and skills and treats them with patience and understanding.

Pupils are encouraged to:

- be open to the world and to integrate new perspectives;
- think and act in a forward-looking manner;
- acquire knowledge and act in an interdisciplinary manner;
- learn how to deal with incomplete and overly complex information;
- approach decision-making processes in a cooperative manner;
- learn how to cope with dilemmas in decision-making situations;
- take part in collective decision-making processes;
- self-motivate to take action and spur others to do the same;
- reflect on their own principles and those of others;
- ground all decision-making and planning actions in the notion of equity;
- plan and act autonomously; and
- show empathy and solidarity towards people in need.

Pupils learn better when:

- The environment promotes their active participation and action-oriented learning.
- Learning takes place in a participatory way and involves everyone.
- They are encouraged to reflect on what has been learned and on the values and perspectives of everyone.
- The learning topics:
  - » take past experiences and cultural factors into account;
  - » are significant in the pupils' daily lives;
  - » directly affect and are interesting to the pupils;
  - » can be linked to existing knowledge; and
  - » are analysed in an interdisciplinary manner and from different perspectives.

The structure: how the learning is organized

To maximize the probability of successful learning outcomes, the forest education modules follow precise didactic criteria and have a distinctive structure.

The forest education material comprises three modules, each aimed at a specific primary-school grade level: Module 1 – Grade 3; Module 2 – Grade 4; and Module 3 – Grade 5.

The central themes of all three modules are the multiple functions of forests and the importance of their sustainable management. Each module also explores a specific theme, as follows:

- **Module 1: Forest products, plants and animals (biodiversity).** Pupils learn about animals and plants that live in forests.
- **Module 2: Forests, health and well-being.** Pupils learn about the benefits (also called ecosystem services) that forests offer people in their daily lives.
- **Module 3: Forests and the climate.** Pupils learn how climate and forests are related and why forest protection and sustainable use are important for the climate.

The modules consist of chapters, with each chapter containing three or four lessons of 40 minutes each. Each chapter follows the same pattern: a first lesson in which the teacher introduces a topic; one or two practical lessons in which the pupils explore the topic through games and activities; and a final lesson for reflection and discussion.

In total, the three modules contain 26 chapters. Each module has its own teacher's and pupils' books, as described below.

Teacher's books

Each teacher's book consists of chapters and a glossary. Each chapter contains an appendix that collates the various photographic images used in the chapter, which may be cut out and used in specific lessons as visual aids.

Each chapter has the same structure, as follows:

- An **overview** of the content, which summarizes the topic addressed in the chapter and the proposed activities.
- **Objectives**, which set out three or four key skills and learnings that the pupils will acquire from the chapter.
- **Background information** comprising three paragraphs to provide teachers with explanations of the topics addressed in the chapter, as well as photographs as visual aids. The background information does not necessarily reflect the flow of a chapter's activities. The latter follow a pedagogical logic and the former presents information sequentially, from simple to complex, to make the text more readable and understandable. Where applicable, the background information contains cross-references to relevant chapters in the same module; these connections enable the teachers to gain a deeper understanding of the contents and, if desired, to make pupils aware of related topics that will be covered later in the course. Although most of the information needed to perform the lessons is included in the activities, teachers are advised to read the background information before teaching the chapter to obtain a preliminary understanding of the topic and to enable them to better answer pupils' questions during the lessons.
- Three or four **lessons** designed to span 40 minutes each. The lessons comprise discussions, drawing, memory games, quizzes and other activities. Typically, the first lesson of a chapter introduces the topic to the

pupils and is designed to build their interest and motivation for the subject through exercises and activities. The activities in the second lesson (and third lesson, where applicable) aim to deepen competencies, and the last lesson encourages reflection and discussion. From this structure, pupils acquire and deepen their knowledge of the chapter's topic while also linking it to related themes. Each activity includes an indication of the time that should be allocated to it, as well as whether it should be performed indoors or outdoors.

- **Activities** present detailed instructions for teachers to follow when engaging with pupils. Where applicable, activities have lists of **required materials**, presented with simple illustrations. A section titled **preparation for the lesson** provides teachers with information on the preparation needed beforehand (although not all lessons require preparation). The expected duration and recommended setting (whether indoors or outdoors) are specified for each activity.

This icon indicates activities best conducted in the classroom.

This icon indicates activities best conducted in the schoolyard – for example, they may require more space for the pupils or are designed to enable pupils to interact with the natural environment.

- A section titled **preparation for the next lesson**. This is included at the end of most lessons and chapters to alert teachers to the need to prepare in advance for following lessons or to bring materials to school (or to ask pupils to do so). Teachers are strongly encouraged to read the instructions well in advance of lessons to ensure adequate preparation.

The teacher's books are colour-coded (yellow for Module 1, orange for Module 2 and green for Module 3), and icons are used to help teachers navigate information while teaching. Background information and preparatory instructions have a coloured background, and instructions for conducting the lessons have a white background.

Pupil's books

All lessons have been structured to be taught without the need of a pupil's book. However, to support children in following the lessons, a pupil's book has been developed for optional use.

The pupil's books are based on the corresponding teacher's books and are designed to serve as a reference for pupils, guide them through activities and help them follow the teacher's instructions.

The pupil's books contain instructions, photographs and drawings to support the pupils in carrying out activities. The children will not write in the pupils' books directly; rather, they will be prompted to write (or draw) in their exercise books where necessary.

Except for the background information, the pupil's books follow the same structure as the teacher's books, with icons helping pupils distinguish the type of activity that they are being asked to perform. For activities that require pupils to make drawings in their notebooks, simple, stylized examples are provided.

Chapter titles, by module

Module 1
Forest products, plants and animals (biodiversity) – Grade 3

In this module, pupils learn about the animals and plants that live in forests.

Chapter 1: Introduction to forests and their biodiversity
Chapter 2: What is a tree?
Chapter 3: Forests and soil
Chapter 4: Animals in the forest
Chapter 5: The life of bees in a colony
Chapter 6: Pollination and bee products
Chapter 7: Beekeeping
Chapter 8: Forest products
Chapter 9: Our forests in the United Republic of Tanzania

Module 2
Forests, health and well-being – Grade 4

In this module, pupils learn about the benefits that forests offer people in their daily lives.

Chapter 1: The benefits of forests
Chapter 2: Food from the forest
Chapter 3: Edible insects
Chapter 4: Hunting
Chapter 5: Forests and water
Chapter 6: Medicinal plants
Chapter 7: Wood products
Chapter 8: Wood processing
Chapter 9: Forests and livelihoods

Module 3
Forests and the climate – Grade 5

In this module, pupils learn how climate and forests interact and why forest protection and sustainable use are important for the climate.

Chapter 1: Weather, climate and forests
Chapter 2: The greenhouse effect and climate change
Chapter 3: Photosynthesis
Chapter 4: Wood and other sources of renewable energy
Chapter 5: Sustainable forest management
Chapter 6: Forest and beekeeping laws
Chapter 7: The work of a forester
Chapter 8: Forests and climate change – What we can do

CHAPTER 1

The benefits of forests

Overview

In this chapter, the pupils will learn about the diverse benefits of forests for people and the environment and what happens when forests are overexploited. The pupils will draw sketches of what they learn, create an "advertising wall" and invite other classes and teachers to view their drawings.

Objectives

By the end of the chapter, the pupils will be able to:

- identify the products and services provided by forests;
- explain the impacts of forest overexploitation; and
- communicate their acquired knowledge on the benefits of forests to teachers and other pupils.

Background information

What services do forests provide?

Forests provide many services for people and the environment. These include:

- **Biodiversity conservation.** It is estimated that forests provide habitat for over half the world's known plant and animal species on land.[1] Maintaining forests helps conserve biodiversity.
- **Climate regulation.** Trees absorb carbon dioxide, a greenhouse gas that contributes to global warming, and store it as carbon, helping to combat climate change. Forests store carbon in tree roots, trunks and branches, as well as in litter (fallen branches and leaves) and the soil. Forests also help cool the air through shading and transpiration. This cooling effect is also an important service in villages, towns and cities.
- **Water management.** When it rains in a forest, most of the water is absorbed by the soil. Some stays near the soil surface, where it is used by trees and other plants and by microorganisms, and some seeps further down in the soil to reach the groundwater. Part of the groundwater is released downslope over time into streams and other water bodies, and some is stored for longer periods. People can use groundwater by collecting it in wells and bores. In this way, forests help regulate water flow by storing it in soils and groundwater (see Chapter 5).
- **Erosion control.** Forest canopies lessen wind speeds and intercept rainfall, both of which help reduce soil erosion. Tree roots bind soils together and reduce runoff, also helping to minimize erosion. Forests help protect against shallow landslides (see Chapter 5).
- **Livelihood improvement.** Forestry provides more than 33 million jobs worldwide.[2] Many other people support their livelihoods by harvesting non-wood products – such as foods and medicines – in forests (see Chapter 9).
- **Opportunities for recreation.** Many people use forests – especially national parks – for activities such as safaris, birdwatching, cycling and hiking. Famous national parks in the United Republic of Tanzania, which are popular with residents and international tourists alike, include the Serengeti, Lake Manyara, Tarangire, Arusha, Kilimanjaro and Mkomazi. Other protected conservation areas commonly used for recreation in the United Republic of Tanzania are the Ngorongoro Conservation Area and the Amani, Uluguru, Kilombero, Nilo, Rungwe, Magamba, Chome, Mkingu Udzungwa Scarp, Rondo Plateau, Minziro and Mount Hanang nature reserves.
- **Cultural and religious identity.** Forests are important for the cultural identity and religious practices of many groups. In northern parts of the United Republic of Tanzania, for example, the Maasai and Sonjo use sacred places in forests – featuring trees such as African olive and fig – for cultural ceremonies and other traditions.

What products do forests provide?

Forests provide a wide range of products that support people's livelihoods and well-being, such as the following:

- **Wood.** Wood is used to make furniture and kitchen utensils, build houses, make paper, produce timber and produce energy (e.g. fuelwood and charcoal for cooking) (see Chapter 7). This is a valuable benefit of forests – as long as harvesting is sustainable.
- **Food.** Forests provide a wide variety of foods, such as fruit, leaves, seeds, nuts and animals (see Chapter 2 and Chapter 3).[3] Forests can provide food when agricultural crops fail, such as during droughts and in other hard times.
- **Medicines.** Many of the drugs on which modern medicine depends are derived from forest plants and were discovered as part of the traditional health systems of forest peoples (see Chapter 6).

Picture 1.1. Wood harvested in a forest

Picture 1.2. Medicinal remedies obtained from a forest

Picture 1.3. Tamarind, a fruit that grows in forests

Picture 1.4. Honey, a food often produced in forests

How can we ensure that forests continue providing their products and services?

Forests need to be managed sustainably if they are to continue providing their many benefits (see Chapter 9).

A global survey using satellite images estimated that nearly 90 percent of deforestation worldwide between 2000 and 2018 was related to agriculture – that is, clearing forests to make way for croplands and pastures.[4] Deforestation negatively affects biodiversity and the livelihoods of people who depend on forest products and services.

Forests can also be degraded – meaning they become less healthy and productive and more vulnerable to wildfire and other pressures, which may lead eventually to the complete loss of forest cover (deforestation).

This degradation is the result of various factors. For example:

- Woodfuel collection is estimated to account for up to half of all forest degradation in Africa.[5]
- Wood overharvesting (when more wood is removed from the forest than can be regrown before the next harvest) leads to forest degradation.
- Due to rising demand for wild meat in towns and cities, where it is consumed as a luxury item or according to tradition, overhunting (see Chapter 4) causes wildlife populations to decline, increasing food insecurity among rural people for whom wild meat is an important food.

Picture 1.5. A bird living in a forest

Picture 1.6. A river flowing in a forest

LESSON 1

What are the benefits of forests?

1

1 Activity 1: Exchange forest experiences

indoor This activity should take **15 minutes**.

1. Organize the class into groups of eight to ten pupils.
2. Ask the pupils, in their groups, to discuss their experiences, and those of their relatives, of going into the forest. Why did they go? What did they do?
3. Ask each group to present the three most common reasons they and their relatives have gone into forests, and write these on the board.

2 Activity 2: Create a mind map of forest benefits

indoor This activity should take **25 minutes**.

1. Write the heading, "Benefits of forests", in the middle of the board, and write the main categories of benefits around it, as shown in Figure 1.1.

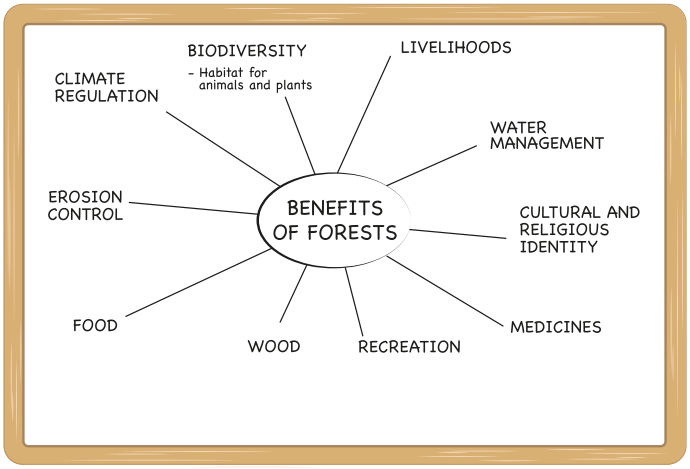


Figure 1.1. Benefits of forests

2. Ask the pupils to think of benefits that forests provide.

3. Write the answers on the board under the related main categories of benefits (use Figure 1.2 as a guide).
4. Read the following text and add to your mind map examples of benefits the pupils did not mention (and see also Figure 1.2):

   - **Biodiversity.** Forests are habitat for many animals and plants and therefore vital for conserving the variety of lifeforms (plants, animals, fungi and microorganisms) and ecosystems on Earth.
   - **Livelihoods.** Forests provide more than 33 million jobs worldwide. Many other people support their livelihoods by harvesting non-wood products – such as foods and medicines – in forests.
   - **Water management.** Forest soils store water like sponges. When it rains in a forest, most of the water is absorbed by the soil. Some stays near the soil surface, where it is used by trees and other plants and by microorganisms, and some seeps further down in the soil to reach the groundwater.
   - **Cultural and religious identity.** Forests are important for the cultural identity and religious practices of many groups. In northern parts of the United Republic of Tanzania, for example, the Maasai and Sonjo use sacred places in forests for cultural ceremonies.
   - **Medicines.** Many modern and traditional medicines come from forest plants. An example in the United Republic of Tanzania is the moringa tree.
   - **Recreation.** People go into forests to enjoy the cool shady environment, observe wildlife and appreciate the tranquility. Activities such as walking safaris, birdwatching and hiking are popular activities in forests, especially national parks.
   - **Wood.** Many products in our everyday lives are made of wood – such as furniture, kitchen utensils, paper, fences, timber, woodfuel (fuelwood and charcoal) and building materials.
   - **Food.** People eat a wide variety of forest foods, such as fruit, mushrooms, nuts, seeds, oils, roots, tubers, vegetables and animals.
   - **Erosion control.** Forest canopies lessen wind speeds and intercept rainfall, both of which reduce soil erosion. Tree roots bind soils together and reduce runoff, also helping to minimize erosion.
   - **Climate regulation.** Trees absorb carbon dioxide, a greenhouse gas that contributes to global warming, and store it as carbon, helping to combat climate change. Forests help cool the air by shading and when they release water into the atmosphere (called "transpiration").

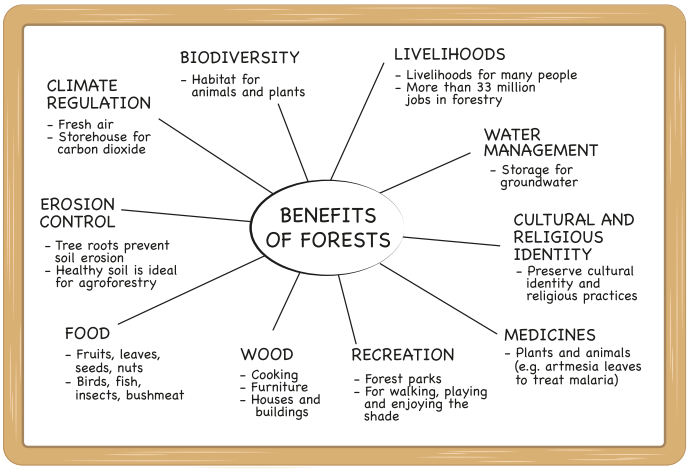


Figure 1.2. Examples of benefits of forests

5. Ask the pupils to copy the mind map into their exercise books.

LESSON 2

Take a fantasy forest journey

2

1 Activity 1: Take a fantasy journey

This activity should take **20 minutes**.

1. Take the pupils into the schoolyard, ideally where there are trees or other plants. Ask the pupils to sit on the ground, close enough to hear you well.
2. Explain the task as follows:
   - **a.** I will read a story to you. As I do, you will close your eyes and imagine an animal that lives in the forest. You will imagine that you are becoming that animal and doing what it does in the forest, such as eating, sleeping, foraging or making a nest.
   - **b.** Or, you will imagine that you are a person who goes into the forest for a certain purpose. Imagine something interesting in the forest that you might want to do, such as hunting, collecting wood or resting under a tree.
   - **c.** Choose the animal, or person, now.
   - **d.** No one may say anything during this activity. You will sit quietly, imagining only in your head.
   - **e.** Now, close your eyes and listen to the story. Listen carefully and do not open your eyes until I say so.
3. Now, slowly and calmly read the text for the fantasy journey below.

Text for the fantasy journey [i]

Imagine that
it is a sunny day and
you are in the middle of the forest.
You move around and enjoy the silence of the forest.
There is nothing to hear, no people, no sounds of the city,
just the sound of the wind in the trees.

Suddenly something happens to you –
your body is changing.
You feel a tingling sensation in every part of your body –
everything about you seems to change.
Think about the person
or animal you chose.
You are now changing into this form.
Look down at yourself and watch your body change.

i. Adapted and translated from Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten, 2017.

You have a new shape now. How do you look?
How do you feel?
Near you is a big old tree, and you move towards it.
Do you walk, run, fly, slither or jump?

What do you do with this tree?
Do you rest under its canopy?
Do you build a nest?
Do you eat its fruit or leaves?
Do you cut it down for wood?

Settle here for a moment as you interact with the big old tree...

It is now time to come back.
Move your attention to the here and now.
Take a deep breath in and out.
Your shape has changed, and you are yourself again.
Feel your fingers and move them slowly.
Feel your arms and legs.
Stretch out and loll around like a cat.
Tense all the muscles in your body and feel the power and energy within you.

Now, I'm going to count backwards slowly, from five to zero.
When I say "zero", open your eyes.
You will be refreshed and awake.
And you will feel comfortable and at ease.

Five, four, three, two, one, zero.
Open your eyes.

2 Activity 2: . Discuss forest benefits

outdoor This activity should take **20 minutes**.

1. When all the pupils have opened their eyes, ask if anyone would like to tell the class about their "journey". Invite three or four pupils to speak. Make sure that different "travel experiences" (different animals and types of people) are represented.
2. Ask them:
   - What animal or person did you transform into, and what did you experience on your journey?
   - How did you use the big old tree that you visited during the journey?
   - For what purpose?

Possible answers:

- Bird – I used the tree as habitat. I ate fruit from the tree and built a nest in it.
- Woodcutter – I used the tree as a source of income. I felled the tree and earned money from it for my family. The wood was used to make furniture.
- Beekeeper – I used the tree as a food source. I placed hives near the flowering tree.
- Elephant – I used the tree as a food source. I ate the young branches of the tree.

3. Ask the pupils:
   - Do you see any conflicts between the different forest uses (for example, if a woodcutter fells the tree, it is no longer there for others to use)?
   - What is a possible solution to this conflict?

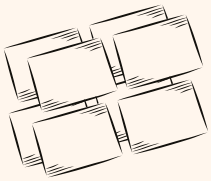
4. Ask four or more pupils to share their thoughts with the class.
5. At the end, remind the pupils about the importance of balance between the various forest uses. **Explain:** We have to balance how much we take from the forest with conserving the forest and the plants and animals that live there. The forest will regenerate itself, as long as we do not harvest more than can grow back before the next harvest.
6. Dictate the above explanation and ask the pupils to write it in their exercise books.

LESSON 3

Promote forest benefits

3

Required materials



MANILA CARDS
(1 per pupil, 10 for the preparation for the lesson)

PENS
(1 per pupil, coloured pens, if available)

ADHESIVE TAPE

Preparation for the lesson

Before the lesson starts, draw Figure 1.1 on the board (see Lesson 1). On each of ten manila cards, in large writing, write one of the following benefits of forests – wood, food, medicine, recreation, biodiversity, water management, preventing soil erosion, livelihoods, climate protection and culture/religion. Select a wall in the classroom with enough space and, using adhesive tape, stick the ten pieces of paper to it, ensuring that there is enough space between the pieces of paper to add drawings later to create an "advertising wall".

1 Activity 1: Draw examples of forest benefits

This activity should take **25 minutes**.

1. Briefly explain Figure 1.1 on the board (a repeat of Lesson 1) to refresh the pupils' memories.
2. Organize the class into ten groups of equal size. Assign each group one benefit of the forest (refer to Figure 1.1).
3. Give each pupil a manila card and a pen.
4. Each pupil should draw an example of their forest benefit. Encourage the pupils in each group to think creatively and, if they can, to each draw a different example.

5. While the pupils are drawing, go around the class. If the pupils are not sure what they should draw, give them some tips, such as:
   - an edible insect for food;
   - a tree absorbing carbon dioxide for climate protection;
   - a woodstove for fuel;
   - a forest worker for livelihoods;
   - a tree with big roots that keep the soil firmly in place for erosion control;
   - a person collecting groundwater from a well for water management.
6. When they are finished, tell the pupils to put adhesive tape on the backs of their drawings so that they will stick to the wall (in the next activity).

2 Activity 2: Create an information wall

This activity should take **15 minutes**.

1. Tell the pupils that, having learned about the benefits of forests, they will now show these to other people by creating an "advertising wall" in the classroom.
2. Ask them:
   - Why do we need forests?
3. Invite a few pupils to name the benefit of forests they drew. Then, ask them to stick their drawings on the wall under the correct label.
4. Invite the rest of the class to also stick their drawings on the wall under the correct labels. Picture by picture, the pupils will create an impressive advertising wall showing forest benefits.
5. Encourage the pupils to invite other classes, teachers and parents to view the advertising wall and to share what they have learned. They can do this during breaks, after school or at a specially organized event.

Notes

[1] **Hirsch, T. & Secretariat of the Convention on Biological Diversity, eds.** 2010. *Global Biodiversity Outlook 3*. Montreal, Canada, Secretariat of the Convention on Biological Diversity. 94 p.

[2] **FAO.** 2022. *The State of the World's Forests 2022 – Forest pathways for green recovery and building inclusive, resilient and sustainable economies.* Rome.

[3] **FAO.** 2022. *The State of the World's Forests 2022 – Forest pathways for green recovery and building inclusive, resilient and sustainable economies.* Rome.

[4] **FAO.** 2022. *Global Forest Resources Assessment – Remote sensing survey.* Rome.

[5] **Kissinger, G., Herold, M. & de Sy, V.** 2012. *Drivers of deforestation and forest degradation: A synthesis report for REDD+ policymakers.* Vancouver, Canada, Lexeme Consulting. As seen in: **Jin, S.L., Schure, J., Ingram, V. & Yoo, B.I.** 2017. *Sustainable woodfuel for food security: A smart choice: Green, renewable and affordable.* Rome, FAO. 34 pp.

CHAPTER 2

Food from the forest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Overview

In this chapter, the pupils will learn about some of the most common foods found in forests. They will do this through discussion and by identifying forest foods through smell and observation and drawing a diagram of the ways in which plant parts and products are used for food.

Objectives

By the end of the chapter, the pupils will be able to:

- name and recognize several common foods in Tanzanian forests;
- identify the sources of various forest foods; and
- recognize the parts of edible forest plants.

Background information

What contributions do forest foods make to people's lives?

Foods from forests and trees have been important in people's diets for thousands of years. Today, about 1 billion people worldwide depend to some extent on the wild foods that they harvest in forests.[1]

Forests contain a huge variety of nutritious foods[2] – such as leafy vegetables, fruit, nuts, mushrooms, root tubers, seeds, insects, leaves, honey and wild meat. Many forest foods are rich in protein, fat, vitamins and minerals that are important for human health and nutrition.[3] In some communities, the wild forest foods that people consume are sufficient to meet minimum dietary requirements for fruit, vegetables and animal-sourced foods.[4]

The types and sources of forest foods consumed and their importance for local communities vary depending on the social and ecological context. Some communities may consume forest foods from the forest because they are less time-consuming and costly than food from a market, and others may consume and value forest foods as part of their traditional culinary heritage.

For some communities, forest foods can be vital in times of crisis.[5] For example, communities living in and around the miombo woodlands in central, eastern and southern Africa obtain up to one-third of their calories from forest foods when agricultural harvests are poor, such as during droughts.[6] The root tuber *ming'oko* is important for food security in the Mtwara region of the United Republic of Tanzania during lean farming months.

In many parts of the world, regardless of development status, collecting forest foods – such as mushrooms and berries – is an important recreational and cultural activity.

What kinds of food are obtained from forests?

Much of the food we eat today is grown on farms. But forests are also sources of many products that are either consumed directly as food or used as ingredients for processed foods.

Forest products consumed directly as food include the following:

- **Plants.** Various parts of plants (including trees) may be edible, such as the fruit, leaves, bark, nuts and roots. Table 2.1 shows some of the edible products that can be harvested from plants found in Tanzanian forests. Three (non-native) trees commonly grown and used in the United Republic of Tanzania for food are:
  - » Cinnamon – the bark (and bark powder) of this tree is used to add flavour to tea and dishes like soup and pilau (brown rice). It is also the source of an essential oil.
  - » Moringa – all parts of moringa trees, such as bark, pods, leaves, nuts, seeds, tubers, roots and flowers, are edible. The leaves can be used fresh and also dried and ground into powder. The seeds are eaten green, roasted or powdered, steeped for tea, and used in curries, soups and stews. Moringa is also used to make medicines for treating various ailments.
  - » Avocado – the fruit of this tree is eaten, and its natural oils are used in cooking and to make skincare products.
- **Fungi.** Mushrooms are the fruiting bodies of fungi. They grow in diverse places, such as at the base of trees, in rings in the grass, and on decaying organic matter. One species (among many) of edible mushroom in Tanzanian forests is called *utyelele* by the Nyamwezi people and *uyoga* in Swahili. Although some mushroom species are edible, others are poisonous.
- **Animals.** Forest animals commonly eaten in the United Republic of Tanzania include longhorn grasshopper (*senene*) (see Chapter 3), warthogs, gazelles, African jacanas, fowls and hares (see Chapter 4).

Picture 2.1. Baobab fruit

Picture 2.2. Fruit of a moringa tree

Picture 2.3. Mushrooms from a forest

Picture 2.4. A gang of African buffaloes

Forest products used as ingredients in mass-produced food include the following:

- Chocolate – produced from beans harvested from cocoa (also called cacao) trees, which grow in forests. Although cocoa is native to South America, about two-thirds of the world's cocoa supply is now grown in Africa, led by Côte d'Ivoire and Ghana. The United Republic of Tanzania also produces cocoa, mostly in Kyela, Mbeya and Morogoro.
- Coffee – produced from the beans of the coffee tree. It is a major commodity crop that grows in forests in many countries worldwide. The United Republic of Tanzania is one of the top 20 coffee producers in the world.[7]
- Tea – prepared by pouring hot water over the cured or fresh leaves of the tea plant, a bush that originated in Chinese forests. The United Republic of Tanzania is a tea producer, and Iringa is famous for its tea production.

Chewing-gum derives from the natural gum of a tree, called chicle, that grows in South America. Today, however, synthetic substances are mostly used instead of chicle.

Picture 2.5. Coffee berries

Picture 2.6. Cocoa fruits

Why is it important to harvest forest foods wisely?

Forests provide important food resources for many communities, especially in hard times. It is essential, therefore, that these resources are managed sustainably and not overharvested or overhunted. Practising responsible and sustainable harvesting will ensure that forest foods are there when they are needed and that the forests stay healthy and productive over time.

Picture 2.7. Wild yam (ming'oko)

LESSON 4

Which foods come from the forest? 4

1 Activity 1: Brainstorm on forest foods

This activity should take **15 minutes**.

1. Ask the pupils:
   - What food can you find in a forest?
2. Tell the pupils that forests contain a huge variety of foods. This includes food from animals but, in this lesson, you will focus on food that does not derive from animals.
3. Write the pupils' answers on the board (including wrong answers, if any).
4. Ask the pupils to consider whether all the answers are correct (refer to the background information for examples). Ask them to indicate which foods written on the board are not from forests (e.g. grain flour is produced by agriculture, although some types of flour – such as chestnut flour – can be made using forest plants).
5. Erase the wrong answers from the board.
6. Add other examples from Table 2.1. Include examples of forest products used as ingredients in mass-produced food (e.g. tea, coffee and chocolate).
7. Ask the pupils to copy the list on the board into their exercise books.
8. **Explain:** Some foods from the forest are now grown on farms and produced on a very large scale.

Food name in English	Swahili or local name	Tanzanian regions where commonly found
Amaranth	*Mchicha, bwache*	Countrywide
Avocado	*Parachichi*	Mbeya, Njombe, Songwe, Iringa, Kilimanjaro, Arusha, Tanga, Kigoma, Kagera, Morogoro
Baobab	*Ubuyu*	Morogoro, Iringa, Dodoma
Blueberry	-	Iringa
Cape gooseberry, ground cherry	*Tuntunu, vichupwa*	Kagera, East Usambara Mountains
Cinnamon	-	Tanga, Morogoro, Mbeya

Grains of paradise	*Nangawo, amashasha*	Morogoro, Iringa, Kagera
Moringa	*Mlonge*	Morogoro, Mbeya
Palm	*Mchikichi*	Kigoma, East Usambara Mountains, Morogoro, Bukoba
Tamarind	*Ukwaju*	Countrywide
Wild raspberry, strawberry	*Vishaa*	Countrywide
Wild yam	*Ming'oko*	Mtwara, Uluguru North, West Usambara Mountains
Sea purslane	*Mboga ya pwani*	Mangrove forests in coastal areas, Tanga, Zanzibar, Dar es Salaam

Table 2.1. Edible products that can be harvested from plants found in Tanzanian forests

2 Activity 2: Describe some food sources in forests

This activity should take **25 minutes**.

1. Ask the pupils the following questions (invite the pupils to volunteer answers first and then give the right answer if no one responds correctly):
   - ► What tree produces the *ubuyu* fruit?
   - » **Answer:** *Ubuyu* is from the baobab tree.
   - ► What does a baobab tree look like?

     Possible answers:
   - » The baobab is a massive tree that grows up to 18 m (metres) tall.
   - » The baobab has a fat trunk that can measure up to 9 m in diametre (i.e. around the trunk) and can store large amounts of water.
   - » The baobab has unique hanging flowers and produces fruit.

2. Figure 2.1 shows drawings of the baobab tree and its fruit (called *ubuyu*) – copy these drawings onto the board and ask the pupils to draw them in their exercise books.

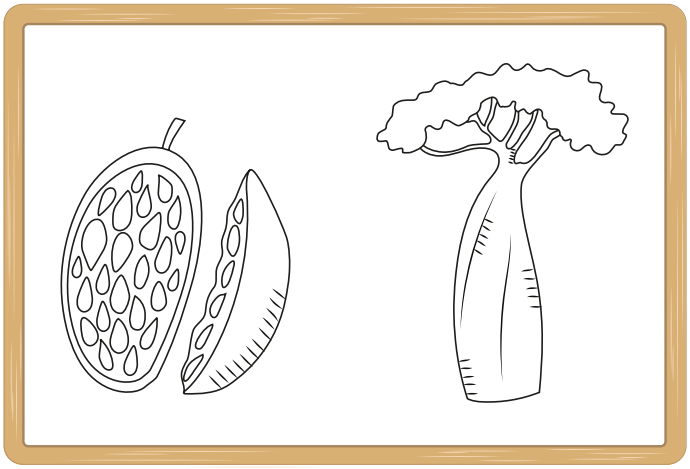


Figure 2.1. Baobab tree, including fruit

3. Ask the pupils the following questions (invite them to volunteer answers first and then give the right answer if no one responds correctly):

   ► Where do mushrooms come from?

   » **Answer:** Mushrooms are fungi (not plants), and they grow in various places, such as at the base of trees, in rings in the grass and on decaying organic matter. Some mushrooms are poisonous, and we must be careful when collecting and eating them. Some people grow mushrooms to eat and sell.

   ► What do mushrooms look like?

   Possible answers:

   » Mushrooms have lightweight, brittle flesh that breaks easily.

   » Mushrooms come in a wide range of colours, such as white, brown, yellow and orange, depending on the species.

4. Copy the drawings of mushrooms in Figure 2.2 onto the board. Ask the pupils to draw these in their exercise books.

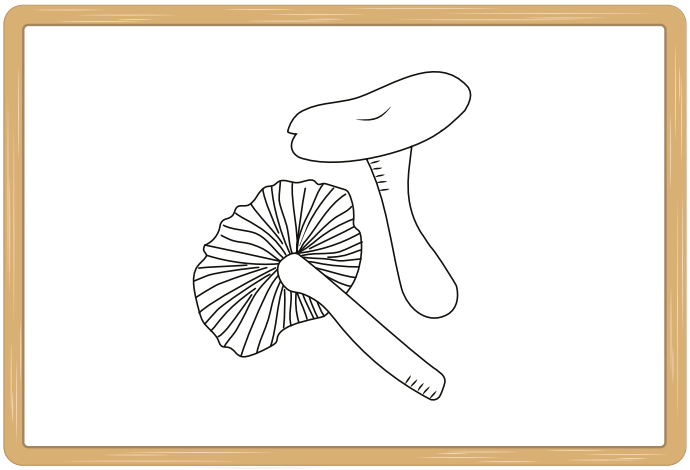


Figure 2.2. Mushrooms

5. Ask the pupils the following questions (invite them to volunteer answers first and then give the right answer if no one responds correctly):

   ► Where do wild yams (*ming'oko*) come from?

   » **Answer:** Wild yams come from climbing plants that grow in natural forests in the United Republic of Tanzania (i.e. yam plants).

   ► What do wild yams look like?

   Possible answers:

   » Wild yams are tubers (tubers are thick underground plant parts).

   » The flesh of wild yams can be various colours, including white, yellow, pink and purple.

6. Next, copy onto the board the drawings of a wild yam tuber and leaves shown in Figure 2.3. Ask the pupils to draw these in their exercise books.

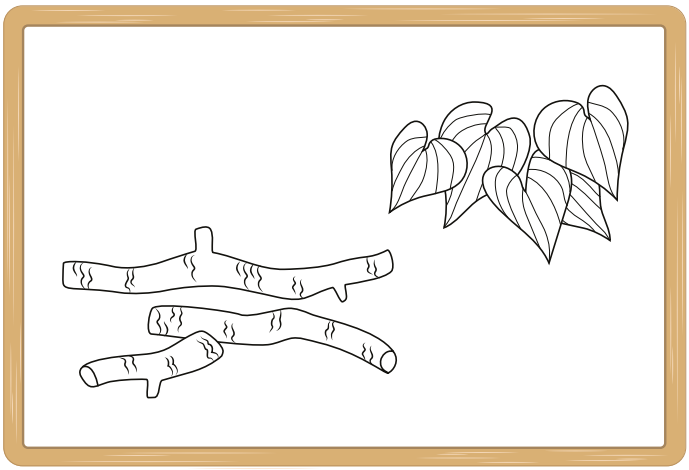


Figure 2.3. Wild yam (ming'oko) *tuber and leaves*

Preparation for the next lesson

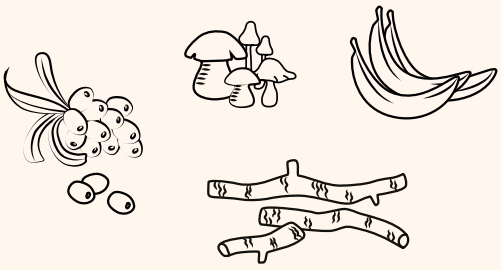
The next lesson needs to be prepared in advance. The instructions are given on the next page.

LESSON 5

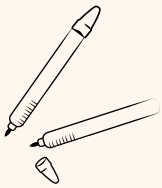
Identify foods from the forest

5

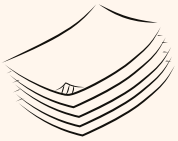
Required materials



4 TYPES OF FOOD FROM THE FOREST
(e.g. amaranth, banana, cinnamon, wild yam, raspberry, strawberry, blueberry and mushroom)



MARKER PENS
(use different colours if available)



16 PIECES OF PAPER
to cover the cups or containers

ADHESIVE TAPE
to secure each cover

16 CUPS
OR OTHER SMALL CONTAINERS
(not transparent)

Preparation for the lesson

Bring to the classroom four types of forest food available in your area. These may be obtained directly in a nearby forest (if permitted) or from a local market. Potential foods you could bring in include baobab fruit, wild yam, cinnamon, amaranth and mushrooms. You will need to put some of each food into four cups or other containers (so you will need 16 cups in total). The lesson requires pupils to smell different foods to identify them (Option A). Alternatively, the activity can be performed by asking the pupils to identify the foods by observation (Option B). Prepare the food stations in advance to ensure that the activity is ready when the pupils are present. The instructions are given below.

How to prepare the food stations

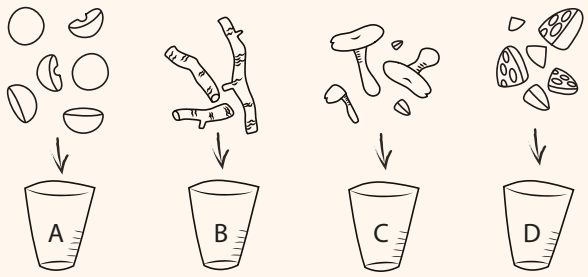
You may choose one of the two following options for this activity:

Option A – pupils identify the foods by smelling them.

Option B – pupils identify the foods by observing them.

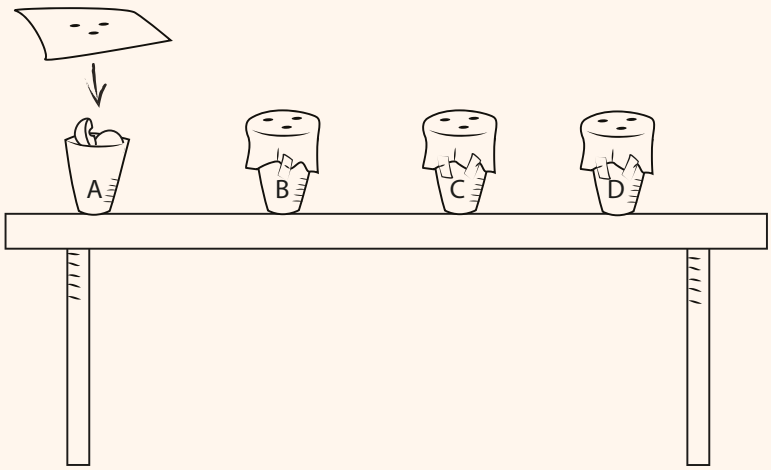
1. Put some of the chosen foods in each cup. You have 16 cups in total, so there will be four cups of each food.

Tip: If Option A is chosen, it is best to slice or crush the foods to release their aromas before placing them in the cups.



2. Assign a letter (A, B, C or D) to each of the food types (e.g. A for amaranth, B for wild yam, C for mushroom and D for raspberry) and label each cup accordingly.
3. Cover each cup with a sheet of paper and secure it with a rubber band. Make small holes in this paper lid using the tip of a pencil so that the pupils can smell the food inside without seeing it.

Note: Skip step 3 if you are using Option B (observation).



4. Set up food stations at four places in the schoolyard (on the ground or on tables). Label the stations 1, 2, 3 and 4. At each station, place four cups – one cup of each of the four food items (i.e. cups A, B, C and D).

5. Ensure that there is enough space between the food stations so that pupils can move around without disturbing the pupils at the other stations.
6. Draw the figure in Figure 2.4 on the board to help explain the activity to the pupils.

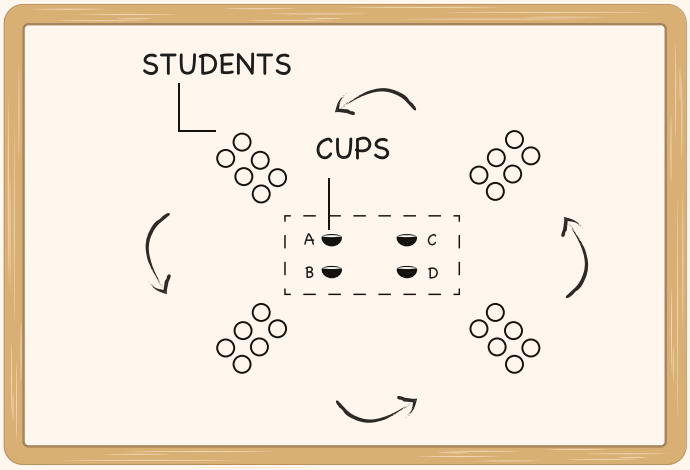


Figure 2.4. A food station showing the four cups (A, B, C and D) and how groups of pupils will move from cup to cup

1 Activity 1: Identify forest foods through smell (Option A) or observation (Option B)

outdoor This activity should take **40 minutes**.

1. In the classroom, explain the task to the pupils using the figure you have drawn on the board and the instructions below.
   - **a.** In the schoolyard, there are four food stations (1, 2, 3 and 4). At each food station, there are four covered cups (A, B, C and D) that contain different forest foods.
   - **b.** Before going to the food stations, the class will be organized into four groups of roughly equal size and given a number from 1 to 4. Each of these groups will go to the food station labelled with their number (i.e. group 1 will go to food station 1, group 2 will go to food station 2, and so on).
   - **c.** Once at the food station, the group will divide into four smaller groups, each sitting next to one of the four cups (A, B, C or D). Figure 2. 4 shows the arrangement at each food station.

OPTION A: SMELLING

   - **d.** Next, each small group will try to identify the food in their covered cup by smelling it, following these rules:
     - » Pupils may not remove the cup covers or look through the holes.
     - » Pupils may not tell others in their small group what they think the food is until everyone has smelt it.
   - **e.** Each pupil will take a turn in smelling the food.
   - **f.** When all the pupils sitting by a cup have smelt the food, they will discuss among themselves what they think it is.
   - **g.** Each pupil in the small group sitting by the cup will write the letter and the group's guess in their exercise book or on a piece of paper (e.g. food A = mushroom).
   - **h.** Groups may not share their answers with any other group.
   - **i.** When the small groups finish at their cups, they will move to the next cup on the food station (e.g. if a group started at cup A, it should move to cup B; if a group started at cup D, it should move to cup A), and so on, until all small groups at each food station have smelt the food in all four cups.

OPTION B: OBSERVING

   - **d.** Next, each small group will try to identify the food in their cup by observing it, following these rules:
     - » Pupils may not tell other pupils in their small group what they think the food is until everyone has observed the foods closely.
   - **e.** Each pupil will take a turn in observing the food.
   - **f.** When all the pupils sitting by a cup have observed the food, they will discuss among themselves what they think it is.
   - **g.** Each pupil in the small group sitting by the cup will write the letter and the group's guess in their exercise book or on a piece of paper (e.g. food A = mushroom).

h. Groups may not share their answers with any other group.

i. When the small groups finish at their cups, they will move to the next cup on the food station (e.g. if a group started at cup A, it should move to cup B; if a group started at cup D, it should move to cup A), and so on, until all small groups at each food station have observed the food in all four cups.

2. After explaining the task, organize the class into four groups of equal size and assign each group a number (1, 2, 3 or 4); these are the food station groups.

> **Note:** The pupils will stay at their assigned food stations throughout the activity. They do not move to other food stations.

3. Then, organize each group into four smaller groups of equal size and assign each a letter (A, B, C or D). Instruct all groups to go to their food stations (group 1 should go to food station 1, group 2 to food station 2, and so on), sit by their cups and start the task.
4. When all forest food groups have guessed the foods in all four cups, encourage the pupils to discuss their experiences by asking them what foods were in each of the four cups.
5. Reveal the correct answers and ask each group how many correct answers it got.
6. Ask the pupils to tidy up and return to the classroom.

LESSON 6

Which parts of forest plants are edible?

6

1 Activity 1: Discover foods that come from the forest

indoor

This activity should take **10 minutes**.

1. Write the names of the foods shown on Figure 2.5 on the board.

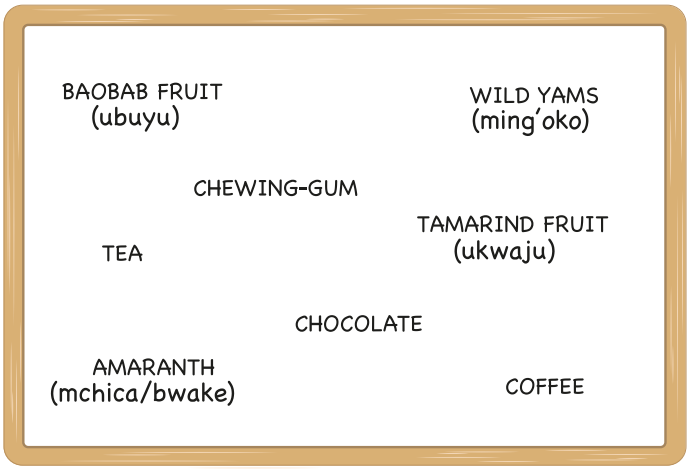


Figure 2.5. Foods that come from the forest

2. Ask the pupils to guess (and vote with a show of hands) which products originate in forests.
3. **Explain:** All the foods listed on the board come from the forest. Some are forest products consumed directly as food, others contain raw materials that originate in forests.
4. Name the plant from which the product or its raw material originates and where in the world and in the United Republic of Tanzania it grows.
   - **Baobab fruit** from the baobab tree.
   - **Tamarind fruit** from the tamarind tree.
   - **Amaranth** from the amaranth plant.
   - **Wild yams** from the wild yam plant.
   - **Chocolate** – produced from beans harvested from cacao trees. Cacao is a native forest tree in South America, but it has also become a huge crop in Africa, including in Kyela in the United Republic of Tanzania.
   - **Tea** – produced from the leaves of a bush that originally came from Chinese forests. The tea bush is now grown widely in the United Republic of Tanzania (e.g. in Njombe and Iringa).

- **Coffee** – produced from the beans of the coffee tree. This forest tree is native to South America but is also widely grown in Africa, including in the United Republic of Tanzania (e.g. in Kagera, Kilimanjaro and Mbeya).
- **Chewing-gum** – until about 50 years ago, most commercial chewing-gum was made from chicle, a natural gum obtained from a South American tree. Today, only a few companies use chicle in their chewing gum.

5. Ask the pupils to write in their exercise books the names of the foods you mentioned above.

2 Activity 2: List the edible plant parts

indoor This activity should take **30 minutes**.

1. Copy Figure 2.6 onto the board and ask the pupils to draw it in their exercise books.
2. Ask the pupils to think of examples of the various edible plant parts and write them in the right places on the Figure (see Figure 2.7).

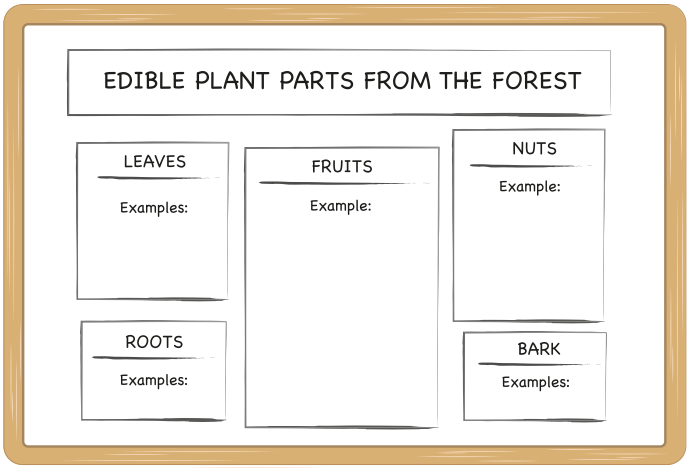


Figure 2.6. Edible parts of forest plants

3. Ask the pupils to compare their answers with those of other pupils sitting nearby and to write down any additional examples.
4. After five minutes, ask the pupils to volunteer answers to the class by raising their hands. Write the volunteered answers in the correct boxes on the board.
5. Add any other examples from the answers in Figure 2.7 not already on the board. Ask all the pupils to write the examples in the Figure in their own exercise books.

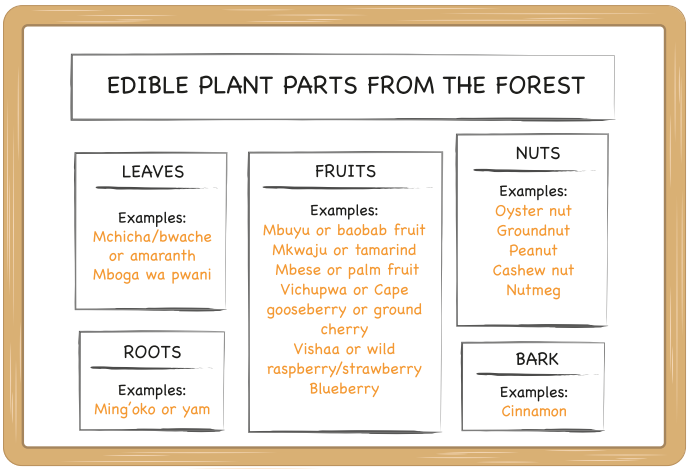


Figure 2.7. Edible parts of forest plants – examples

6. Finish the lesson by **explaining:**
   - » Forests provide foods for many people.
   - » It is important that forests are managed sustainably and that no more food is taken from the forest than can regrow before the next harvest. This will ensure that forests remain healthy and productive over time and help satisfy the needs of people today and in the future.

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Notes

[1] **FAO & UNEP.** 2020. *The State of the World's Forests 2020: Forests, biodiversity and people.* Rome. 214 p. https://doi.org/10.4060/ca8642en

[2] **Vinceti, B., Termote, C., Ickowitz, A., Powell, B., Kehlenbeck, K. & Hunter, D.** 2013. The contribution of forests and trees to sustainable diets. *Sustainability*, 5(11): 4797–4824.

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[4] **Rowland, D., Blackie, R.R., Powell, B., Djoudi, H., Vergles, E., Vinceti, B. & Ickowitz, A. 2015.** Direct contributions of dry forests to nutrition: a review. *International Forestry Review,* 17(S2): 45–53. https://doi.org/10.1505/146554815815834804

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[6] **Gumbo, D.J., Dumas-Johansen, M., Muir, G., Boerstler, F. & Xia, Z.** 2018. *Sustainable management of Miombo woodlands: Food security, nutrition and wood energy.* Rome, FAO. 64 p. www.fao.org/3/i8852en/I8852EN.pdf

[7] **FAO.** 2022. FAOSTAT: Forestry production and trade. In: *FAO*. Rome Cited 27 March 2022. www.fao.org/faostat/en/#data/FO

CHAPTER 3

Edible insects

Overview

In this chapter, the pupils will find out what insects are and why they are important for forests and people. They will draw an insect, learn about insects that people can eat, and reinforce what they have learned with a guessing game.

Objectives

By the end of the chapter, the pupils will be able to:

- describe the external and distinguishing features of insects;
- explain how edible insects benefit people's health and livelihoods; and
- develop awareness of the ways in which insects affect forest ecosystems.

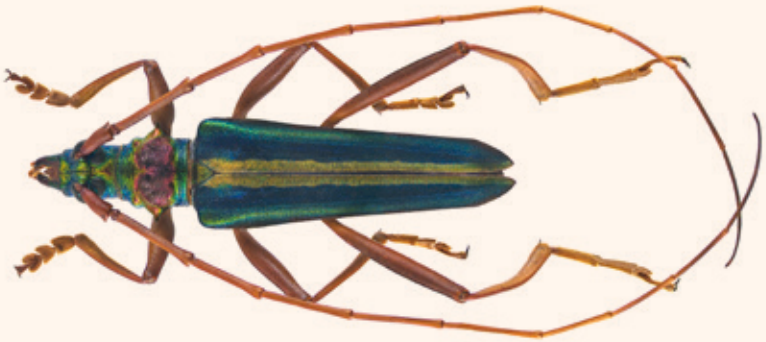
Background information

What are insects?

Animals are either vertebrates or invertebrates. Vertebrates have a vertebral column ("backbone" or "spine") and invertebrates do not. Invertebrates include insects such as butterflies, annelids such as earthworms, arachnids such as spiders, and gastropods such as snails. More than 90 percent of all animals are invertebrates.

Insects are invertebrate animals with six legs. They have an external skeleton (called an "exoskeleton"), which gives them shape, support and protection. Insect bodies have three main parts:

- **Head** – includes the brain, eyes, a pair of antennae and a mouth.
- **Thorax** – the middle segment between the head and the abdomen. It includes the legs and, in some species, one or two pairs of wings (not all insects have wings).
- **Abdomen** – contains the heart, reproductive organs and digestive organs. In some species (e.g. honeybees), the abdomen also holds a sting.



Picture 3.1. Insect body

There have been insects on Earth for more than 400 million years and, today, there are more than 1 million species.[1] Insects are highly diverse – for example, bees, ants, beetles, termites, mosquitos and butterflies are all insects. Many are crucial for plant reproduction by assisting with pollination; there are an estimated 100 000 pollinator animal species in the world, and almost all (98 percent) of them are insects.[2]

What are edible insects?

Edible insects are insects considered suitable for human consumption. It is estimated that, worldwide, several hundred million people eat insects.[3] Edible insects are important in many traditional diets, but they are also increasingly being farmed on a large scale as a high-protein food source with low environmental impact.

More than 1 900 species of insect are consumed as food. The most common types of edible insects are beetles, caterpillars, bees, wasps and ants.[4] In the United Republic of Tanzania, two insects commonly eaten by people are the flying termite (*kumbikumbi*) and the longhorn grasshopper (*senene*).[5] The cone-headed grasshopper (*senene*) is also commonly consumed.[6]

A common misconception about insects as food is that they are consumed only as a last resort. In most cases, however, insects are staples in local diets and are consumed because of their taste and nutritional value – not because no other foods are available. Some insects, such as mopane caterpillars in southern Africa and weaver ant eggs in Southeast Asia, can fetch high prices and are thought of as delicacies.[7]

Insects can be eaten either directly or indirectly in recomposed foods (foods that contain protein from insects as well as other ingredients). Such recomposed foods are being produced and consumed in countries where insects have not traditionally been part of the diet, such as in Europe and North America.[8]

Picture 3.2. Flying termite

Picture 3.3. Longhorn grasshopper (senene)

Why are edible insects good for people and the environment?

Edible insects can be beneficial for human health and livelihoods as well as for forests and the environment. They can help meet the dietary needs of the growing global population with a lower environmental impact than that caused by the rearing of other livestock.[9]

Human health

- Edible insects contain high-quality protein, fatty acids, vitamins, fibre and minerals that help meet people's nutritional needs. They are also high in calcium, iron and zinc. For example, forest caterpillars contain even more protein, fat and energy than the equivalent amount of meat and fish.[10]
- Insects contain high levels of antioxidants, which are naturally occurring chemicals that help prevent heart disease and cancer.

Livelihoods

- Insects can be collected easily in forests and other habitats, enabling people to supplement their diets and earn cash by selling excess supplies.
- Rearing insects as "minilivestock", at both the household and industrial scales, provides people with income. In East Africa, insect farming for food and livestock feed is a relatively new but rapidly growing business.[11]
- Insects can be farmed at a low cost and with minimal equipment, meaning that anyone can participate in this income-earning activity. Insects can be reared in small spaces, making it feasible for people with minimal land assets to raise them.

Environment

- Insect farming requires significantly less land and water than that needed for larger livestock such as cattle, chickens and goats.
- Insects produce fewer greenhouse gases and air pollutants than larger livestock.[12]
- Insects need less food than traditional livestock to gain the same amount of weight – and they can consume organic waste such as food waste, fish offal and animal slurries. The larvae of the black soldier fly, an insect native to the United Republic of Tanzania, can convert waste into protein with extraordinary efficiency and are renowned for being easy to rear.[13]

Forests

- Many insects are pollinators, meaning that they help carry pollen from one flower (or flower part) to another to enable the plant to produce fruit and seeds. This is an essential ecosystem service.
- Some insects prey on harmful insect pests and thereby help protect important plants such as agricultural crops and trees.
- Some insects enrich the soil by recycling nutrients. Some edible insects – such as beetle larvae and termites – consume dead plant and animal material and ultimately make nutrients available for use by other living organisms.

Picture 3.4. Edible cricket farming

Picture 3.5. Edible insects for sale in a market

Picture 3.6. A traditional Tanzanian dish made out of senene

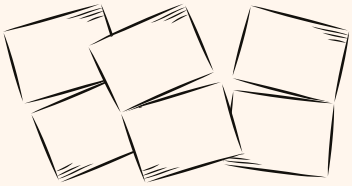
Picture 3.7. Cricket cracker snacks made with cricket flour

LESSON 7

What is an insect?

7

Required materials



A4 SHEETS OF PAPER
CUT IN HALF
(1 half per pupil)

ADHESIVE TAPE

1 Activity 1: Brainstorm on insects you know

indoor

This activity should take **20 minutes**.

1. Write the following questions on the board but don't put up the answers yet. Ask the pupils to brainstorm first, then write the answers on the board.

   - What kinds of insect are found in Tanzanian forests and grasslands?
   - » **Answer:** Ants, wasps, flying termites (*kumbikumbi*), butterflies, cone-headed grasshoppers (*senene*), other grasshoppers and honeybees.
   - Which of these insects are edible?
   - » **Answer:** Flying termite, cone-headed grasshopper and some other grasshoppers.
   - What dishes do we serve containing edible insects?
   - » **Answer:** Termites with *ugali*; termites with rice; grasshoppers with chips; and chilled grasshoppers.
   - How many people do you think eat insects worldwide?
   - » **Answer:** Several hundred million people.
   - Why might edible insects be good for your health?
   - » **Answer:** Edible insects are highly nutritious – they contain a lot of protein, fat, vitamins, fibre and minerals.
   - Why might eating insects be good for the planet?
   - » **Answer:** Edible insects generally require fewer resources (space, water and feed) than traditional livestock such as cattle, pigs, goats and chickens to produce the same amount of food.

2. Ask the pupils to copy the questions and answers into their exercise books.

2 Activity 2: Draw an insect

indoor This activity should take **20 minutes**.

1. Ask the pupils to think of a specific insect (edible or not) that they know well. Options are flying termites, cone-headed grasshoppers, beetles, caterpillars, honeybees, wasps and ants.
2. Tell the pupils that insects, edible or not, share common characteristics. **Explain:**
   - » All insects have six legs and a pair of antennae, and many insects also have wings.
   - » The body of an insect can be divided into three parts: the head, thorax and abdomen.
   - » Rather than having a skeleton inside their bodies, insects have a hard outer covering called an exoskeleton.

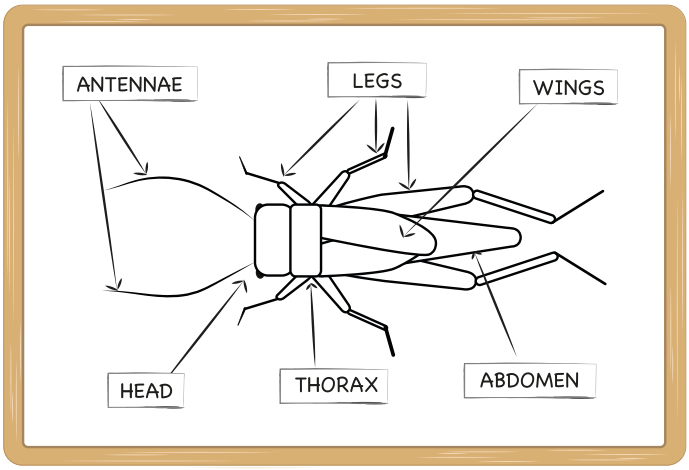


Figure 3.1. The main parts of an insect

3. As you are explaining, draw Figure 3.1 on the board and point to the various features. The pupils can find the same image in their pupils' books.
4. Give each pupil a sheet of paper (half an A4 sheet).
5. Ask the pupils to draw their chosen insect and to include and mark the insect's main body parts, such as the head, thorax, wings (if any), abdomen, antennae and legs.
6. Tell the pupils they have 10 minutes to draw their pictures.
7. After 10 minutes, tell the pupils to finish their drawings and sign them.
8. Collect the drawings and stick them on the classroom walls using adhesive tape. If there is insufficient space, put half the drawings up for one week and the other half up for the following week.

Tip: When the drawings are taken down from the wall, return them to the pupils so that they can insert them into their exercise books.

LESSON 8

Explore the benefits of edible insects

8

Preparation for the lesson

Divide the board into four quadrants and write "Benefits of insects" at the top (Figure 3.2).

1 Activity 1: Discuss the benefits of insects

indoor

This activity should take **40 minutes**.

1. Start the activity by **explaining:**
   - » Insects are an increasing part of the diet of people around the world.
   - » Some insects, such as mopane caterpillars in southern Africa and weaver ant eggs in Southeast Asia, can fetch high prices and are thought of as delicacies.
   - » Insects can be eaten directly, or indirectly in foods that contain insects, such as protein powders for athletes.
   - » Foods containing insect proteins are being produced and consumed in countries where insects have not traditionally been part of the diet, such as in Europe and North America.
   - » Insects can have many benefits for people, forests and the environment.
2. In the quadrants on the board, write "Health", "Livelihoods", "Forests" and "Environment", as shown in Figure 3.2.

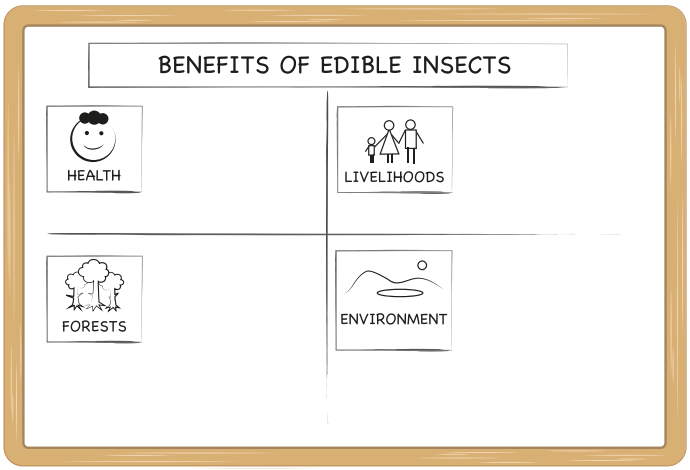


Figure 3.2. Four quadrants showing the benefits of edible insects

3. Ask the pupils (allow them time to think and then invite some pupils to volunteer answers):
   - ► What are the health benefits of insects?
4. After a few minutes, **explain:**
   - » Edible insects are considered good food for people because they are high in protein, fat, vitamins, fibre and minerals.
   - » Edible insects may be less likely than other edible animals, such as mammals and birds, to transmit infections to humans.
   - » Many insects contain high levels of antioxidants, which help prevent heart disease and cancer.
5. Write the following in the "**health**" quadrant:
   - **Protein**, **fat**, **vitamins**, **fibre**, **minerals**
6. Ask the pupils to copy this into their exercise books.
7. Next, ask the pupils (allow them time to think and then invite some pupils to volunteer answers):
   - ► How can edible insects support people's livelihoods?
8. After a few minutes, **explain:**
   - » Edible insects can be collected in forests and other habitats, and they can also be farmed at low cost and with minimal equipment and space.
   - » This means that people in urban and rural areas can easily gather and cultivate insects.
   - » People can cook and eat insects at home to improve their own diets, and they can also sell their excess production (for example, as street food) to earn extra income.
9. Write the following in the "**livelihoods**" quadrant:
   - **Gathering** and **farming**
     - » Consumption —> Better diet
     - » Selling —> Extra income
10. Ask the pupils to copy this into their exercise books.
11. Ask the pupils (allow them time to think of answers and then invite a few pupils to volunteer answers):
    - ► Why are insects important for forests?
12. After a few minutes, **explain:**
    - » Many insects play important roles in plant reproduction as pollinators, meaning that they help carry pollen from one flower (or flower part) to another. This enables plants to produce fruit and seeds.
    - » Some insects prey on harmful insect pest species, helping protect crops, trees and other plants.
    - » Some insects eat dead plant and animal material, breaking it down into tiny pieces so it can be consumed by fungi and bacteria. In this way, the minerals and nutrients of dead organisms become available in the soil to nourish plants.
13. Write the following in the "**forests**" quadrant:
    - **Pollination** (nearly all pollinators are insects)
    - **Pest control**
    - **Soil nourishment and enrichment**
14. Ask the pupils to copy this into their exercise books.

15. Finally, ask the pupils (allow them time to think of answers and then invite a few pupils to volunteer answers):
    - ► Why is eating insects good for the environment?
16. After a few minutes, **explain:**
    - » Edible insects need less food than common farm animals to produce the same amount of food.
    - » Some typical farm animals, like cattle and pigs, emit large quantities of methane – a powerful greenhouse gas – with their flatulence and burps. Insects emit far less.
    - » Insect farming requires much less land and water than would be needed to produce the same amount of food from cows, pigs, goats and chickens. Insects can be reared in small spaces, making it feasible to farm them on small plots of land – even in the city!
17. Write the following in the "**environment**" quadrant:
    - Less **methane** and other air pollutants emitted
    - Less **water** used
    - Less **land** used
    - Less **feed** to grow for livestock
18. Ask the pupils to copy this into their exercise books. The board should now look like Figure 3.3.

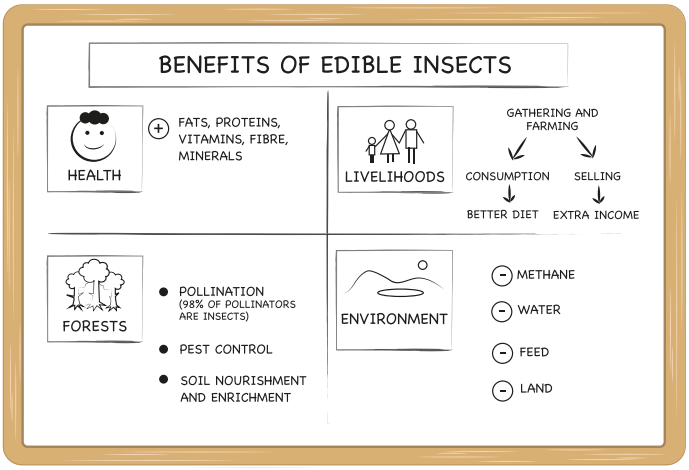


Figure 3.3. How the board should look at the end of the activity

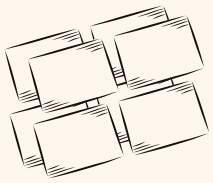
19. **Explain:** It is best to time the harvest of wild insects after they have laid their eggs to ensure that another generation of insects will be born to replace those harvested. This is important for the sustainability of insect gathering.

LESSON 9

Discover an edible insect recipe

9

Required materials



MANILA CARDS
(1 per group of pupils)

Preparation for the lesson

Write the following questions on the board (do not indicate which are the correct answers, in bold):

- How many legs do insects have?
  - a. 4
  - b. **6**
  - c. 8

- How many people worldwide eat insects?
  - a. 1 000
  - b. 1 million
  - c. **Hundreds of millions**

- What are the three main body parts of an insect?
  - a. **Head, thorax and abdomen**
  - b. Head, body and feelers
  - c. Front, middle and end

- How do insects benefit forests?
  - a. They pollinate plants
  - b. They decompose waste
  - c. **Both "a" and "b"**

- What are the nutritional values of insects?
  - a. **Protein, fat, vitamins and minerals**
  - b. Sugar
  - c. Oil
- Which of the following edible insects are found in the United Republic of Tanzania?
  - a. Flying termite (*kumbikumbi*)
  - b. Cone-headed grasshopper (*senene*)
  - c. **Both "a" and "b"**
- What is the structure that supports the bodies of insects called?
  - a. Skeleton
  - b. Muscles
  - c. **Exoskeleton**
- Which of the following produces a larger quantity of methane when farmed?
  - a. **Cows**
  - b. Insects
- How many species of insects are edible?
  - a. **More than 1 900 species**
  - b. 100 species
  - c. 10 species

1 Activity 1: Test your knowledge of insects

This activity should take **30 minutes**.

1. Organize the class into groups of eight to ten pupils. Give each group a small piece of paper or a manila card.
2. Ask the pupils to think about the questions on the board.
3. Read the first question to the class. Read each of the possible answers and tell the pupils that only one is correct.
4. Allow the pupils 2 minutes to discuss the question in their groups and to write down the group's answer.
5. Once all the groups have written down an answer, erase the wrong answers to reveal the correct one. Each group should mark their answer with a tick if correct and a cross if incorrect.
6. Continue with the rest of the questions.
7. Once all the questions have been answered, ask each group to count how many correct answers they have. The group with the highest score wins.
8. Ask the pupils to write the questions and correct answers in their exercise books.

2 Activity 2: Learn how to cook flying termites

indoor This activity should take **10 minutes**.

1. Ask the pupils if any of them have eaten insects. Invite a few pupils to answer and discuss their experiences. You can ask the following questions:
   - What did the insect feel like in your mouth?
   - What sound did it make when you bit it?
   - What did it taste like?
2. Show the pupils the photo below (cooked flying termites) and ask some of them to describe what they see. For example, what colours can they see? What size are the insects? What shape are their bodies? How are they being cooked? Can they guess which insect species it is?

Picture 3.8. A traditional Tanzanian dish made out of senene *with* ugali *and vegetables*

3. Tell the pupils that they will learn a recipe for cooking flying termites.
4. Write the list of ingredients (below) on the board and ask the pupils to copy it into their exercise books.

   Ingredients:

   - 500 grams raw flying termites (1 dish)
   - Salt
   - *Ugali*

5. Write the steps of the recipe on the board in random order, as shown in Figure 3.4.

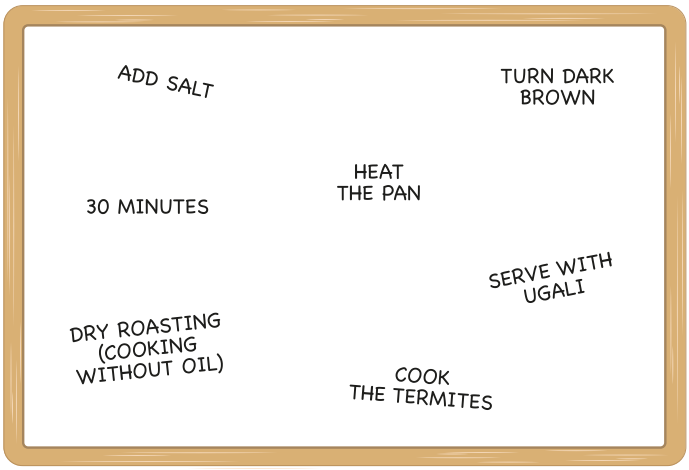


Figure 3.4. The recipe for flying termites with ugali, in random order

6. Ask the pupils to write the steps into their exercise books in the correct order.

   Correct order of steps:
   Heat the pan. Cook the termites by dry roasting (cooking without oil), add salt, and cook for **30 minutes** until the termites **turn dark brown. Serve with *ugali*.**

7. After you have revealed the correct order, invite the pupils to discuss this topic in their homes and to share with their families what they have learned about the benefits of edible insects.

Preparation for the next lesson

Ask the pupils to discuss hunting with their families.

- Have they or any family members ever participated in a hunt?
- Do they know people who have hunted? If so, what animals were hunted?
- Do they know how a hunt works?
- What does their family think about hunting?

Notes

[1] **Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. & Vantomme, P.** 2013. *Edible insects: Future prospects for food and feed security.* FAO Forestry Paper No. 171. Rome, FAO. www.fao.org/3/i3253e/i3253e.pdf

[2] **Ingram, M., Nabhan, G.P. & Buchmann, S.L.** 1996. Our forgotten pollinators: protecting the birds and bees. *Global Pesticide Campaigner*, 6(4): 1–12.

[3] **Van Huis, A., Halloran, A., Van Itterbeeck, J., Klunder, H., & Vantomme, P.** 2022. How many people on our planet eat insects: 2 billion? *Journal of Insects as Food and Feed*, 8(1): 1–4.

[4] **Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. & Vantomme, P.** 2013. *Edible insects: Future prospects for food and feed security.* FAO Forestry Paper No. 171. Rome, FAO. www.fao.org/3/i3253e/i3253e.pdf

[5] **Mmari, M.W., Kinyuru, J.N., Laswai, H.S., & Okoth, J.K.** 2017. Traditions, beliefs and indigenous technologies in connection with the edible longhorn grasshopper *Ruspolia differens* (Serville 1838) in Tanzania. *Journal of Ethnobiology and Ethnomedicine*, 13(1): 1–11. https://agris.fao.org/agris-search/search.do?recordID=US201800241637.

[6] **Mmari, M.W., Kinyuru, J.N., Laswai, H.S., & Okoth, J.K.** 2017. Traditions, beliefs and indigenous technologies in connection with the edible longhorn grasshopper *Ruspolia differens* (Serville 1838) in Tanzania. *Journal of Ethnobiology and Ethnomedicine*, 13(1): 1–11. https://agris.fao.org/agris-search/search.do?recordID=US201800241637

[7] **FAO.** 2013. *The contribution of insects to food security, livelihoods and the environment*. Rome. 4 p. www.fao.org/3/i3264e/i3264e00.pdf

[8] **Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. & Vantomme, P.** 2013. *Edible insects: Future prospects for food and feed security.* FAO Forestry Paper No. 171. Rome, FAO. www.fao.org/3/i3253e/i3253e.pdf

[9] **FAO.** 2021. *Looking at edible insects from a food safety perspective: Challenges and opportunities for the sector.* Rome. https://doi.org/10.4060/cb4094en

[10] **Pierce Colfer, C.J., ed.** 2012. *Human health and forests: A global overview of issues, practice, and policy.* People and Plants International – Conservation Series. London, Earthscan. As seen in: **FAO**. 2020. *Forests for human health and well-being: Strengthening the forest–health–nutrition nexus*. Forestry Working Paper No. 18. Rome. https://doi.org/10.4060/cb1468en

[11] **Tanga, C.M., Egonyu, J.P., Beesigamukama, D., Niassy, S., Emily, K., Magara, H. J., et al.** 2021. Edible insect farming as an emerging and profitable enterprise in East Africa. *Current Opinion in Insect Science*, 48: 64–71.

[12] **Van Huis, A., Van Itterbeeck, J., Klunder, H., Mertens, E., Halloran, A., Muir, G. & Vantomme, P.** 2013. *Edible insects: Future prospects for food and feed security.* FAO Forestry Paper No. 171. Rome, FAO. www.fao.org/3/i3253e/i3253e.pdf

[13] **Ministerie van Landbouw, Natuur en Voedselkwaliteit.** 2018. Making money from maggots in Tanzania. In: *Ministerie van Landbouw, Natuur en Voedselkwaliteit.* Cited 13 October 2022. www.agroberichtenbuitenland.nl/landeninformatie/tanzania/achtergrond/latest-developments/making-money-from-maggots-in-tanzania

CHAPTER 4

Hunting

Overview

In this chapter, the pupils will learn that sustainable hunting for animals can help in managing wildlife and their habitats while also providing people with livelihoods and supplementing their diets. The pupils will also learn about different types of hunting by sharing stories from their families, neighbours and communities. They will play a guessing game to learn about some commonly hunted animals in the United Republic of Tanzania.

Objectives

By the end of the chapter, the pupils will be able to:

- describe different types of hunting;
- name and describe some of the wild animals commonly hunted for food in the United Republic of Tanzania; and
- explain how responsible hunting can help conserve biodiversity while also providing livelihoods for hunters.

Background information

What is hunting and how does it contribute to people's livelihoods?

Hunting is the tracking, chasing, capturing and killing of wild animals. Illegal hunting is called poaching. Around the world, many rural communities and Indigenous Peoples hunt reptiles, birds and mammals in forests and other habitats to obtain wild meat (also called bushmeat) for food and income.

In many regions of the world, wild meat is a key source of protein and fat as well as of iron and other micronutrients. It is an essential part of the diets of many Indigenous Peoples and rural communities, particularly in the tropics and subtropics – in some rural communities, wild meat provides up to 80 percent of the protein intake of households.[1] Wild meat is especially important in areas where rearing livestock and fishing is not possible and for supplementing diets during lean periods, such as droughts.

Hunting is a significant aspect of life in many rural African communities. It was once the main source of animal protein, and it also provided materials for making tools and clothing. Today, hunting still plays a central role in many rural people's diets and is a main source of protein, fat and micronutrients for many.

How is hunting regulated in the United Republic of Tanzania?

In the United Republic of Tanzania, the Wildlife Conservation Act 2009[2] provides guidance on hunting, such as specifying at which times of the year hunting is allowed and the species that may be hunted.

About 70 species can legally be hunted in the United Republic of Tanzania, including mammals such as hyenas, zebras, elephants, jackals, lions, buffaloes, antelopes and wild boar, and various species of birds and reptiles. The hunting season in the United Republic of Tanzania runs from July to December. A reason for not allowing hunting from January to May is that, for many Tanzanian trophy animals, this is a key period for breeding and rearing. Hunting is prohibited in national parks and the Ngorongoro Conservation Area and allowed in game reserves, game-controlled areas and wetland reserves. Normally, no animal may be hunted or trapped without a permit. All hunters (both Tanzanians and tourists) are required to obtain hunting licences or other written authority from the Director of Wildlife in the Ministry of Natural Resources and Tourism. Not all people abide by the law, however, and poaching also occurs.

Tanzanian law recognizes the following categories of hunters:

- **Residents.** Citizens and resident non-citizens are permitted to hunt wild animals for meat if they have obtained a licence. The traditional communities of Wahadzabe in the districts of Mbulu and Iramba and of Wandorobo in the districts of Simanjiro and Kiteto are permitted to hunt in their respective areas under the authority of the Director of Wildlife.
- **Tourists.** Tourists may hunt and fish for sport and trophies, although they are not allowed to export the meat. "Trophy hunting" is hunting an animal to obtain its head, horns, skin or other body part, which the hunter keeps as a souvenir.

Picture 4.1. A young hunter in a traditional community

Picture 4.2. Impalas graze near a forest area in Mikumi National Park

How does legal and sustainable hunting contribute to wildlife protection?

In many communities, hunting animals for their meat in and around forests is an important cultural and economic practice, which also contributes to food security.

Overhunting can endanger wildlife species and destroy people's livelihoods. Rising demand for wild meat – especially in urban areas, where it is consumed both traditionally and as a luxury item – is encouraging an increase in hunting. Overhunting leads to declines in wildlife populations (including endangered and rare species), which, in turn, increases food insecurity among those local rural communities who cannot afford alternative sources of protein.

It is important, therefore, to hunt sustainably – that is, not to take more animals than can be replaced by natural means over the long term. The aim of sustainable wildlife management is to enable hunting for food and income while ensuring that populations of hunted species, and their habitats, remain stable over time, thereby helping ensure healthy natural ecosystems and forests.

Picture 4.3. African buffaloes drinking water in Mikumi National Park

LESSON 10

Who hunts what in Tanzanian forests?

10

1 Activity 1: Discuss hunting

indoor This activity should take **20 minutes**.

1. Ask the pupils whether they know or have met people who hunt wild animals. Ask several to share their stories. If no pupils volunteer, encourage them to share what they have heard about hunters or hunting from others or the media, and their own ideas about hunting.
2. Write the words "Who," "Which", "How" and "What" on the board.
3. Below are some questions to guide the conversation. Point to the words on the board as you ask the questions.
   - Who hunts wild animals? For example, someone in the family or in the local neighbourhood, or tourists from other countries.
   - Which animals are hunted? For example, hyenas, zebras, elephants, jackals, lions, antelopes, wild boar and various birds and reptiles.
   - How does the hunt take place? For example, are hunters alone or in groups? Do they hunt with guns, traps or something else?
   - What happens to the hunted animals? For example, are they sold to traders? Do the hunters and their families eat the meat or sell it in the village?
   - How do people use game animals? For example, do they eat the meat? Do they use the fur and skins to make clothing or rugs? Do they use the bones for tools? Do they use feathers for decoration? Do they sell any of these products?

2 Activity 2: Categorize hunters

indoor This activity should take **20 minutes**.

1. Explain that there are two main categories of hunters in the United Republic of Tanzania: residents and tourists.
2. Write the two on the board (Figure 4.1).

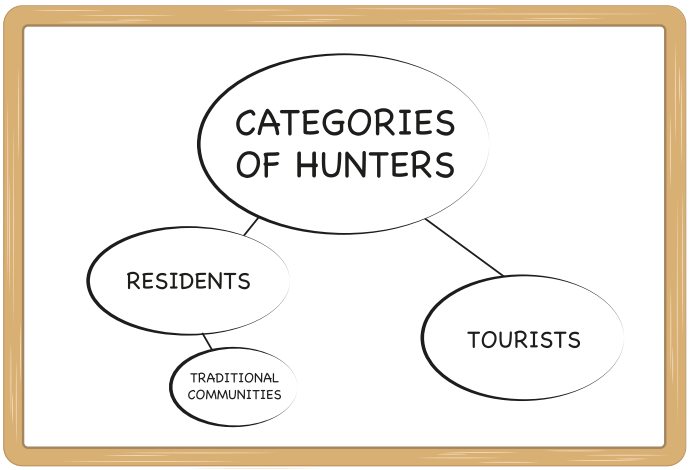


Figure 4.1.Categories of hunters in the United Republic of Tanzania

3. **Explain:**
   - » **Residents.** People living in the United Republic of Tanzania are permitted to hunt wild animals for meat if they have obtained a licence. Hunting is an important aspect of life in many rural African communities. Traditional communities, such as the Wahadzabe in the districts of Mbulu and Iramba and the Wandorobo in the districts of Simanjiro and Kiteto, which rely on hunting for food, are allowed to hunt in their areas under the authority of the Director of Wildlife.
   - » **Tourists.** Tourists may hunt for sport and trophies, although they may not export the meat. "Trophy hunting" is hunting an animal to obtain its head, horns, skin or other body part, which the hunter keeps as a souvenir.
4. **Explain:** In the United Republic of Tanzania, the hunting season runs from July to December. A reason for not allowing hunting from January to May is that, for many Tanzanian trophy animals, this is a key period for breeding and rearing. Banning hunting in these months is designed to ensure the successful breeding of the hunted species.
5. Ask the pupils to copy the picture on the board (Figure 4.1) into their exercise books.
6. Ask the pupils the following question;
   - ► What are the advantages and disadvantages of hunting?
7. Allow them to think and then invite a few pupils to volunteer answers.

Note:

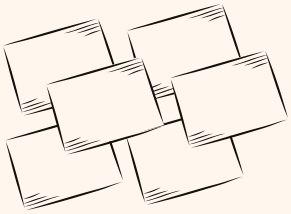
- The discussion does not have to come to final conclusions. The aim is to encourage the pupils to think about the possible advantages and disadvantages of hunting and to consider different arguments.
- The discussion is in preparation for the conclusion of Lesson 12, which emphasizes the importance of sustainable hunting.

LESSON 11

Play a hunted species guessing game

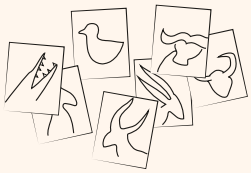
11

Required materials



6 SHEETS OF MANILA CARD

1 PAIR OF SCISSORS TO CUT OUT THE INFORMATION SHEETS



INFORMATION SHEETS

Preparation for the lesson

Cut out the information sheets included at the end of this chapter. Each contains a photo and a description of an animal commonly hunted for food in the United Republic of Tanzania. These information sheets will be used in Activity 2.

1 Activity 1: Guess the animal

indoor

This activity should take **5 minutes**.

1. Tell the pupils that this lesson is about animals that are often hunted for meat in the United Republic of Tanzania. Tell them that about 70 animal species can legally be hunted in the United Republic of Tanzania.
2. In this activity, you will describe one such animal, and the pupils will try to guess what it is.
3. Explain the rules, as follows:
   - » I will give you six clues to help you guess the animal.
   - » Guess which animal it is, but don't say it out loud.
   - » As soon as you think you know the name of the animal, put your finger on your nose so we can all see that you think you know.

4. Begin the game, starting with the most difficult clues first:
   - I live in herds and exist in the wild only in Africa.
   - I eat plants.
   - I can run very fast.
   - My enemies are leopards, hyenas and lions.
   - I am a kind of horse.
   - I have black and white stripes.
5. When all the clues have been read out, ask the pupils to shout out the name of the animal together.

Note: The correct name of the animal is **zebra**.

2 Activity 2: Test your knowledge about hunted animals

indoor

This activity should take **35 minutes**.

1. Explain to the pupils that they will now create their own guessing game. Ask them to listen carefully while you explain the task. Afterwards, you will organize the class into six groups.
2. Explain the task:
   - Each group will receive a blank sheet of paper (or manila card) and an information sheet containing a photo and description of an animal that is commonly hunted in the United Republic of Tanzania.
   - Using the information sheet, each group will write down four or five clues about the animal (see the example below) on the blank paper. You will show these clues to another group later, and they will try to guess the name of the animal.
   - You can choose difficult clues, but be sure to include some that are specific to the animal you are describing so the other group can study the clues and solve the puzzle.

Important: Work quietly, and don't show your information sheet to the other groups or tell them which animal you are describing.

Example:

Information sheet

- The animal exists naturally only in Africa and lives in herds.
- It eats plants.
- It can run very fast.
- Its enemies are leopards, hyena and lions.
- It belongs to the horse family.
- It has black and white stripes.

Clues

- I am found only in Africa.
- I can run very fast.
- I eat plants.
- I belong to the horse family, and I look like a horse.
- I have black and white stripes!

» Each group will have 10 minutes to discuss and write down the clues.

» When the time is up, each group will go to the group next to them and swap clues. Each group will then guess the animal of the other group.

3. Organize the class into six groups of equal size. Give each group a sheet of A4 paper or a manila card. Remind the class that they should work quietly in their groups, ensuring that other groups cannot see their information sheets or hear their clues.

Important: Make sure that groups complete their clues within 10 minutes. When all the groups have finished, they can play the game with another group and guess the other's animal.

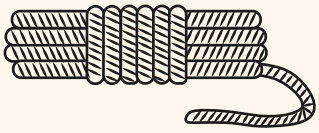
4. Ask each group to find another group and exchange the clue sheets. One of the two groups will try to guess the other group's animal, based on the clues, and come up with an answer. Then the second group will try to guess the other group's animal.
5. After each group has finished guessing, ask a pupil from each group to share the name of the animal they guessed. Write the name of the animal on the board.
6. Repeat the process until the names of all the animals are written on the board.
7. Ask the pupils to write down the names of the animals in their exercise books.
8. At the end of the activity, collect all the information sheets and clue sheets for safekeeping.

LESSON 12

Why should hunting be sustainable?

12

Required materials



A ROPE
(the rope should be long enough to perform a "tug of war" involving half the class)

Preparation for the lesson

Draw a line on the ground in the schoolyard using a stick or a piece of chalk.

1 Activity 1: Learn the importance of balance

outdoor

This activity should take **20 minutes**.

1. Ask the pupils to go outside, taking their exercise books with them.
2. Organize the class into two equal groups. One group will be the observers and the other group will be the players. The two groups will later swap roles.
3. Organize the group of players into two equal teams (trying to keep a good balance in terms of strength between the two groups) – nominate one team to represent humans and the other team to represent animals.
4. Ask the "animal team" to stand on one side of the line drawn on the ground and hand them one end of the rope. Ask the "human team" to go to the other side of the line and ask them to take hold of the other end of the rope.
5. The two teams should now be facing each other on either side of the line. In each team, the pupils should be standing one behind the other, with each pupil gripping the rope.

6. Tell both teams to start pulling. Each team should try to pull hard enough to pull the opposing team to their side of the line. Because there is an equal number of pupils in each team, the game should be evenly balanced. It should not be easy for either team to pull the other team across the line.
7. Allow the players some time to feel the struggle and then ask one of the pupils in the animal team to let go of the rope. After a little more struggle, ask another member of the animal team to let go. If necessary, ask another animal team member to let go.
8. Soon, the animal team will be too weak to resist the stronger human team. The animals will lose.
9. Now, ask the observers to take on the role of animals and humans in the tug-of-war, and repeat the process.

2 Activity 2: Discuss the importance of sustainable hunting

This activity should take **20 minutes**.

1. Ask the pupils to gather around you.
2. Invite some pupils to share what they noticed when they were observing the game . Then **explain:**
   - As long as the two teams were equal in size, neither was able to easily overcome the other, and the game was evenly balanced. As the number of animals started to decline, however, the animal team weakened and eventually lost the game.
   - The same happens in hunting. If done responsibly and with the environment in mind, animal populations can recover, and both humans and animals will remain in balance. Hunting too much or irresponsibly, however, will cause the populations of hunted species to decrease, and they might even become extinct.
3. Conclude the lesson by recapping what the pupils have learned and explaining why sustainable hunting is important. Ask the pupils to write the sentences in their exercise books.
   - Forests are home to many species of animals, some of which are hunted.
   - Hunting can have positive and negative impacts, depending on whether hunters behave responsibly.
   - Hunting is a livelihood for many people, providing them with food, clothing, other products and income.
   - If hunting is practised unsustainably, it will eventually deplete wildlife populations.
   - In the United Republic of Tanzania, hunting is regulated by laws designed to ensure sustainability.
   - Not all people abide by the law, and some poach wildlife. Poachers are breaking the law and endangering the sustainability of legal hunting.
   - Controlled, legal and sustainable hunting can benefit conservation.

East African oryx

Habitat: Semi-arid areas, bush savannahs and steppes.

Distribution: Found in Ethiopia, northern and eastern Kenya, parts of the United Republic of Tanzania, and South Sudan.

Size: 110–120 cm (centimetres) tall and 160–190 cm long.

Weight: Up to 80 kg (kilometres).

Appearance:
- Grey fur on top with a white belly.
- A black stripe runs along the sides, up the chest and on the face.
- Long, thin, pointed horns.

Lifespan: 18 years.

Speed: Extremely fast. East African oryx can run at speeds of nearly 90 km (kilometres) per hour.

Social structure: Forms large herds, with males and females together.

Threats: The species is endangered by the building of human settlements on grazing lands.

Diet: Herbivore – they eat only plants, such as:
- grasses
- leaves
- fruit
- buds

Interesting fact: East African oryx can store water in times of drought by raising their own body temperature so they don't sweat.

Buffalo

Habitat:	Swamps and floodplains, as well as mopane grasslands and the forests of the major mountains of Africa. Prefers habitat with dense cover, such as reeds and thickets, but can also be found in open woodland.
Distribution:	Sub-Saharan Africa.
Size:	120–150 cm tall.
Weight:	250–1 000 kg.
Appearance:	» Horns. » Hooves. » Dark red or brown coat.
Lifespan:	11–29 years.
Speed:	Fast. Buffalo can run at speeds of up to 46 km per hour.
Social structure:	Buffalo live in big herds of up to 500 animals.
Threats:	Humans – farmers often consider them to be pests. The species is classified as "near threatened".
Diet:	Herbivore – buffalo eat only plants, such as: » grass » herbs » shrubs and trees
Interesting fact:	African buffaloes are grouchy and unpredictable. They are known to be dangerous to hunters.

Grysbok

Habitat:	Woodland areas with low-growing scrub and medium-length grass. Grysbok also live in rocky, hilly country but prefer the more fertile zones on lower slopes.
Distribution:	Widespread in southeastern Africa. Found in northern South Africa, on the Caprivi Strip and in Botswana, Malawi, Mozambique, Namibia, the United Republic of Tanzania around Lake Victoria, Zambia and Zimbabwe.
Size:	45–50 cm tall.
Weight:	7–11.5 kg.
Appearance:	» Brown fur speckled with white. » Dark, V-shaped mark between the ears. » Large ears with white-grey markings inside.
Lifespan:	Up to 8 years.
Speed:	Rather than run, grysbok seem to leap and dart, and to hide.
Social structure:	Some grysbok live in groups, but others roam alone.
Threats:	Grysbok face no major threats, although the species is not as widespread as it once was due to the spread of settlements and associated habitat destruction and hunting.
Diet:	Grysbok are herbivores, meaning that they eat only plants, including: » fruit » grasses » shrubs
Interesting fact:	When frightened, grysbok will stop and freeze in place.

Emerald-spotted wood dove

Habitat:	A wide variety of habitats, including savannahs, grasslands, woodlands and forests.
Distribution:	Widespread in parts of the United Republic of Tanzania.
Size:	25–29 cm.
Weight:	Male 130–210 g (grams); female 85–191 g.
Appearance:	Stout bodies, with short legs and short beaks.
Lifespan:	1–5 years.
Speed:	Up to 150 km per hour.
Threats:	Hawks, owls and bad weather.
Diet:	Berries, seeds and grains.
Interesting fact:	In some cultures, doves are symbols of love, purity, peace and hope.

Wildebeest

Habitat:	Grasslands, savannahs (grasslands with some trees), forests, woodlands and scrub.
Distribution:	Found mainly in eastern and southern Africa, especially in the Serengeti Masai Mara.
Size:	115–145 cm tall.
Weight:	260–290 kg.
Appearance:	» Greyish to brown fur with a silvery-blue sheen (hence sometimes called "blue wildebeest"). » Shoulders and horns that resemble those of a cow. » Black or white beard.
Lifespan:	Up to 24 years.
Speed:	Extremely fast. A wildebeest can run at speeds of up to 80 km per hour.
Social structure:	Wildebeest are known to gather in huge migratory herds. Sometimes they form mixed herds with other species, such as zebras.
Threats:	Mainly humans, who can impede the migration of wildebeest herds with fences and other structures. Using water to irrigate agricultural crops can also reduce the water resources available for wildebeest.
Diet:	Herbivore – the wildebeest eats only plants (mainly short grass).
Interesting fact:	Migratory wildebeest herds can contain as many as 1.5 million individuals.

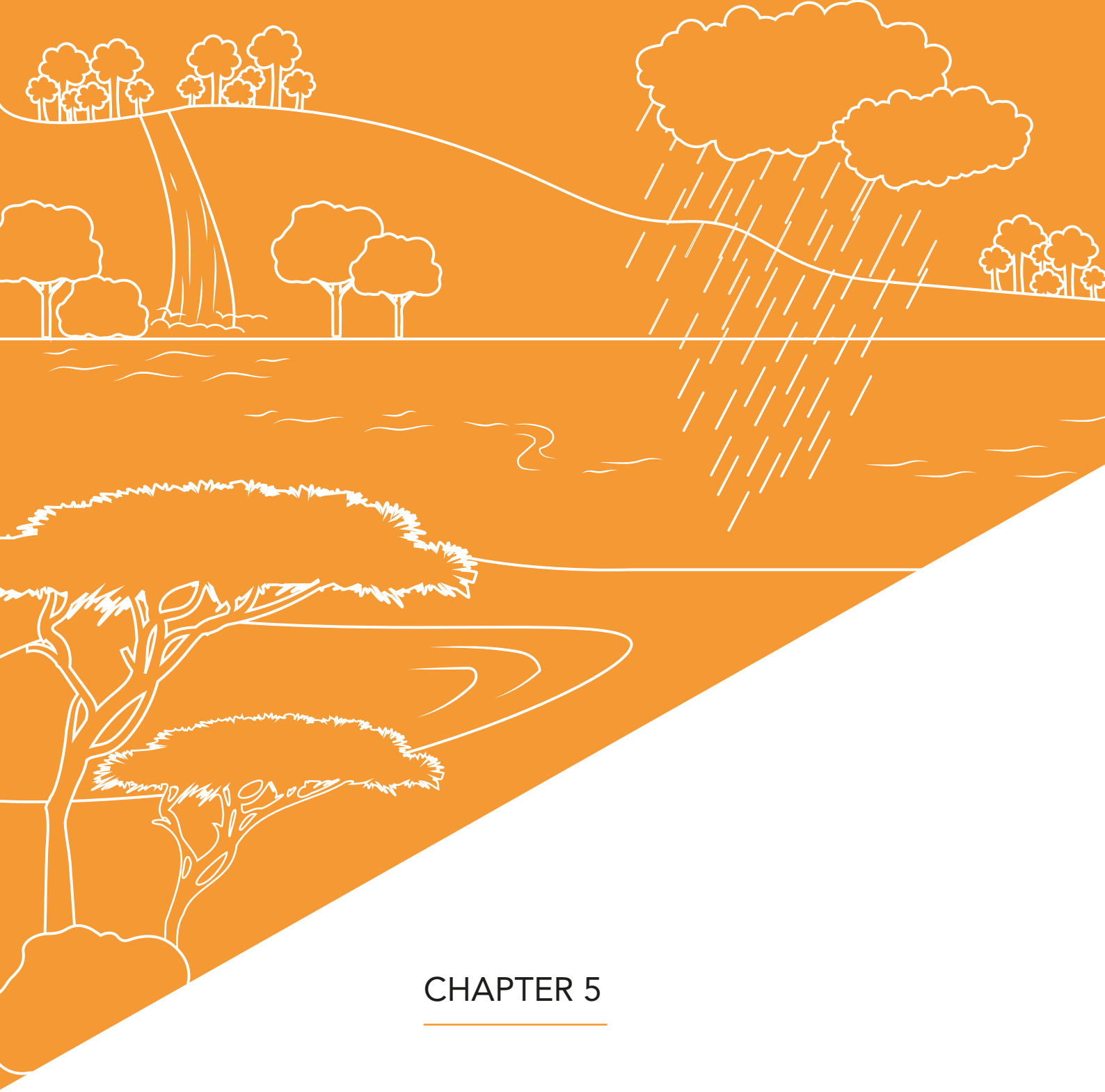
Nile crocodile

Habitat:	Rivers, lakes, dams, swamps and marshes.
Distribution:	Widely distributed in the United Republic of Tanzania and occurs in almost all game reserves.
Size:	Male 2.9–4.4 m (metres); female 2.4–3.8 m.
Weight:	Male 220–750 kg; female 40–250 kg.
Appearance:	» Its body is covered with tough scales. » Has cone-shaped teeth on both jaws.
Lifespan:	70–100 years.
Speed:	30–35 km per hour.
Social structure:	Does not form social groups but can congregate in certain sections of rivers.
Threats:	Has almost no natural predator except for humans.
Diet:	Up to 70 percent of the adult diet is fish. Other prey items can include zebras, hippos, porcupines, pangolins and migrating wildebeest.
Interesting fact:	» If a baby crocodile is in danger, the adult female will pick them up and flip them into her mouth or gular (throat) pouch for protection. » When fish are migrating, crocodiles may hunt cooperatively by forming semi-circles across a river and herding the fish. They then eat the fish that are closest to them.

Notes

[1] **Gumbo, D.J., Dumas-Johansen, M., Muir, G., Boerstler, F. & Xia, Z.** 2018. *Sustainable management of Miombo woodlands: Food security, nutrition and wood energy*. Rome, FAO.

[2] **Tanzania (United Republic of).** *Wildlife Conservation Act*, 2009.



CHAPTER 5

Forests and water

Overview

In this chapter, the pupils will learn the stages of the water cycle through interactive experiments. They will learn the difference between saltwater and freshwater and understand the importance of forests and trees in the Earth's water cycle.

Objectives

By the end of the chapter, the pupils will be able to:

- explain the two main types of water (freshwater and saltwater) and their distribution on Earth;
- develop an awareness of the importance of water;
- explain the five steps of the water cycle and the roles played by forests in regulating this; and
- understand the importance of forests in water management.

Background information

What are the two main types of water, and how are they distributed on Earth?

All living organisms need water to survive. Without water, there would be no life on Earth.

There are two main types of water: freshwater and saltwater.

- **Freshwater** is found mainly in glaciers, lakes, rivers, wetlands, icecaps and underground. Water is "fresh" when it contains very little salt (i.e. less than 0.1 percent).
- **Saltwater** is found mainly in oceans and seas. It is called "salt" water if it contains more salt than is acceptable for freshwater (i.e. more than 0.1 percent). Humans cannot drink saltwater.

There is approximately 1.4 billion cubic kilometres of water on Earth.[1] Of this, more than 97 percent is saltwater and less than 3 percent is freshwater.[2] More than 99 percent of the freshwater is inaccessible to humans because it is either frozen or underground.[3] The volume of water available for human consumption, therefore, is very small.

Accessible freshwater – mainly surface freshwater found in rivers, lakes and other freshwater bodies – must meet a wide variety of human needs, such as drinking, cooking, hygiene and agriculture. Freshwater use by humans has grown at almost twice the rate of the population over the last 100 years, and an increasing number of regions worldwide are chronically short of water.[4] Because freshwater is so precious and rare, it is important to use it wisely.

A large part of the world's freshwater comes from forested areas, and millions of people depend on the high-quality water flowing from forests.[5] In the United Republic of Tanzania, for example, the forests of the Uluguru Mountains supply drinking water to the 2.5 million residents of Dar es Salaam.[6]

How does the water cycle work, and what roles do forests play?

Although the amount of water on Earth is constant, water changes between its liquid, gaseous and solid states. The global water cycle has the following five main stages, with forests and trees playing key roles in many of these:

- **Evaporation** is the process by which water changes from a liquid to a gas. It happens when the sun causes the air temperature to rise. This, in turn, warms water bodies such as icecaps, glaciers, oceans, lakes, rivers, vegetation and soils to form water vapour. Water vapour rises because warm air is lighter than cold air. Trees are part of this process because they take in water from the soil through their roots and release it into the air through their leaves, branches and trunks in the form of vapour. Trees also contribute through transpiration, which is vapour released from leaf pores (like perspiration from humans). There is often considerable water vapour above forests because of evaporation and transpiration from trees.
- **Condensation** occurs when water vapour in the atmosphere cools down and changes into water droplets (liquid state). These tiny droplets form clouds when they accumulate in large quantities. Condensation ("dew") can also occur on plants. Trees and forests can cause condensation by reducing temperatures (with their shade) and increasing humidity (through evaporation and transpiration).
- **Precipitation** occurs when clouds release water, which falls to the Earth's surface as rain (liquid) or snow (solid).
- **Infiltration** occurs when some of the water that falls on the ground seeps into the soil and is stored underground as groundwater. Infiltration improves water quality because soils filter out pollutants. Tree roots increase water infiltration by creating tiny tunnels (channels) in the soil – this increases the amount of water stored in the soil, which plants can use later, enabling them to survive and continue growing during dry periods.
- **Surface runoff** is the water from precipitation that is not absorbed by the soil and instead runs overland and directly into streams and rivers and other surface water bodies. Forests help reduce and slow down surface runoff by improving the infiltration of water into the soil. This helps minimize soil erosion and the risk of flooding and increases the volume of water going into the groundwater.

The water cycle has no beginning or end, and no water is ever lost entirely to the system.

Picture 5.1. Forest transpiration

Picture 5.2. Freshwater in a forest

What is the role of forests in water management?

Forests play many important roles in the water cycle. For example, they:

- **Protect water bodies.** The deep root systems of trees help stabilize the banks of rivers and lakes, and reduce the speed of runoff while also providing habitat for aquatic and terrestrial wildlife.
- **Reduce soil erosion and landslides.** Tree canopies intercept rain, thereby reducing the direct impact of rain on soils. The roots of trees and other forest plants help hold soils together. By doing so on steep slopes, forests can help prevent shallow landslides.
- **Reduce the risk of floods and droughts.** Forest soils act as sponges and retain water for longer than soils under other land uses. This reduces the risk of flooding in high-rainfall periods and the risk of drought in dry seasons.
- **Maintain high water quality.** Forests produce good-quality water by minimizing soil erosion and filtering water pollutants. They reduce the rate at which sediments and other contaminants flow into water bodies.

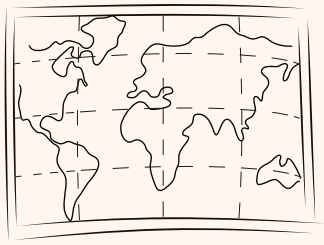
Picture 5.3. Mangrove forests

LESSON 13

How much freshwater is there on Earth?

13

Required materials



WORLD MAP OR GLOBE

1 Activity 1: Learn about freshwater

indoor

This activity should take **10 minutes**.

Option A – if the class has at least 40 pupils:

1. Ask 40 pupils to stand up.
2. Explain to the class that these 40 pupils represent all the water found on Earth.
3. Nominate one of the 40 pupils to stay standing and ask all the others to sit down.
4. Explain that the pupils who sat down represent all the saltwater and the one pupil left standing represents all the freshwater (which is only 2.5 percent of the total amount of water on Earth).
5. Tell the pupils that we get most of our freshwater from lakes and rivers, where it is relatively easy to collect, but most freshwater on Earth is either frozen or underground.
6. Ask the pupil still standing to hold up their hand.
7. Explain to the pupils that the amount of freshwater available to us is only about one-hundredth of the one remaining pupil – perhaps about half the size of their hand.

Option B – if the class has fewer than 40 pupils:

1. Ask 20 pupils to hold up both their hands.
2. Explain to the class that these 40 raised hands represent all the water found on Earth.
3. Nominate one of the 20 pupils and ask all the others to put down their hands. The one remaining pupil should put down one hand, leaving the other in the air.

4. Explain to the class that the hands that have been put down represent all the saltwater on the planet. The remaining one raised hand represents all the freshwater (which is only 2.5 percent of the total amount of water on Earth).
5. Tell the pupils that we get most of our freshwater from lakes and rivers, where it is relatively easy to collect, but most freshwater on Earth is either frozen or underground.
6. Explain to the pupils that the amount of freshwater available to us is only about one-hundredth of the one remaining hand – little more than a fingernail!

2 Activity 2: Discover how water is distributed on Earth

This activity should take **5 minutes**.

1. Show the pupils the world map or globe.
2. Show the pupils the area covered by land (continents) and by water (usually indicated by blue to represent oceans and seas).
3. Tell the pupils that there is also water on land. This can be found in water bodies such as rivers, streams, lakes and ponds. Show some of those on the map – such as Lake Victoria, one of the world's largest lakes, and the River Nile, the world's longest river.
4. Tell the pupils that the water found in oceans and seas is salty (unsuitable for human consumption because it contains too much salt), and most of the water on land and which forms rivers, streams, lakes and ponds is fresh (meaning not salty, and suitable for human consumption).
5. Tell the pupils that there is groundwater, too. Groundwater is water stored underground in spaces such as soil pores and rock crevices. Some groundwater is fresh and some is salty.
6. Explain to the pupils that, in the following lessons, they will learn more about the importance of conserving our precious freshwater resources and the role that forests play in this.

3 Activity 3: Compare fresh and salty water volumes

This activity should take **25 minutes**.

1. Draw the image in Figure 5.1 on the board, step by step. As you do so, ask the pupils to copy it into their exercise books.
2. **Step 1.** Draw a rectangular box to indicate the total amount of water on Earth.
3. **Step 2.** Draw a line across a very thin portion of the top of the box to indicate that only a small portion (about 2.5 percent) of all water on Earth is freshwater.
4. **Step 3.** Indicate that the rest of the water in the box is saltwater – that is, the water in oceans and salty groundwater.

5. **Step 4.** To the right of the rectangle, draw a circle. Tell the pupils that the circle represents all freshwater available on Earth. Divide the circle into ten slices. Fill in two slices to indicate the amount of freshwater contained in groundwater (2 slices = 20 percent). Fill in almost eight slices to indicate the amount of freshwater contained in icecaps and snow glaciers (almost 8 slices = 79 percent). The remaining thin slice in the circle (= 1 percent of all freshwater resources) represents the freshwater that is accessible to humans as surface water in lakes, rivers and other freshwater bodies.

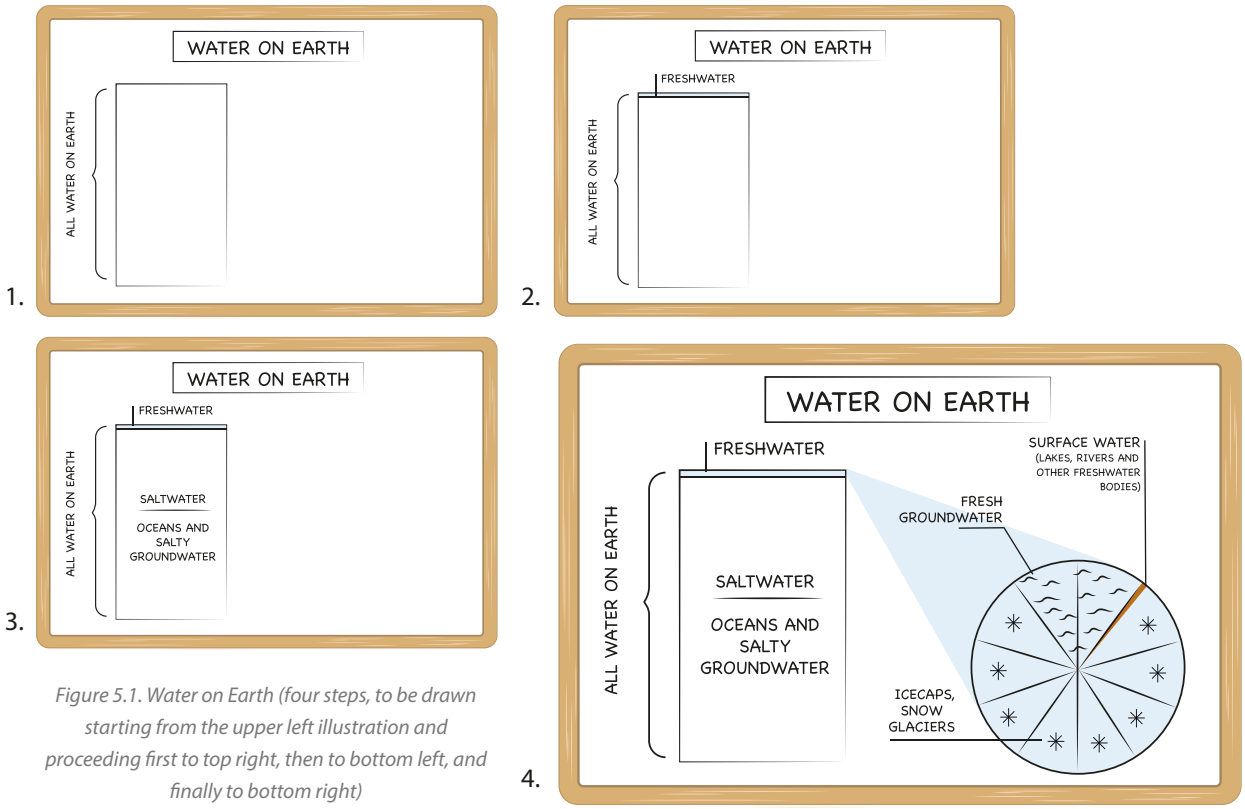


Figure 5.1. Water on Earth (four steps, to be drawn starting from the upper left illustration and proceeding first to top right, then to bottom left, and finally to bottom right)

6. Explain the finished drawing to the pupils:
   - » Only a very small amount of the water on Earth is fresh (low in salt and suitable for human consumption).
   - » Of this freshwater, most is found in glaciers and as permanent snow or ice cover. A smaller amount is inaccessible groundwater, which is underground water.
   - » Of the small fraction of the Earth's water that is freshwater, only a tiny amount is relatively easy for people to access as surface water in lakes, rivers and other water bodies.
7. **Explain:** Only a tiny proportion of all water on Earth is freshwater that is easily available to us. This water comes mainly from rivers, lakes and other freshwater bodies. It is therefore very important to use freshwater wisely because it is both rare and essential for life. It is our most precious resource!
8. Conclude by **explainig:** A large part of the world's drinking water comes from forests. Billions of people depend on high-quality freshwater flowing from forests![8] In the United Republic of Tanzania, forests in the Uluguru Mountains supply drinking water to the 2.5 million residents of Dar es Salaam.

LESSON 14

Make clouds

14

Required materials

Option A

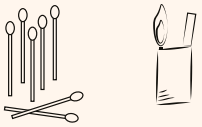
GLASS BOWL

GLASS CUP
or cut plastic bottle

ICE CUBES (a handful)
OR COLD WATER (a jar)

A PIECE OF PAPER

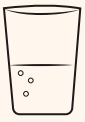
HOT WATER
(around 250 ml)



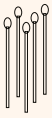
MATCHES OR LIGHTER

Option B (if ice cubes or hot water are unavailable)

1.5 LITRE PLASTIC BOTTLE
WITH LID/CAP*



150 ml OR HALF A CUP
of drinking water



LONG MATCHES

*If you use a plastic bottle, use a sharp knife to cut off the top to form a cup before the lesson starts.

1 Activity 1: Make clouds

indoor This activity should take **40 minutes**.

1. Demonstrate the following activity to the class (Option A). If ice cubes or hot water are unavailable, perform the second experiment instead (Option B).

OPTION A

a. Put the glass or plastic cup on the desk where the pupils can see it.

b. Fill one-third of the cup with hot but not boiling water.

c. Light a piece of paper with a match or lighter and drop the paper into the water so that smoke fills the cup.

d. Immediately place the bowl filled with ice cubes or cold water on top of the cup. Be careful to ensure it balances well, holding it in place if necessary. As you can see in the drawing below, the cup will fill with water vapour like a cloud. Wait two minutes and then remove the bowl of ice cubes.

e. Allow the pupils to observe what happens and then ask them to describe what they see.

f. **Explain** to the pupils what happened in the experiment:

- As the hot water evaporates it creates vapour in the air above it, and this hot moist air rises. The ice cubes or cold water cool the air as it reaches the bowl at the top of the cup and swirls around. The smoke makes the moist air visible, and you should be able to see the air moving in a circular motion.
- The water vapour continues to rise until it cools, at which time it moves back down. After a while, the vapour condenses into droplets on the cool surface of the bottom of the bowl and on the upper surface of the cup, especially where it touches the bowl (and therefore is coldest). When the temperature has dropped sufficiently, the vapour and smoke disappear.
- To form droplets, the water vapour needs what are known as condensation nuclei, which are tiny dust particles suspended in the air. In this experiment, the soot particles from the burnt paper form condensation nuclei.

g. Repeat the experiment without the burning paper and see what happens (the cloud will not form).

h. If you used ice, tell the pupils that they observed the three physical states of water in the demonstration: liquid (the water in the cup), gas (as shown by the smoke) and solid (in the form of ice in the bowl at the top).

i. Ask the pupils to think of examples of each physical state of water.

Possible answers:

- Liquid – water running out of a tap; water in lakes and rivers; water in the sea; raindrops.
- Gas – steam rising while cooking; haze or fog after a rain shower.
- Solid – ice from a freezer; glaciers; snow (e.g. the white caps at the top of Mount Kilimanjaro).

OPTION B

> **Note:** You can demonstrate this activity in front of the class, or, if you have additional sets of materials, you can ask the pupils to form groups and guide them as they do the experiment themselves.

a. Pour water carefully into the plastic bottle, stopping when the water is well below the brim. Tightly screw the cap onto the bottle. Tell the pupils that there is both water and air inside the bottle.

b. Squeeze the bottle with your hands, explaining that this increases the air pressure inside the bottle and causes the temperature of the air inside to rise. When you stop squeezing the bottle, the air pressure decreases, and so does the temperature.

c. Tell the pupils that the same effect occurs with the weather. Air is warmer in high-pressure parts of the atmosphere and colder in low-pressure areas.

d. Tell the pupils that they will now learn how to make a cloud.

e. Light a long match, let it burn briefly and then blow it out. Tell the pupils to notice that the smoke rises. Open the bottle and drop in the recently extinguished match so that the smoke is caught inside the bottle. Immediately put the cap on the bottle and tighten it. There will now be tiny ash particles inside the bottle as well as water and air.

f. Gently squeeze the bottle again, reminding the pupils that this increases the air pressure inside the bottle, causing the temperature to rise.

g. Explain that some of the water in the bottle is evaporating into the air (that is, moving from a liquid to a gaseous state) as you squeeze because the temperature rises as the air pressure rises.

h. Release your grip on the bottle. This will cause the temperature to drop again (because the pressure will drop), and you will see a cloud form.

i. **Explain** to the pupils what happened in the experiment:

- As the air cools, the water vapour in the air starts transforming into liquid water droplets again. This is called condensation.
- To form droplets, the water vapour needs what are known as condensation nuclei, which are tiny dust particles suspended in the air. In this case, the ash particles from the burnt match became condensation nuclei. This is also how clouds form in the atmosphere.

j. Write the following on the board:

- A cloud is made up of many tiny water droplets.
- Clouds usually form when the air cools down.

k. Tell the pupils that they have seen two of the three states – liquid (the water in the cup) and gas (as shown by the smoke).

l. Ask the pupils to think of examples of each physical state of water.

Possible answers:

- Liquid – water running out of a tap; water in lakes and rivers; water in the sea; raindrops.
- Gas – steam rising while cooking; haze or fog after a rain shower.

2. Ask the pupils if they have ever played in a puddle after it has rained. Remind them that, after a while, the puddle disappears. Why?

   Explanation: The water in the puddle seems to disappear into thin air. In a way, that's exactly what it does – it transforms from a liquid (the puddle) into a gas (water vapour). When the sun comes out, the ground absorbs its heat, which warms the water in the puddle until it starts evaporating. (Note that some of the water may also seep into the ground.)

3. Ask the pupils to write the following into their exercise books:
   - Water can transform into different physical states – solid, liquid and gas.
   - Water moves between locations – such as underground, in oceans, lakes, rivers and streams, and the air.
   - There is a constant amount of water on Earth (including in the atmosphere). No water is lost – but it changes its physical state and location.
   - The transformation of water into different physical states, and its relocation around the Earth, is called the water cycle.
4. Tell the pupils that forests play a key role in the water cycle. We will discover more about it in the next lesson!

LESSON 15

How do forests fit into the water cycle?

15

1 Activity 1: Discuss the role of forests in the five stages of the water cycle

indoor

This activity should take **40 minutes**.

1. Tell the pupils that you are going to talk about the five stages of the water cycle and how forests contribute to those.
2. For each stage, ask the pupils what they know. Invite some pupils to volunteer answers and then add anything they missed.
3. As you go through each stage, refer to the drawings on the board. As you go along, write the definition of each stage under the appropriate drawing. To make sufficient room, you may need to erase one drawing (one "stage") before starting on the next.
4. Ask the pupils to copy the drawings and write the definitions in bold in their exercise books as you go through each stage.

► **What is evaporation?**

Evaporation is the process by which water changes from a liquid to a gas. It happens when the sun causes the air temperature to rise. This, in turn, warms water bodies such as icecaps, glaciers, oceans, lakes, rivers, vegetation and soils to form water vapour. Water vapour rises because warm air is lighter than cold air. Trees are part of this process because they take in water from the soil through their roots and release it into the air through their leaves, branches and trunks in the form of vapour. Trees also contribute through transpiration, which is vapour released from leaf pores (like perspiration from humans). There is often considerable water vapour above forests because of evaporation and transpiration from trees.

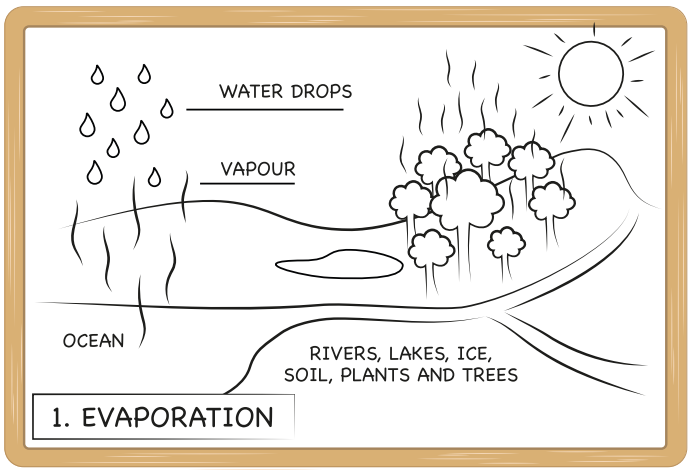


Figure 5.2. Evaporation

What is condensation?

Condensation occurs when water vapour in the atmosphere cools and thereby changes into water droplets. These tiny droplets form clouds when they accumulate in large quantities. Condensation ("dew") can also occur on plants. Trees and forests can cause condensation by reducing temperatures (with their shade) and increase humidity (through evaporation and transpiration).

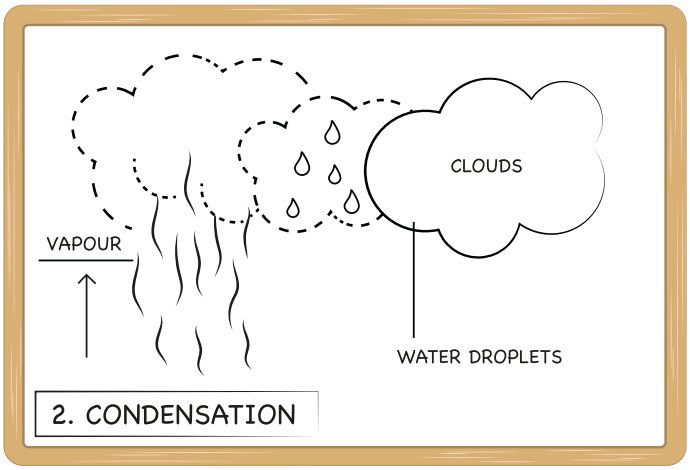


Figure 5.3. Condensation

What is precipitation?

Precipitation occurs when clouds release water, which falls to the Earth's surface as rain or snow. When it rains over forests, the tree canopies intercept some of the rain, reducing the damage the raindrops would do if they hit the soil directly. Millions of raindrops hitting unprotected soil can cause erosion and wash away the soil.

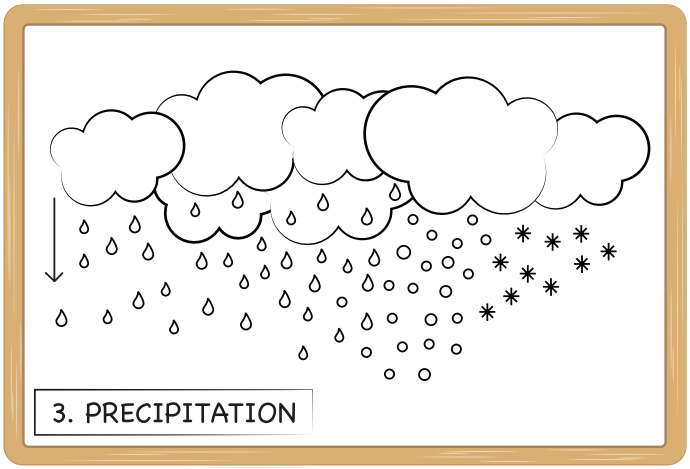


Figure 5.4. Precipitation

What is infiltration?

Infiltration occurs when some of the water that falls on the ground seeps into the soil and is stored underground as groundwater. Infiltration improves water quality because soils filter out pollutants. Tree roots increase water infiltration by creating tiny tunnels (channels) in the soil – this increases the amount of water stored in the soil, which plants can use later, enabling them to survive and continue growing during dry periods.

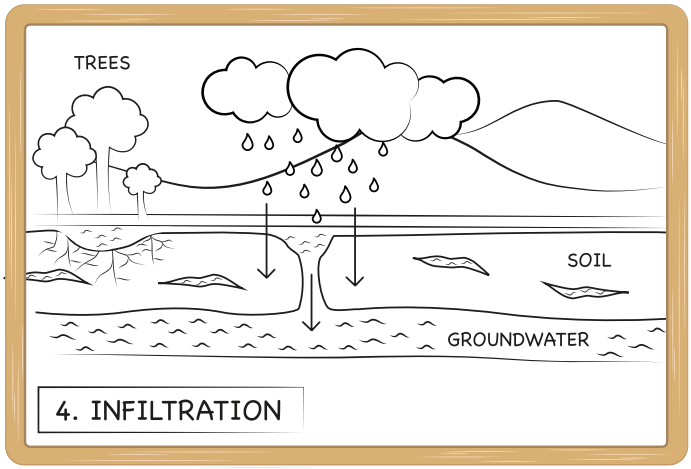


Figure 5.5. Infiltration

What is surface runoff?

Surface runoff is the water from precipitation that is not absorbed by the soil and instead runs overland and directly into streams and rivers and other surface water bodies. Forests help reduce and slow down surface runoff by increasing the infiltration of water into the soil. In turn, this reduces soil erosion and the risk of flooding and increases the amount of water reaching the groundwater, where it is stored and can be used later.

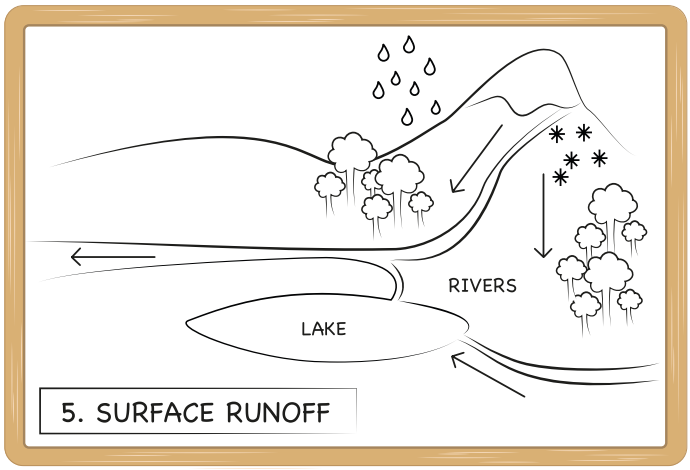


Figure 5.6. Surface runoff

3. Repeat the explanation of the natural water cycle:
    - Water circulates continuously.
        - » The sun warms liquid water on the land surface, which evaporates as water vapour. Warm air makes this invisible water vapour rise into the atmosphere.
        - » As the water vapour rises, its starts to cool (because the air is cooler the further it is from the Earth's surface). The water vapour condenses around tiny particles called condensation nuclei, and clouds begin to form.
        - » When the air becomes very dense with water droplets, these droplets start falling as rain or snow.
        - » The water that falls as rain and snow again enters rivers, lakes, oceans, soils and groundwater. The water cycle is continuous, and no water escapes the planet.
    - The five steps of the water cycle are:
        1. Evaporation
        2. Condensation
        3. Precipitation
        4. Infiltration
        5. Surface runoff
    - These other things are also important in the water cycle:
        - » sunlight, which heats the water;
        - » gravity (the Earth's force, which pulls all objects towards the Earth and is the reason why rain and snow fall);
        - » plants that store water; and
        - » soils that store water.
4. Conclude the lesson by **explaining:** Forests play an active role in the water cycle by regulating evaporation (through transpiration), precipitation and water flows. They also help reduce floods, droughts and shallow landslides.

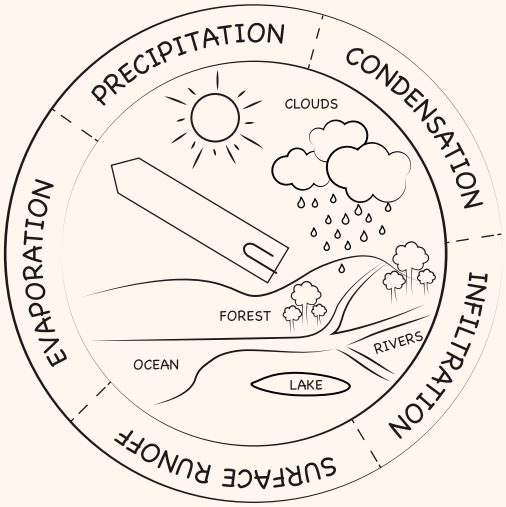
LESSON 16

Create a water cycle model

16

Preparation for the lesson

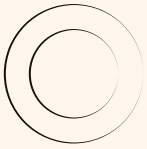
Before the lesson, prepare the model in Figure 5.7 by following the instructions provided in Activity 1 and show it to the pupils as an example of how their models should look.



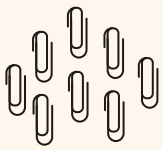
WATER CYCLE

Figure 5.7. Model of the water cycle

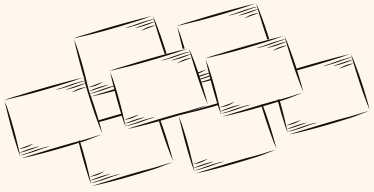
Required materials



1 PLATE



8 PAPER CLIPS
(1 per group)



8 PIECES OF MANILA CARD
(large enough to cover the plate)

8 PAIRS OF SCISSORS (1 per group)
or 4 PAIRS OF SCISSORS (1 pair for every 2 groups)

ADHESIVE TAPE

1 Activity 1: Create a water-cycle model

indoor This activity should take **30 minutes**.

1. Ask the pupils if they remember the five steps of the water cycle from the previous lesson. Encourage them to look at the notes in their exercise books.
2. Tell the pupils that they will review the steps in the water cycle by creating a model (Figure 5.8 illustrates the steps involved).
3. Organize the class into eight groups of equal size and explain the following:
   - » Each group will create a water-cycle model. Give each group a card, a pencil and a paperclip.
   - » Each group must decide which group members do the following tasks. Everyone should do at least one task:
     - **a.** Use the pencil to draw a circle on their card. The circle should be as large as possible while fitting on the card. The plate can be used as an aid by tracing around it.
     - **b.** Use the scissors to cut out the circle and then use the pencil to draw lines dividing the circle into five equal sections (like slices in a cake).
     - **c.** Using the pencil, make a small hole in the middle of the circle.

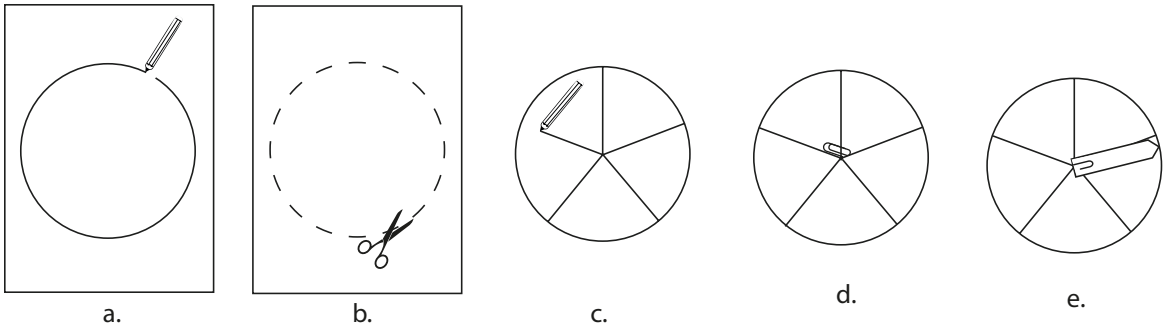


Figure 5.8. Making a water-cycle model

   - **d.** Use a piece of the card left over after cutting out the circle to make an arrow about 7 cm (centimetres) long; one end should be square and the other pointed. The arrow will later be attached to the centre of the circle.
   - **e.** Label each section as one of the stages of the water cycle (evaporation, condensation, precipitation, infiltration and surface runoff).
   - **f.** Draw a scene or a landscape in each of the slices of the circle showing one of the five stages of the water cycle. Show them the model you made before the lesson if they need guidance and inspiration.
   - **g.** Fasten the square end of the arrow at the centre using the paper clip. The arrow should be able to move around like a clock hand, pointing to each of the five drawings.
4. Once all models have been created, stick them on the classroom wall.

2 Activity 2: Reflect on the role of forests in the water cycle

This activity should take **10 minutes**.

1. Encourage the pupils to reflect on the role of forests in the water cycle.
2. Ask them:
   - ► Why are trees and forests important in the water cycle?
3. Give them time to answer, then write the correct answers on the board.
   - » Trees absorb water from the ground, which eventually evaporates from the leaves. This is called transpiration.
   - » Transpiration in forests contributes to the formation of clouds because of the water vapour it releases.
   - » Clouds produce rain. The larger the forest area, the more evaporation occurs, the more clouds are formed, and the more rain is produced.
4. Ask the pupils to copy the question and answers into their exercise books.
5. **Explain:** Forests not only play vital roles in the water cycle, they also help reduce flooding and soil erosion, and provide drinkable water for humans. Forests:
   - » Protect water bodies. The deep root systems of trees help stabilize the banks of rivers and lakes, and reduce runoff while providing habitat for wildlife, both on the land and in the water. The shade cast by trees near water bodies helps keep the water cool, and the insects, seeds and leaves that fall into the water from trees provide food and nutrients for aquatic life.
   - » Minimize soil erosion and landslides. Tree canopies intercept rainfall, reducing the damage raindrops would cause if they hit the soil directly. By holding soils together on steep slopes, forests can help prevent shallow landslides.
   - » Reduce the risk of floods and droughts. Forest soils act like sponges and can retain water longer than soils under other land uses. This reduces the risk of flooding in high-rainfall periods and the risk of drought in dry seasons.
   - » Maintain high water quality. Forests help ensure high water quality by minimizing soil erosion and filtering out water pollutants. They reduce the rate at which sediments and other contaminants enter water bodies (including for drinking water).
6. Conclude by telling pupils that water management is one of the most important benefits of forests!

Preparation for the next lesson

Ask the pupils to bring into class medicinal plants or parts of medicinal plants that are commonly used in the United Republic of Tanzania, such as baobab fruit and seeds, moringa drumstick branches and leaves, aloe leaves, and other common and easy-to-find medicinal plants. As another option, bring these items in yourself.

Notes

[1] **FAO.** 2017. *Water for sustainable food and agriculture: A report produced for the G20 Presidency of Germany.* Rome. 33 p.

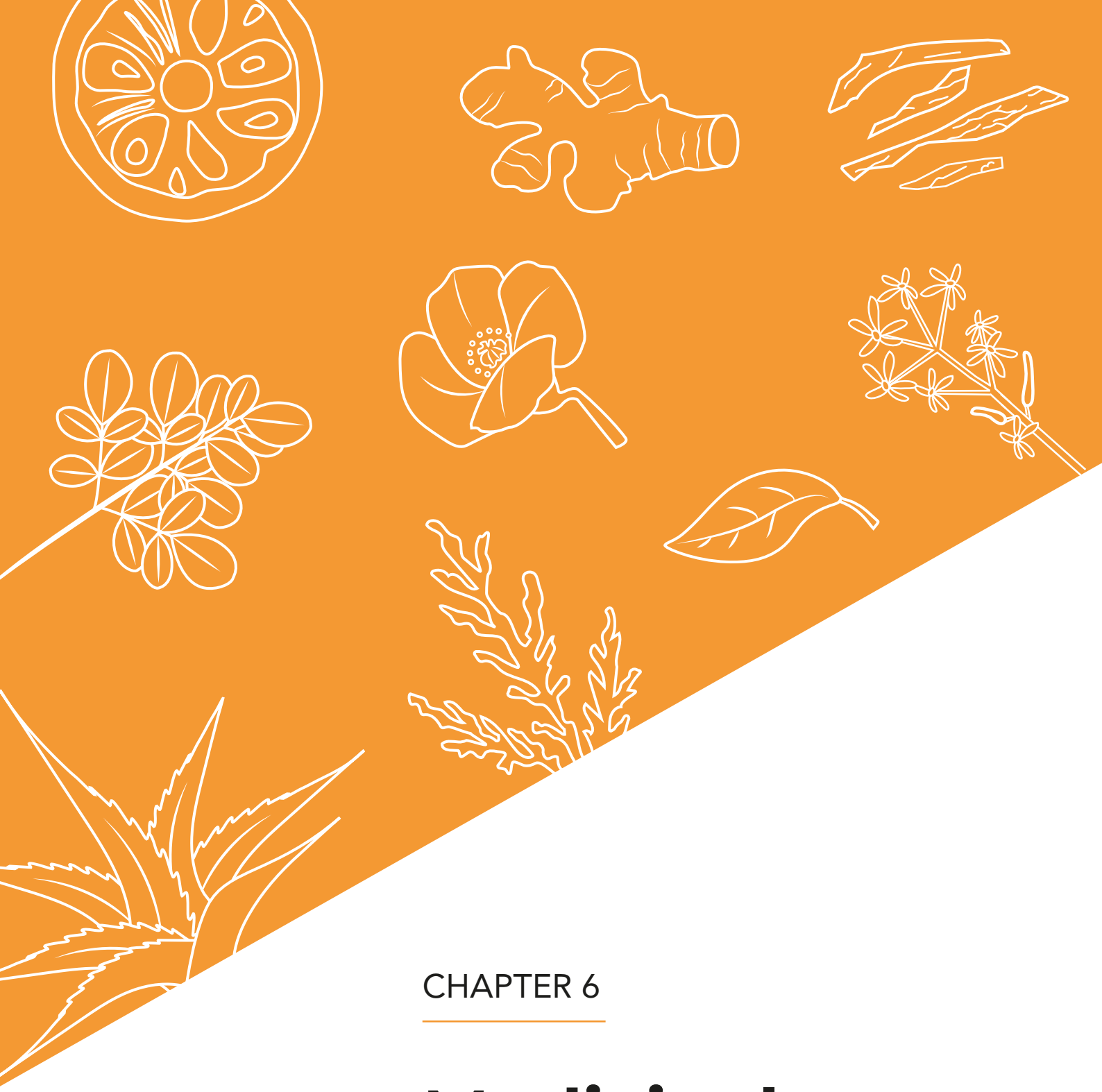
[2] **World Bank.** 2022. Earth's Water. In: *Earth's water.* Cited 14 April 2022. https://olc.worldbank.org/sites/default/files/sco/E7B1C4DE-C187-5EDB-3EF2-897802DEA3BF/Nasa/chapter1.html

[3] **World Bank.** 2022. Earth's Water. In: *Earth's water.* Cited 14 April 2022. https://olc.worldbank.org/sites/default/files/sco/E7B1C4DE-C187-5EDB-3EF2-897802DEA3BF/Nasa/chapter1.html

[4] **FAO.** 2017. *Water for sustainable food and agriculture: A report produced for the G20 Presidency of Germany.* Rome. 33 p.

[5] **FAO, International Union of Forest Research Organizations & United States Department of Agriculture.** 2021. *A guide to forest–water management.* FAO Forestry Paper No. 185. Rome. https://doi.org/10.4060/cb6473en

[6] **FAO.** 2022. Forest and Water. Sustainable Forest Management (SFM) Toolbox. In: *FAO.* Cited 14 April 2022. www.fao.org/sustainable-forest-management/toolbox/modules/forest-and-water/basic-knowledge



CHAPTER 6

Medicinal plants

Overview

In this chapter, the pupils will learn about the most common types of medicinal plants in the United Republic of Tanzania, how they are prepared and used, and their medical uses. They will learn these through storytelling, a memory quiz and role-playing. Through class discussion, pupils will also learn about some modern medicines and synthetic drugs that use medicinal plants or their active ingredients.

Objectives

By the end of the chapter, the pupils will be able to:

- identify examples of medicinal plants found in forests in the United Republic of Tanzania and the plant parts typically used as traditional remedies;
- describe the common uses of these medicinal plants and the ailments they can treat; and
- recognize some forest plants whose active ingredients are synthetized and used in modern medicines.

Background information

Why are forests considered a natural pharmacy?

Of the 443 000 vascular plant species known to science, about 8 percent (34 400 species) have documented medicinal uses.[1] New medicinal plant species are being discovered and recorded every day, and many are found in forests. Medicinal plants are used as remedies, treatments and nutritional supplements.

Nature has been a source of medicinal agents for thousands of years. A large number of modern drugs have been isolated from natural sources, many based on their use in traditional medicine.[i, 2]

Before industrially manufactured medicines, people depended heavily on the healing power of plants for treating ailments. Many people knew which plants were useful for which illnesses, and where to find them. In many cultures, women (as primary caregivers) were – and still are – the custodians of considerable traditional knowledge and expertise on medicinal plants.[3]

Up to 80 percent of people in Africa use traditional medicines to meet their primary healthcare needs.[4] Because of their remoteness from centralized health services and the high cost of pharmaceuticals, forest communities are often highly dependent on the medicines that they obtain from forests, which are generally widely available. Often, traditional medicine is also the only culturally acceptable source of healthcare and well-being.[5]

In the United Republic of Tanzania, about eight in every ten people use indigenous traditional medicines and medicinal herbs to treat ailments. Traditional medicines also create jobs for many Tanzanians in traditional medicinal value chains.[6]

[i] The World Health Organization defines traditional medicine as the "sum total of the knowledge, skill, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness".

Which parts of which plants are used as natural remedies?

We use plants as medicines by harnessing the complex compounds that the plants produce as strategies for their own survival. These are compounds to ward off pests, diseases and other attackers and to overcome environmental challenges, such as high levels of ultraviolet light from the sun.

In the United Republic of Tanzania, an estimated 1 200 plant species are used as medicines to treat various health conditions.[7] Medicinal plants found in Tanzanian forests include the following (see also Table 6.1 on pages 105–106):

- moringa
- baobab
- ginger
- sodom apple
- candelabra tree
- aloe

Picture 6.1. Moringa powder, leaves and seeds

Picture 6.2. Baobab fruit and seeds

Picture 6.3. Ginger roots, leaves and powder

Picture 6.4. Sliced aloe leaf and extracted aloe gel

Various plant parts are used as medicine, including roots, flowers, bark, leaves, fruit, twigs, stems and seeds (see Table 6.1). Sometimes, several plant species are mixed to treat an illness; for example, ginger is mixed with lemon and honey to alleviate flu symptoms. Moringa is often referred to as a panacea – it is used as a cure for more than 300 diseases.[8]

Sometimes the plant parts have to be harvested at a specific growth stage (e.g. picking a fruit before it ripens and digging up roots before the plant flowers) to obtain the desired chemical composition.

People from indigenous cultures who use plants as medicine often have an intimate connection with the environment around them, including knowledge of seasonal patterns of plant potency. Some cultures take special care to plant, collect or harvest at certain times of the day, or during specific moon phases.

Which drugs sold in pharmacies contain elements of medicinal plants?

Many modern pharmaceutical products are derived from tropical forest plant species and were "discovered" based on traditional knowledge and use. Some of these products are now produced artificially and some are still collected in the wild. The following are well-known medicines available in pharmacies that use, or are based on, basic ingredients from plants:

- **Aspirin** – used to alleviate pain and low-grade fever, and reduce inflammation. It contains acetylsalicylic acid, a chemical originally extracted from the bark of willow trees but now made artificially.
- **Morphine** – used to treat severe or long-lasting pain. It contains opium, which is derived from the opium poppy.
- **Artemisinin** – used to treat malaria. It is extracted from the sweet wormwood plant.
- **Quinidine** – used to treat malaria and abnormal heartbeat. It is derived from the bark of cinchona trees.

Some modern drugs originate from forest organisms other than plants. For example, penicillin, which is used to treat bacterial infections, is derived from a forest fungus.

Picture 6.5. A candelabra tree in a forest landscape

LESSON 17

How do forest plants keep us healthy?

17

Required materials

SOME MEDICINAL PLANTS/ PLANT PARTS
brought in by the teacher, pupils or both

ADHESIVE TAPE

6 FOREST MEDICINAL PLANT PICTURES
(cut out the pictures provided at the end of the chapter)

A PAIR OF SCISSORS

Preparation for the lesson

Cut out the pictures of medicinal plants included at the end of this chapter. During the class you will use adhesive tape to stick the pictures on the board. If the pupils have their pupils' books, they will find the picture there, and there is no need to cut the pictures out of this book.

1 Activity 1: Discuss the role of forest medicinal plants

This activity should take **25 minutes**.

1. Read the story of Malaika and Jabari aloud to the class.

   "Malaika and Jabari like to play outdoors because there is so much for them to discover. They run and climb and play with their friends. They rarely fall sick. This morning, however, they have woken up tired and exhausted. They both have a sore throat, a cough and a slight fever. Malaika and Jabari cannot go to school and, instead, must stay home in bed. Their mother wonders how she can help her two children return to their usual good health."

2. Ask the pupils if they have any ideas about how the children's mother can help them get well again.
3. Ask them what their mothers and grandmothers always say they should do or take when they are sick. Allow the pupils time to think and then invite them to volunteer suggestions.
4. Write the answers on the board. Possibilities include:
   - Make them rest until they feel better.
   - Make them a hot lemon, honey and ginger drink.
   - Prepare hot soup for them.
   - Place cool, wet rags on their foreheads.
   - Use aloe leaves to treat their fevers.
   - Give them moringa leaf powder to strengthen their immune systems.
   - Take them to the hospital for diagnosis and treatment.
5. Show the forest medicinal plants you (or the pupils) brought into the classroom.
6. **Explain:** All these plants are found in forests and all are used as traditional medicines. They are called medicinal plants.
7. Now stick on the board the pictures of the six medicinal plants you cut out before the lesson (the same pictures are included in the pupils' books).
8. Point to one picture at a time and (using information in Table 6.1) give the names of:
   - the tree or other forest plant; and
   - the illness(es) that it can help treat (concentrate on three or four diseases likely to be known by the pupils that can be treated with forest plants).

Plant name, and where it is found	Plant part used, preparation, and illness treated
Moringa Found in the Morogoro urban district and the Mbeya region in the south of the mainland of the United Republic of Tanzania.	• Leaves ground into powder – used to boost immunity; aid the digestive system; and treat vitamin deficiencies, malnutrition, constipation, fungal skin infections and body sores. • Seed oil – used to detoxify; and treat sunburn. • Flower – used to boost immunity. • Fruit – used to address vitamin deficiencies. • Boiled/powdered roots – used to treat constipation.
Baobab Found in dry areas of the United Republic of Tanzania.	• Bark – used to ease toothache. • Seed oil – used to treat inflamed gums. • Tea made from leaves – used to aid the digestive system; and treat fever, inflammation and kidney and bladder diseases. • Decoction made from the fruit and seeds – used to aid the digestive system; treat fever; and reduce pain.

Ginger Found in high-rainfall areas of the United Republic of Tanzania.	• Rhizome (underground stem) – used to treat migraines.
Sodom apple Found in the Morogoro urban district and the Kondoa district of the Dodoma region in the central mainland of the United Republic of Tanzania. Also occurs in the Tabora region and western mainland of the United Republic of Tanzania, where it is used by the Nyamwezi tribe.	• Roots – the sap is swallowed to relieve stomach pain and constipation; a root infusion is used as a mouth wash. • Fruit juice – used to reduce toothache. • Stems – made into toothbrushes (believed to have an antibacterial effect). • Leaves, roots and fruit – used to treat sore throat, colic, headache and menstrual pain. • Burnt leaves – used to suppress hiccups.
Candelabra tree Found in the Tabora region in the western mainland of the United Republic of Tanzania, where it is used by the Nyamwesi tribe. It also occurs in the Kondoa district of the Dodoma region in the central mainland of the United Republic of Tanzania.	• Latex – used to treat coughs, wounds, sores and warts. • Powdered stem ash – used to relieve symptoms of eye infections. • Boiled roots – used to treat stomach-ache and severe constipation. • Boiled twigs – used to treat constipation.
Aloe Commonly found in parts of the Kilimanjaro, Tanga, Katavi, Rukwa and Mara regions. Other aloe species occur in the Mbozi, Kigoma, Mkweni and Morogoro districts and in the Tabora region of the western mainland of the United Republic of Tanzania, where they are used by the Nyamwezi tribe.	• Uses are mainly specific to the species and to particular regions and areas. • Exudate (fluid) of aloe – used to treat chest pain, headaches and burns.

Table 6.1. Medicinal plants found in forests, and the parts used as medicine

9. Ask the pupils to write in their exercise books the names of the trees or other plants that they have learned about and their corresponding uses in medicine.
10. At the end of the activity, collect all the forest medicinal plants pictures you cut for safekeeping.

2 Activity 2: Learn which parts of moringa are used in traditional remedies

indoor This activity should take **15 minutes**.

1. Point to the picture of a moringa tree on the board and ask the pupils which parts of the tree are used for traditional medicine.
2. Invite a few pupils to volunteer ideas. Check Table 6.1 for the correct answers.
3. If the answers are correct, write them on the board, as shown in Figure 6.1. If the pupils do not mention all the parts of the plant, add them to the picture yourself.

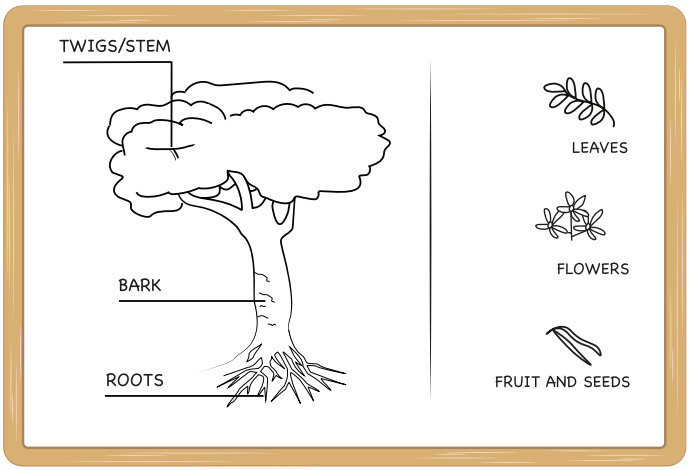


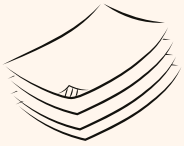
Figure 6.1. A moringa tree and parts used as medicines

4. Conclude by **explaining:** Almost all parts of the moringa tree can be used as medicinal remedies. The plant can be used as a cure for more than 300 diseases!

LESSON 18

Perform a medicinal plant role play 18

Required materials



4 A4 SHEETS OF PAPER,
1 for each group

MARKER PENS
(use different colours if available)

Preparation for the lesson

- Create four information sheets on medicinal plants (one sheet per plant species) by choosing four of the six samples shown below.
- On the back of each sheet, copy all the following roles that the pupils will play:

  Role 1: Instructor – to your group, read the information on the medicinal plant written on the front side of this card.

  Role 2: Medicinal plant – imitate or describe what the plant looks like.

  Role 3: Sick patient – describe how you would feel if you had one of the illnesses that can be treated with this plant (see "Treatment" on the other side of the card).

  Role 4: Medicinal plant collector – act out the process of harvesting the medicinal plant (e.g. digging up roots or picking leaves).

  Role 5: Treatment maker – act out how you would prepare the medicinal plant.

  Role 6: Medicine giver – act out how you would administer the medicine to the ill person.

! **Note:** This activity (Activity 1) assumes a class size of about 100 pupils, with about 25 pupils in each group. Adjust the group size, and the number of pupils playing each role, according to the actual number of pupils in the class.

MORINGA	BAOBAB	GINGER
• Plant part used as medicine – leaf • Used as – powder (served in hot water) • Used to – aid digestion	• Plant part used as medicine – bark • Used by – placing a piece of bark inside the mouth • Used to – treat toothache	• Plant part used as medicine – rhizome (underground stem) • Used as – tea • Used to – treat migraines
SODOM APPLE	**ALOE**	**CANDELABRA TREE**
• Plant part used as medicine – root • Used by – chewing the root like a gum • Used to – treat constipation	• Plant part used as medicine – leaf sap • Used by – smearing on the affected area • Used to treat – burns	• Plant part used as medicine – root • Used by – drinking boiled juice • Used to – treat constipation

1 Activity 1: Learn which medicinal plants are used for different diseases

outdoor This activity should take **40 minutes.**

1. Take the class outside and find a suitable place for the activity.
2. Organize the class into four groups (of around 20–25 pupils each).
3. Tell the pupils that each group is assigned a different medicinal plant. Ask the class to listen quietly while you describe the task. Explain each role. Encourage the pupils to be creative when they act out their roles. (Adjust the number of pupils in each role, as necessary.)
   - » **Role 1: Instructor** – one pupil in each group will read the text to the other pupils in the group. All group members will discuss what they know about the plant.
   - » **Role 2: Medicinal plant** – four pupils will represent the medicinal plant. They will act out an impression of the plant or draw the outline of it or its special features on the ground with a stick.
   - » **Role 3: Sick patients** – four pupils will pretend to be sick with one of the ailments that the medicinal plant is used to treat. They will describe how they feel, and they can also use gestures.
   - » **Role 4: Medicinal plant collector** – four pupils will imitate the process of collecting or harvesting the medicinal part of the plant using gestures. Then, they will pretend to hand over the medicine to the pupils playing treatment makers (role 5).
   - » **Role 5: Treatment maker** – four pupils will act out the process of preparing the medicinal plant (e.g. by making tea from leaves, grinding it into a powder or cooking the plant part to extract the oil) and give the medicine to the medicine givers (role 6).
   - » **Role 6: Medicine giver** – four pupils will administer the natural medicine to the "sick patients" (role 3).

4. After explaining the task, give each group an information sheet. Tell the pupils that, for now, they should keep their information sheet and medicinal plant secret from other groups.

> **Important:** The pupils should not let other groups know the identity of their medicinal plants. Other groups will try to guess it later through role-play.

5. Ask the pupils to divide the roles among themselves, ensuring that each pupil has a role and that each role (except role 1) has roughly the same number of pupils. Each group should discuss their assigned medicinal plant among themselves and the roles they will play. Give the groups five minutes to do this.
6. After five minutes, call the pupils together and ask them to form a circle.
7. Ask the groups one by one to present their medicinal plants to the class, through role-play. After each group presentation, ask the other pupils to guess the following:
   - Which illness was the medicine used to treat?
   - Which part of the plant was used?
   - How was it prepared (e.g. tea, powder)?
   - What is the name of the medicinal plant?

> **Note:** If the pupils do not know the answer (e.g. for plants that were not introduced in advance), guide them to the correct answer. You can reinforce this process by showing the pictures of the plants used in Lesson 22, Activity 1. At the end of the activity, collect the forest medicinal plants pictures for safekeeping.

8. Conclude by **explaining:**
   - Different plant species have different properties and are used to treat different symptoms and diseases.
   - Therefore, it is important to maintain the full diversity of plant species used as medicines, both now and in the future. Among other things, this means looking after forests, which provide habitat for many of these species.
   - Sometimes the plant parts have to be harvested at a specific growth stage (e.g. picking a fruit before it ripens or digging up roots before the plant flowers) to obtain the desired chemical composition.
   - It is important to follow traditional techniques that avoid overharvesting. Many medicinal plants today are threatened with extinction.
   - Women, as the main caregivers, are often the custodians of traditional knowledge and expertise on medicinal plants. This knowledge is valuable.

Preparation for the next lesson

Ask the pupils to talk with their families about what they do when someone becomes ill. Which medicinal plants do they use, for which illnesses? How are the medicines prepared? Do they also use medicines from a pharmacy? Ask the pupils to write down the answers in their exercise books and bring them to the next lesson.

LESSON 19

Which modern medicines come from the forest?

19

Preparation for the lesson

On the board, make two columns. Label one column with "Medicinal plants" and the other with "Modern medicines" (Figure 6.2).

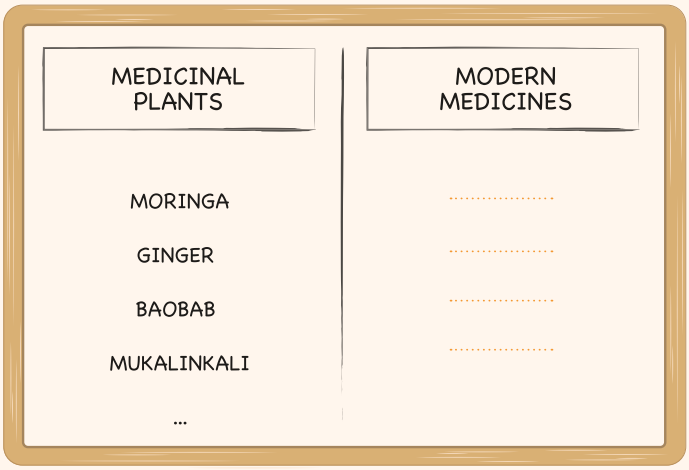


Figure 6.2. Medicinal plants and modern medicines

1 Activity 1: Learn about modern medicines that come from medicinal plants

indoor This activity should take **20 minutes**.

1. Invite several pupils to tell the class about the medicinal plants and modern medicines that their families use to treat various illnesses.
2. Write on the board the correct answers given by the pupils, listing natural medicines separately to modern medicines (Figure 6.3).

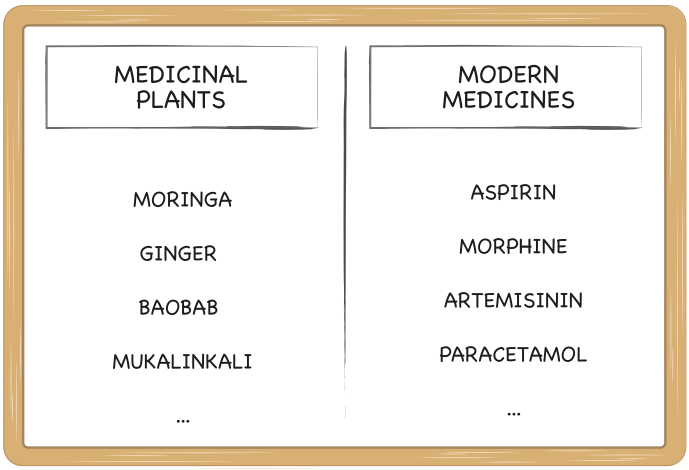


Figure 6.3. Medicinal plants and modern medicines

3. **Explain:**
   - » The medicines that we buy in pharmacies often contain ingredients taken from medicinal plants.
   - » Sometimes, these ingredients are extracted from plants, and sometimes they are manufactured in factories.
4. Present some examples of well-known medicines available in pharmacies that use ingredients from plants.
5. Reproduce Figure 6.4 on the board – one column shows the medicines that we can buy in pharmacies, one column shows the pain that it helps alleviate, and one column shows the plants that the medicine was extracted from originally.
6. Ask the pupils to copy Figure 6.4 into their exercise books.

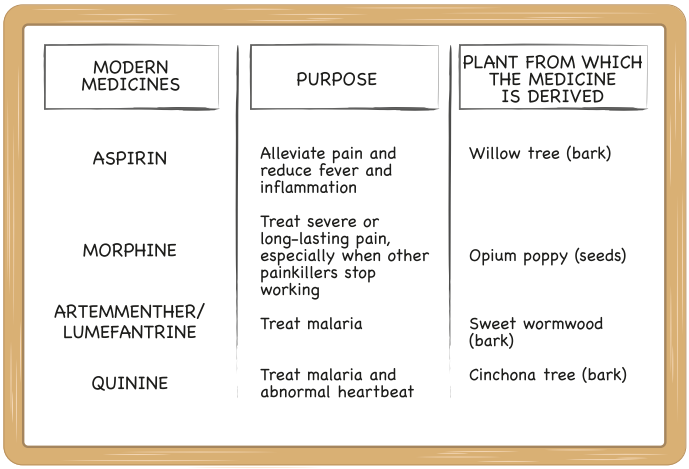


Figure 6.4. Ingredients in modern medicines derived from plants

2 Activity 2: Test your knowledge about medicinal plants

This activity should take **20 minutes**.

1. Tell the pupils that they will now learn some facts about medicinal plants through a multiple-choice quiz.
2. Write the following questions and possible answers on the board (but do not reveal the correct answers yet – shown below in bold).
   - How many plants are estimated to be used as medicinal plants in the United Republic of Tanzania?
     - **a.** 10
     - **b.** 100
     - **c.** **1 200**
   - How many people are estimated to use indigenous traditional medicines, including medicinal plants, in the United Republic of Tanzania?
     - **a.** Fewer than 2 people in 10
     - **b.** 4 people in 10
     - **c.** **8 people in 10**
   - How many plants are recorded as being used as medicine worldwide?
     - **a.** About 200
     - **b.** About 1 000
     - **c.** **More than 34 000**
3. Read each question aloud and invite some pupils to tell the class their guesses before revealing the correct answers.
4. Ask the pupils to copy the questions and correct answers into their exercise books.
5. End the lesson with the following question:
   - Can you buy medicinal plants in a pharmacy?
     - » **Answer:** Yes, you can often buy medicinal plants in pharmacies (e.g. teas), as well as modern medicines with active ingredients derived from plants. This is one reason why it is important to conserve biodiversity. People in all countries worldwide use plants for healing, and it's likely that more undiscovered cures and treatments exist in forest plants waiting to be discovered. But we will only find them if we protect the forests.
6. If there is still time, write the answer on the board and ask the pupils to copy it into their exercise books.

Moringa

Baobab

Aloe

Sodom apple

Candelabra tree

Ginger

Notes

[1] **Royal Botanic Gardens Kew.** 2022. Medicinal Plant Names Services. In: *Royal Botanic Gardens Kew*. Cited 15 October 2022. www.kew.org/science/our-science/science-services/medicinal-plant-names-services

[2] **World Health Organization.** 2019. G*lobal report on traditional and complementary medicine.* Geneva, Switzerland.

[3] **FAO.** Health Benefits from Forests. Sustainable Forest Management (SFM) Toolbox. In: *FAO*. Cited 14 April 2022. www.fao.org/sustainable-forest-management/toolbox/modules/health-benefits-from-forests/in-more-depth

[4] **World Health Organization.** 2002. *Traditional Medicine Strategy 2002–2005.* Geneva, Switzerland.

[5] **FAO.** 2020. *Forests for human health and well-being.* Forestry Working Paper No. 18. Rome. https://doi.org/10.4060/cb1468en

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[7] **Hilonga, S., Otieno, J.N., Ghorbani, A., Pereus, D., Kocyan, A. & de Boer, H.** 2019. Trade of wild-harvested medicinal plant species in local markets of Tanzania and its implications for conservation. S*outh African Journal of Botany,* 122: 214–224. https://doi.org/10.1016/j.sajb.2018.08.012

[8] **Gopalakrishnan, L., Doriya, K. & Kumar, D.S.** 2016. *Moringa oleifera:* a review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 5(2): 49–56.

CHAPTER 7

Wood products

Overview

In this chapter, the pupils will learn about various types of wood products and their importance in daily life through discussion, drawing and group sharing.

Objectives

By the end of the chapter, the pupils will be able to:

- understand various uses of wood products in everyday life;
- recognize products made of wood used in schools, homes and communities; and
- identify some of the trees from which wood products are made.

Background information

How are wood products used in people's lives?

Wood products are incredibly versatile and have many uses in our schools, homes and communities. People use wood products every day – such as paper and pencils, furniture like bookcases, desks and chairs, kitchen utensils and fence posts. As a construction material, wood is strong, lightweight and durable. The world's tallest wooden building, Mjøstårnet, in Norway, is 18 storeys (85 metres) high.[1]

Another important wood product is woodfuel (fuelwood – or firewood – and charcoal), which is widely used globally for both household use and sale. In many countries, woodfuel harvesting is also a major cause of deforestation.[2]

Many countries earn income by exporting wood products. The United Republic of Tanzania, for example, earned more than USD 127 million in 2021 by exporting wood products in the form of boards, electricity poles, paper and furniture.[3] Wood production is the biggest forest-based employer in the United Republic of Tanzania.

What products come from which kind of tree?

There are two main types of wood: softwood and hardwood.

- **Softwood** is produced by pines and other trees that grow from seeds that are not enclosed in fruit. Most softwood trees grow quite quickly, and the wood is usually soft and light. In the United Republic of Tanzania, softwood trees grow mainly in plantations and woodlots in the Iringa, Kilimanjaro, Mwanza and Kagera regions, as well as in many districts. Softwood is commonly used to make furniture such as tables, chairs and beds and in the construction of houses.
- **Hardwood** is produced by trees that grow from seeds that are enclosed in fruit. Their wood is usually harder and heavier than softwood, and the trees tend to grow more slowly than softwood species. Most hardwood comes from trees with broad leaves such as acacia, African mahogany and ebony (*msindi*). Many hardwoods are ideal for uses that require high durability, such as outdoor and high-quality furniture, as well as doors, window frames and electricity poles. Hardwood is often more expensive than softwood because it grows relatively slowly and also takes longer to dry out after harvesting. Hardwood tree species are found throughout the United Republic of Tanzania.

Forests with high species diversity often contain numerous tree species with a wide variety of uses. Miombo woodlands in the United Republic of Tanzania host 42 timber tree species.

Picture 7.1. A pine (softwood) plantation

Picture 7.2. A eucalypt (hardwood) plantation

Why is wood good for the environment?

One reason that wood products are good for the environment is because they help combat climate change. For example:

- Trees absorb carbon dioxide from the atmosphere and store it as carbon in their wood. When trees are cut down to make wood products like furniture and timber for construction, the carbon stays locked inside these products.[4]
- Many wood products last for hundreds of years, storing carbon over their lifetimes.[5]
- It takes less energy to make wood products compared with similar products made of steel, aluminium and concrete. Increasing the use of wood in construction and in products such as furniture, cabinets, flooring, doors and window frames could present a significant opportunity for reducing greenhouse-gas emissions associated with human activities, particularly when wood is used as a substitute for non-renewable and less climate-friendly materials.

Wood is a renewable resource, which means that it can be regrown in perpetuity. Forests will regenerate, as long as we do not harvest more wood than can grow back before the next harvest. The overharvesting of tree species can cause forests to become degraded and therefore compromise the long-term provision of wood as well as forest conservation.[6]

Picture 7.3. The Metropol Parasol, in Spain, one of largest wooden structure in the world

LESSON 20

How do we use wood products?

20

1 Activity 1: Brainstorm on wood products

This activity should take **10 minutes**.

1. Ask five pupils to tell you about wood products they have seen at home or on their way to school.
2. Draw pictures of the answers on the board. Write the name of each item next to its drawing (you can write the pupils' answers without pictures if you prefer not to draw).
3. Start a discussion with the class:
   - What wood products have you seen at home?
   - What wood products did you see on the way to school today?
   - What wood products do you see in the classroom?
   - What trees do you know are used to make wood products?

2 Activity 2: Draw some wood products you know

This activity should take **30 minutes**.

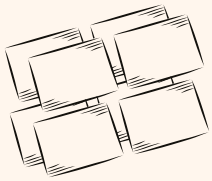
1. Ask the pupils to draw in their exercise books some of the wood products that they see at school or in their homes or communities.
2. Tell the pupils that they should not show their drawings to anyone else for now.
3. Tell them that, in the next lesson, they will be organized into groups, where they will share their drawings with other pupils.

LESSON 21

Create a wood product gallery

21

Required materials



SHEETS OF MANILA PAPER,
1 for every 8-10 pupils

ADHESIVE TAPE

1 Activity 1: Discuss the importance of wood products

outdoor

This activity should take **15 minutes**.

1. Organize the class into groups of eight to ten pupils. Instruct the pupils to go outside with their exercise books and to sit in their assigned groups.
2. Instruct the pupils to share the drawings they completed in the previous lesson with the other pupils in their group.
3. Tell each group to choose one wood product by asking:
   - Which wood product do you think is most important?
4. On a manila card, each group should draw a picture of their selected wood product.

2 Activity 2: Show your group's drawing

outdoor

This activity should take **10 minutes**.

1. Ask the pupils to put their group drawings on the ground (weighted by stones to stop them blowing away).

> **Note:** If it is raining, the pupils should stay in the classroom and stick their drawings on the wall using adhesive tape.

2. Tell the pupils to move quietly around in a "gallery walk" to view the group drawings. After 10 minutes, instruct them to return to the classroom for the next activity.

3 Activity 3: Discuss the drawings

This activity should take **15 minutes**.

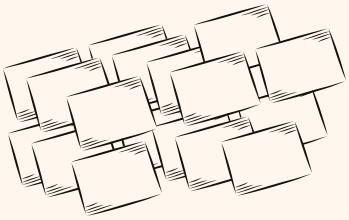
1. Ask the questions below to encourage pupils to discuss their gallery walk.
   - Which items were drawn most?
   - What items were missing?
   - Which items did you find surprising, and why?
2. Write a summary of pupils' responses on the board. Ask the pupils to copy the summary into their exercise books.

LESSON 22

Play a wood product guessing game

22

Required materials



18 MANILA CARDS
(or 5 sheets of A4 paper cut into quarters, 1 piece per pupil)

MARKER PENS
(use different colours if available)

ADHESIVE TAPE
to secure each cover

1 PAIR
OF SCISSORS

6 TREE PICTURES
(cut out the pictures provided at the end of the chapter)

Preparation for the lesson

- Before the class starts, cut out the six examples of trees from the back of this book and stick them on the board. Make as much space as possible between the cut-outs so that the pupils can add their manila cards later.
- Prepare 18 manila cards (or five sheets of A4 paper, cut into quarters) for the activity by copying the text on each card, as shown below. You will distribute the cards to the groups later.

Tip: If available, use a different coloured marker pen for each of the six tree types (African mahogany, pine, ebony, etc.).

MANILA CARDS FOR LESSON 22, ACTIVITY 1

I am a **table** made of **pine** (softwood)	I am a **bed** made of **pine** (softwood)	I am **paper** made of **pine** (softwood)	I am a **chair** made of **pine** (softwood)
I am a **woodcarving/ souvenir** made of **East African blackwood** (hardwood)	I am a **rod/staff** made of **East African blackwood** (hardwood)	I am a **rod/staff** made of **ebony** (hardwood)	I am a **woodcarving/ souvenir** made of **ebony** (hardwood)
I am a **door** made of **acacia** (hardwood)	I am a **window frame** made of **acacia** (hardwood)	I am **woodfuel** made of **acacia** (hardwood)	I am an **electricity pole** made of **acacia** (hardwood)
I am a **door** made of **East African mahogany** (hardwood)	I am a **window frame** made of **East African mahogany** (hardwood)	I am **woodfuel** made of **East African mahogany** (hardwood)	I am an **electricity pole** made of **East African mahogany** (hardwood)

1 Activity 1: Identify wood products from different types of trees

This activity should take **40 minutes**.

1. Organize the class into eight groups and distribute the manila cards among them (each group should receive two cards). Written on each card is the name of a wood product and the tree from which it is made (e.g. "I am a chair made of pine (softwood)").
2. Tell the pupils to look at the examples of trees stuck on the board. Ask them:
   - ► Which trees do the wood products on your cards come from?
3. Allow the pupils to discuss in their groups before they decide.
4. Ask each group to assign a pupil from their group to stick their manila cards (using a piece of adhesive tape you will provide them with) to the board underneath the trees they think belong to their wood products.
5. Once all the cards have been taped to the board, check if any are under the wrong trees and move them to the correct ones.
6. Tell the pupils to copy the names of the trees and the examples of wood products made from them into their exercise books.
7. Conclude the lesson by **explaining:**
   - » Forests often contain many tree species, which are used for a wide variety of purposes.
   - » Wood is a renewable resource. This means that, in a well-managed forest, when a tree is cut down to make a wood product, another will regrow in its place.
   - » Over time, that tree, too, can be harvested for wood. To be able to do this forever, it is important not to harvest too many trees too often.
   - » Overharvesting can cause forest degradation – and the forest will start losing its capacity to regrow and to perform its valuable roles.

Pine tree – softwood

Acacia tree – hardwood

Ebony tree (*msindi*) – hardwood

East African mahogany – hardwood

East African blackwood (*mpingo*) – hardwood

Notes

[1] **Moelven.** 2022. Mjøstårnet. In: *Moelven*. Cited 14 April 2022. www.moelven.com/mjostarnet

[2] **Jin, S.L., Schure, J., Ingram, V. & Yoo, B.I.** 2017. *Sustainable woodfuel for food security: A smart choice: Green, renewable and affordable.* Rome, FAO. 34 p. www.fao.org/3/i7917e/i7917e.pdf

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[4] **Beyer, G., Defays, M., Fischer, M., Fletcher, J., de Munck, E., De Jaeger, F., Van Riet, C. et al.** 2011. T*ackle climate change: Use wood.* Third edition, second revision. CEI Bois.

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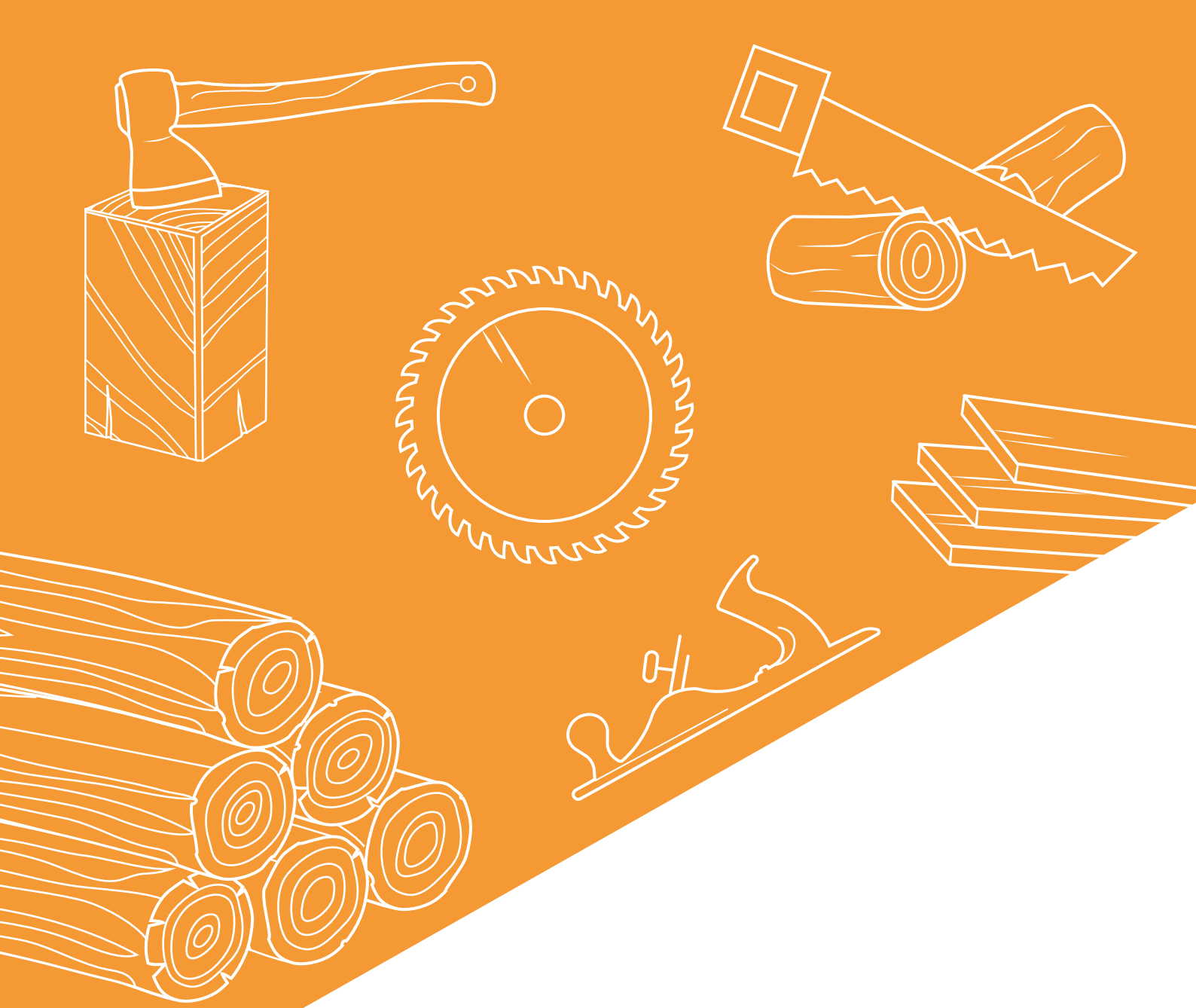


CHAPTER 8

Wood processing

Overview

In this chapter, the pupils will learn how wood is processed so it can be turned into wood products. They will discover two methods of wood processing through drawing and group discussions. They will see how wood can be transformed into useful objects by making their own wooden picture frames.

Objectives

By the end of the chapter, the pupils will be able to:

- identify products made from sawnwood and woodpulp;
- explain various ways in which wood is processed; and
- understand how sawmills work.

Background information

What is wood processing?

Wood processing is the transformation of logs harvested in a forest into products such as furniture, cooking utensils, paper and tools.

Processed wood is also used in building construction and to make bridges and boats. Although it isn't common (yet), it is even possible to make a car body out of wood. Almost all the paper we use is made from wood.

Some wood products are made from sawnwood and others are made from woodpulp. When a tree is cut down, the trunk (also called the bole) is usually cut into smaller lengths ("logs") near where it is felled and then taken to a processing mill. This may be a sawmill, a pulpmill or another type of mill, depending on the product to be manufactured.

How is wood processed?

There are two main mill types, sawmills and pulpmills:

Sawmills. Sawlogs are logs intended to be sawn into boards (also called sawnwood or lumber). Sawlogs are transported from the forest to a sawmill. There, a powerful saw slices the logs into boards of various lengths, widths and thicknesses; these can be further processed (e.g. planed, to make them smoother) so they are suitable for various uses, such as construction and the manufacture of furniture, flooring and window frames.

Pulpmills. Trees grown and harvested especially for pulp are usually smaller (and younger) than those grown for sawnwood. Wood can be turned into pulp in two main ways – by (1) chemical and (2) mechanical means. These processes produce a mushy product (the pulp) used to make writing paper, fabrics, tissues, cardboard and other similar products.

The leftovers from harvesting and sawnwood and pulp processing (e.g. branches, sawdust, woodchips, offcuts and bark) can be used to make wood briquettes and pellets to be burnt as fuel (e.g. for cooking).

In the United Republic of Tanzania, most harvested wood is processed in sawmills, which are mainly small enterprises with fewer than ten employees. The country has only a few large sawmills. Sawmills produce boards of varying dimensions, which can be used to construct buildings and to manufacture products such as packaging, window frames, floors, staircases, doors and furniture.

Picture 8.1. Utility poles made out of tree logs seen in a sawmill

Picture 8.2. A truck carrying utility poles made out of tree logs seen in a sawmill

How does a sawmill work?

Modern sawmills use motorized machines that cut logs longitudinally (lengthways) into boards. The main steps in a sawmill are as follows:

- **Log delivery and pre-sorting.** When a truckload of logs arrives at a mill, the logs are unloaded and separated according to species, diametre, length and intended use, and the bark is removed.
- **Sawing the logs.** Larger sawmills use powerful machines to saw the logs. Smaller sawmills use small machines, such as chainsaws or handsaws.
- **Sorting.** The sawn boards are sorted by size and quality. This can be done using machines but in small mills is usually done by hand.

- **Drying.** Living trees contain large quantities of water. When first processed, sawnwood also contains considerable moisture, so the boards need to be dried. Drying can be done in the open air (which can take several months) or in a kiln (which might take a few days). Sawnwood becomes stronger as it loses moisture and it also changes colour. Sawnwood will weigh less after drying because of the weight that is lost when the water is removed – this makes it easier to transport.
- **Inspection and storage.** Before the finished sawnwood is stored it is inspected for defects such as cracks, which can occur during the drying process. At this stage, the surface of the wood may be planed using an electric planer to make it smoother.
- **End product.** What came in as logs leaves the sawmill in the form of boards.

Picture 8.3. Log delivery and pre-sorting

Picture 8.4. Sawing the logs

Picture 8.5. Sorting

Picture 8.6. Drying

Picture 8.7. Inspection and storage

Picture 8.8. End products (sawn boards ready for shipping)

LESSON 23

How is wood processed?

23

Preparation for the lesson

Draw the sketch in Figure 8.1 on the board

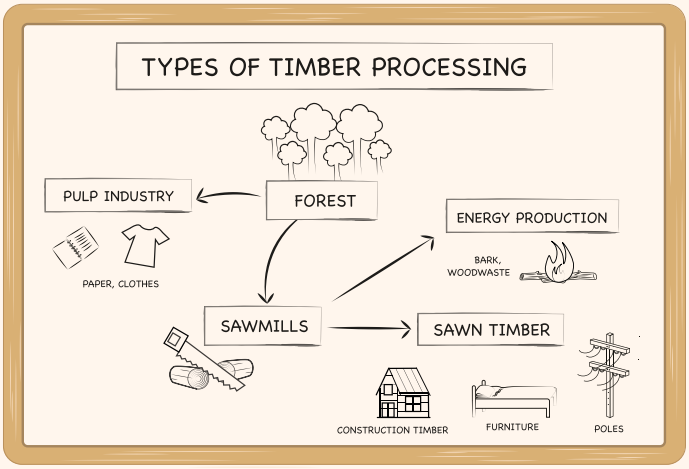


Figure 8.1. Types of timber processing

1 Activity 1: Review some types of wood products

indoor This activity should take **10 minutes**.

1. Tell the pupils that they will review what they learned in Chapter 7 on wood products.
   - » Crumple a piece of paper into a ball. Throw it to a pupil and ask them to name something made of wood.
   - » Once the pupil has answered correctly, ask them to throw the paper ball to another pupil, who should give a different example of a wood product.
   - » Keep the ball moving from one pupil to another until several examples have been given.
   - » If needed, provide some examples, such as paper and clothing made from woodpulp and furniture, doors and window frames made from sawnwood.

2 Activity 2: Discover two ways in which wood is processed

This activity should take **30 minutes**.

1. Link the different wood products identified by the pupils to one of two types of wood processing – sawing and pulping.
2. Explain that some wood products are made from sawnwood and some from woodpulp.
3. Ask some pupils to describe in their own words what they see in the sketch on the board.
4. Ask the pupils to give examples of the wood products that result from each processing type. Use the discussion to review the two types of wood processing.
5. **Explain:**
   - In a **sawmill**, logs are cut into boards ("sawnwood"), which are used to make various products, such as furniture and window frames. Wood waste from sawmills, such as sawdust and wood offcuts, can be used to make briquettes for use as fuel (e.g. for cooking). In the United Republic of Tanzania, most sawmills are small enterprises with fewer than ten employees. There are only a few large sawmills in the country.
   - In a **pulpmill**, wood is broken down by chemicals or mashed by machines into a fibrous pulp, which is used to make products like paper and fabrics.
6. Ask the pupils to copy the sketch on the board into their exercise books.

Tip: If pupils in the class have a special connection to a sawmill or a pulpmill (e.g. through their families), ask them to tell the class what they know. If possible, invite a mill manager or employee to speak to the class so that the pupils can learn directly about wood processing in the United Republic of Tanzania. First-hand accounts generally make topics more exciting!

Preparation for the next lesson

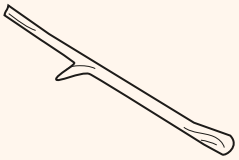
Ask the pupils to each bring to the next lesson a stick – as straight as possible – from a tree or shrub. It should be at least 1 cm (centimetre) (maximum 3 cm) in diametre and 30–40 cm long. Show the pupils an example of the size of stick you want them to bring in. As another option, bring these items in yourself.

LESSON 24

Make a wooden picture frame

24

Required materials



1 STICK PER PUPIL
(30–40 cm long, and 1–3 cm in diametre, brought by the pupils)

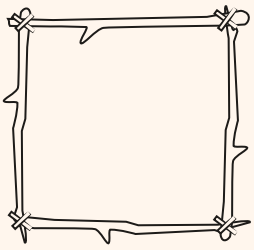
A BALL OF STRING, YARN OR TWINE
(brought in by the teacher)

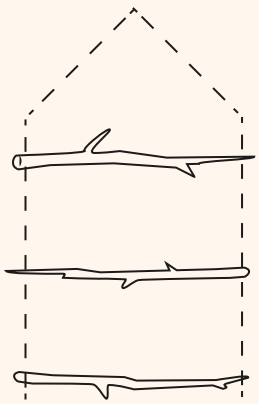
SCISSORS
(1 pair for each group)

GLUE OR PASTE
(4–8 tubes)

Preparation for the lesson

It is recommended that you make both kinds of picture frames in advance, which you can show the pupils as a guide.





EXAMPLES

1 Activity 1: Do your woodwork

This activity should take **40 minutes**.

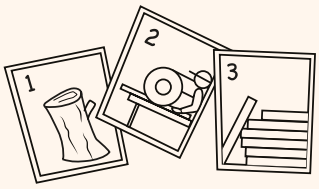
1. Organize the class into groups of seven pupils each.
2. Explain that today they will become woodworkers by making picture frames using the branches and string (or woollen thread or twine).
3. Explain how to make the picture frames, as follows:
   - » You will make a picture frame by tying four branches together (later, you will place the frame over a picture or staple a picture to it).
   - » Then you will make a second frame, for a picture collection, with one stick at the top, one in the middle and one at the bottom. Tie the three sticks together, one below the other, using string or other thread. Hang strings of different lengths from the sticks; later, you can attach individual pictures to these.
   - » Decorate your frames by gluing leaves and other materials from nature (found in the schoolyard) onto them. Be creative!
4. Tell the pupils to keep their picture frames safe because they will need them in the next lesson.

LESSON 25

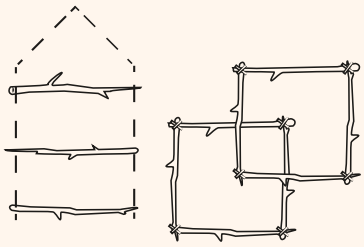
How does a sawmill work?

25

Required materials

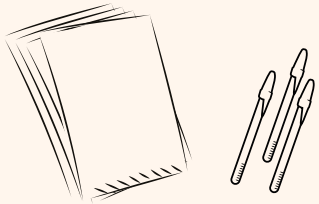


PICTURES OF THE WORK STEPS IN A SAWMILL
(cut out the pictures provided at the end of the chapter)



PICTURE FRAMES
made by the pupils in the previous lesson

ADHESIVE TAPE AND STRING
(if necessary)



PAPER OR MANILA CARDS AND PENS
If possible, choose paper in a size that fits the picture frames, or provide tape to stick several sheets together

SCISSORS
(to cut the strings and the pictures)

Preparation for the lesson

Cut out the pictures of the six work steps lin a sawmill included at the end of this chapter. If the pupils have their pupils' books, they will find the pictures there, and there is no need to cut out the pictures in this book.

1 Activity 1: Discuss how a sawmill works

This activity should take **20 minutes**.

1. Remind the pupils that, in the United Republic of Tanzania, most wood is processed in sawmills.
2. Explain the six main steps in a sawmill and show them the pictures that you have cut out from pages 165–175. If they have their pupils' books, tell the pupils to look at the corresponding pictures as you explain.

    a. **Log delivery and pre-sorting.** When a truckload of logs arrives at a sawmill, the logs are unloaded and separated according to species, diametre, length and intended use, and the bark is removed.

    b. **Sawing the logs.** Larger sawmills use powerful machines to saw the logs. Smaller sawmills use small machines, such as chainsaws or handsaws.

    c. **Sorting.** The sawn boards (sawnwood) are sorted by size and quality. This can be done using machines but in smaller mills, this is usually done by hand.

    d. **Drying.** Living trees contain large quantities of water. Drying can be done in the open air (which can take several months) or in a kiln (which might take a few days). Sawnwood will weigh less after drying because of the weight lost when the water is removed – this makes it easier to transport.

    e. **Inspection and storage.** Before the finished sawnwood is stored, it is inspected for defects such as cracks, which can occur during the drying process. At this stage, the surface of the wood may be planed using an electric planer to make it smoother.

    f. **End products.** What came in as logs leaves the sawmill in the form of boards.

2 Activity 2: Reflect on what happens in a sawmill

This activity should take **20 minutes**.

1. Ask the pupils to form the same groups they were in when they made their picture frames (Lesson 24).
2. Assign one of the six sawmilling steps to each group (if there are more than six groups, you can assign the same step to more than one group).
3. Briefly review the six steps.
4. Ask the pupils to draw pictures that represent their assigned step. If they have their pupils' books, they can copy the corresponding pictures from there. Tell the pupils that, when completed, they will put their pictures into the picture frames.
5. Each group should discuss their step among themselves and how to draw it. Then, each pupil will draw their own picture.
6. Help the pupils attach the pictures to the frames. One picture should be placed in the square type of frame, and the other pictures can be hung from the second type of frame.

STEP 1:
Log delivery and pre-sorting

STEP 2:
Sawing the logs

STEP 3:
Sorting

STEP 4:
Drying

STEP 5:
Inspection and storage

STEP 6:
End products (sawn boards ready for shipping)

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CHAPTER 9

Forests and livelihoods

Overview

In this chapter, the pupils will learn about the importance of forests for people's livelihoods. By creating a mind map, the pupils will learn about the numerous benefits of forests. Through an outdoor game, they will understand the consequences for livelihoods of a steadily decreasing forest area.

Objectives

By the end of the chapter, the pupils will be able to:

- describe how local communities benefit from forests;
- identify possible sources of income from forests; and
- understand the importance of managing forests sustainably for maintaining livelihoods over time.

Background information

How do forests contribute to people's lives and livelihoods?

It is estimated that forest products provide food, income and nutritional diversity for some 1.6 billion people – which is about 20 percent of the global population.[1] Millions of people in the United Republic of Tanzania rely on forests. Forests contribute to livelihoods and quality of life in many ways (Chapter 1), such as the following:

- **Food security.** Forests supply foods such as fruit, seeds, roots, nuts, edible mushrooms, tubers, vegetables, edible insects, honey and wild meat (Chapter 2, Chapter 3 and Chapter 4).
- **Water security.** Forests improve the quantity and quality of water available for human needs by protecting rivers, lakes and other water bodies, helping regulate the water cycle and increasing the infiltration of rainwater into soils, where it can be stored (Chapter 5).
- **Health and well-being.** Forests provide medicinal plants that can be used to treat diverse ailments (Chapter 6). Forests also improve air quality by absorbing carbon dioxide, releasing oxygen and filtering air pollutants. Trees and forests add beauty and colour to the environment and provide opportunities for recreation, with positive effects on human health.
- **Energy.** Globally, nearly one-third of the world population uses woodfuel (fuelwood – or firewood – and charcoal) for cooking. Woodfuel provides more than half the national energy supply in 29 countries, mainly in sub-Saharan Africa.[2]
- **Wood.** Forests and trees outside forests provide wood for a wide range of uses, from house construction, to furniture, electricity poles and paper. As a renewable resource that stores carbon, wood is more environmentally friendly than many alternative materials (Chapter 7 and Chapter 8).
- **Income.** Forests produce many goods, such as wood, fruit and medicinal plants, that are harvested by local people for sale or their own consumption. For example, goods harvested in miombo woodlands supply more than two-fifths of household income in some areas of the United Republic of Tanzania.[3] Forests also contribute to the economy through, for example, employment in forest-related sectors (e.g. forest management, and wood harvesting and processing) and ecotourism.
- **Preventing natural hazards.** Forests hold soils together, thus helping prevent shallow landslides. Forest soils act as sponges and retain water for longer than soils under other land uses. This reduces the risk of flooding in high-rainfall periods and makes more water available during dry periods.
- **Tackling climate change.** Forests help combat climate change by absorbing carbon dioxide, one of the gases responsible for global warming.

What are the main forest-based livelihood activities?

- **Forestry jobs.** Foresters are people who manage and protect forests. They may have professional training, or they may be traditional forest custodians. Foresters prepare and implement forest management plans – this might involve calculating how many trees may be removed from a forest area each year, planting new trees, keeping track of how many trees are harvested, managing protected forests, and guarding against illegal logging and wildfires, among other responsibilities.
- **Beekeeping.** Beekeeping is the occupation of owning and breeding bees for their honey and other products. Forests are a natural habitat for bees and are rich in melliferous plants, which are the plants on which bees feed to produce honey. Forest conservation is crucial, therefore, for sustainable beekeeping.
- **Timber harvesting and wood processing.** Some people earn money by working in forest harvesting – typical jobs are logging, operating machines to drag logs from the forest, and driving log trucks. Many people also work in sawmills. Timber production and processing provide steady jobs and income for millions of people worldwide.
- **Fuelwood and charcoal selling.** Charcoal is the biggest source of energy for cooking in the United Republic of Tanzania. Many people gather wood in forests and sell it as fuelwood or convert it into charcoal in kilns, often in community enterprises. The woodfuel industry is an important source of income and employment in the United Republic of Tanzania.
- **Wood-carving and other artisanal work.** People earn livelihoods by making and selling everyday products from wood, such as spoons and bowls, as well as souvenirs and works of art.
- **Hunting and gathering.** Many people gather food such as fruit, herbs and eggs in forests and hunt for wild meat. They may eat the food themselves or sell it to other people to increase their income.

Picture 9.1. Forest rangers

Picture 9.2. Beekeepers

Picture 9.3. Sawmill worker

Picture 9.4. Charcoal seller

Picture 9.5. Wood-carving

Picture 9.6. Game hunters

How do deforestation and forest degradation threaten livelihoods?

In many countries, forests are overharvested for wood – this is especially so when logging is illegal and therefore unplanned. Overharvesting (when more wood is removed from a forest than can be regrown before the next harvest) leads to forest degradation. This, in turn, makes forests more vulnerable to wildfires and other pressures and may lead eventually to the complete loss of forest cover (deforestation). Deforestation negatively affects biodiversity and the livelihoods of people who depend on the products and services provided by forests.

In many countries in Africa, unsustainable forest harvesting for woodfuel accounts for as much as half of all forest degradation.[4] Woodfuel harvesting doesn't need to be unsustainable, however – the key is to limit harvesting to the capacity of forests to regrow. Sustainable woodfuel production requires forest management that ensures that forest regrowth is at least equal to the amount of wood harvested.

Overhunting can endanger wildlife species and destroy people's livelihoods. It is a serious issue in many parts of the world, with rising demand for wild meat encouraging an increase in hunting. Overhunting leads to declines in wildlife populations, which, in turn, reduce the livelihoods of hunters and the food security and nutrition of communities that cannot afford alternative sources of protein.

With good management and governance, it is possible to use forests in ways that ensure that they stay healthy and productive over time and thereby contribute to the lives and livelihoods of present and future generations.

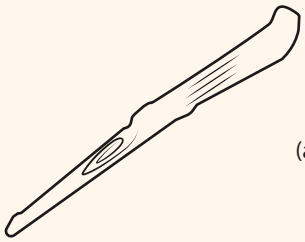
Picture 9.7. A Tanzanian woman carries some goods in Uluguru Nature Forest Reserve

LESSON 26

How do people earn a living from forests?

26

Required materials



A STICK
(approximately 20 to 30 cm long)

1 Activity 1: Collect ideas on forests and livelihoods

indoor

This activity should take **10 minutes**.

1. Explain to the pupils that forests are an important source of livelihoods for many people.
2. Ask the pupils to think about why this is so. Ask them if they know people who earn money from forests.
3. Ask the pupils to suggest ways in which people can earn a living from forests. Use the "talking-stick" to add interest to the discussion.
4. Ask the pupils to raise their hands if they want to volunteer answers to the questions.
5. Give the talking-stick to a pupil with a raised hand and tell them that they may speak for a few seconds. When you clap your hands, however, they must give the stick to another pupil who also wants to answer the question.
6. Clap your hands after the next pupil has spoken for a few seconds, and so on, to keep the stick moving around the classroom.

Important: At this stage of the lesson, you are collecting ideas, whether right or wrong. There is no need to correct wrong answers.

2 Activity 2: Learn about the main forest-based livelihood activities

indoor This activity should take **30 minutes**.

1. Write in the middle of the board: "Main forest-based livelihood activities".
2. Briefly explain each type of livelihood in Figure 9.1 and write it on the board.

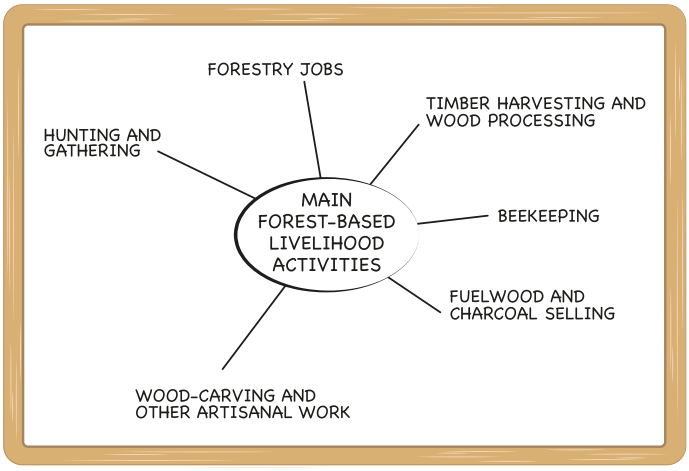


Figure 9.1. Types of forest-based livelihoods

3. If you know of other types of forest-based livelihoods in your area, or if the pupils came up with other good ideas in the previous activity, add them to the Figure. Use the list of possible forest-based livelihoods below to help you:
   - **Forestry jobs.** Foresters are people who manage and protect forests. They may have professional training, or they may be traditional forest custodians. Foresters prepare and implement forest management plans – this might involve calculating how many trees may be removed from a forest area each year, planting new trees, keeping track of how many trees are harvested, managing protected forests and guarding against illegal logging and wildfires, among other responsibilities.
   - **Beekeeping.** Beekeeping is the occupation of owning and breeding bees for their honey and other products. Forests are a natural habitat for bees and are rich in melliferous plants, which are the plants on which bees feed to produce honey. Forest conservation is crucial, therefore, for sustainable beekeeping.
   - **Timber harvesting and wood processing.** Some people earn money by working in forest harvesting – typical jobs are logging, operating machines to drag logs from the forest, and driving log trucks. Many people also work in sawmills. Timber production and processing provide steady jobs and income for millions of people worldwide.
   - **Fuelwood and charcoal selling.** Charcoal is the biggest source of energy for cooking in the United Republic of Tanzania. Many people gather wood in forests and sell it as fuelwood or convert it into charcoal in kilns, often in community enterprises. The woodfuel industry is an important source of income and employment in the United Republic of Tanzania.

- **Wood-carving and other artisanal work.** People earn livelihoods by making and selling everyday products from wood, such as spoons and bowls, as well as souvenirs and works of art.
- **Hunting and gathering.** Many people gather food such as fruit, herbs and eggs in forests and hunt for wild meat. They may eat the food themselves or sell it to other people to increase their income.
- If there is still space on the board, add some key points to the mind map, as shown in Figure 9.2.

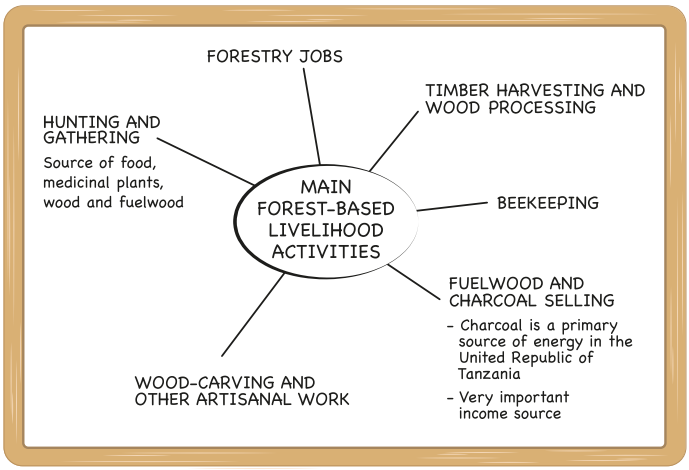


Figure 9.2. Key points on forest livelihoods

4. Ask the pupils to copy the mind map into their exercise books.

LESSON 27

What happens when a forest declines?

27

Required materials

12 STICKS
to mark the playing fields

Preparation for the lesson

In a suitable area outside, mark three square playing fields measuring 10 paces × 10 paces with sticks. The playing fields should be close enough together so that all pupils can follow your explanation of the game (Figure 9.3).

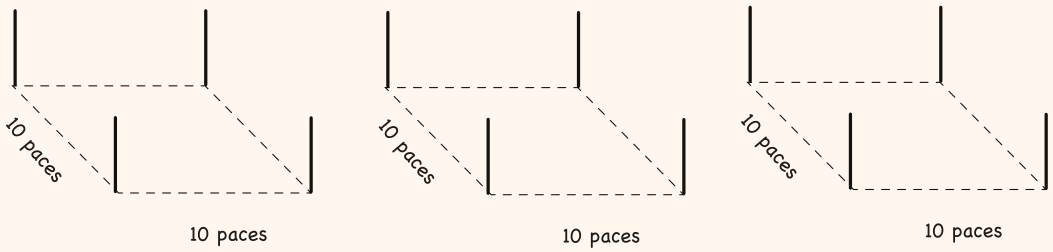


Figure 9.3. The playing fields

1 Activity 1: Learn the importance of balance

outdoor This activity should take **40 minutes**.

1. Organize the pupils into three groups of equal size.
2. Explain to the pupils that each of the three playing fields represents a forest, and each of the three groups represents the population of a village. Each village owns and uses a forest.

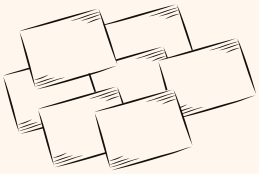
3. Assign each group to one of the playing fields and tell them to stand inside their "forest".
4. Now assign jobs for the pupils to mime inside their forests. For example, some might gather forest foods or fuelwood, some might fell trees, some might hunt and some might collect medicinal plants.
5. Ask the pupils to go into their forests and mime their activities.
6. Ask the pupils:
   - ► Is there enough space for all the livelihood activities inside the forest?
   - » **Answer:** The playing field is big enough to host all the activities of the village inhabitants. (The pupils should answer "yes".)
7. Now ask the pupils to move aside while you reduce the size of the playing fields to 5 paces × 5 paces.
8. Explain that, in the villages, forest clearing has reduced the forest area.
9. Ask the pupils to go into their forests again and mime their jobs. Because the space is much smaller, the pupils will need to stand close together.
10. Ask the pupils:
    - ► Is there still enough space for all the livelihood activities inside the forest?
    - » **Answer:** Although you are standing very close to each other, there might still be enough room for everyone.
11. Ask the pupils to step aside again while you reduce the size of the playing fields to 2 paces × 2 paces.
12. Explain that even more forest has now been cleared.
13. Ask the pupils to go into their forests again and to try to fit everyone into the space and mime their jobs. Remind them that everyone in the village uses the forest in some way as part of their livelihoods, so everyone needs their "space" in the forest.
14. Ask the pupils:
    - ► Is there still enough space for all the livelihood activities inside the forest?
    - » **Answer:** No!
15. **Explain:** As you saw, reducing the size of the forest means that the forest will no longer be sufficient as a source of livelihoods for all the people in the village.
16. End the lesson by **explaining:**
    - » Forests and forest products provide food, income and nutritional diversity for about 20 percent (one in every five people) of the global population – some 1.6 billion people.
    - » In the United Republic of Tanzania, millions of people rely on forests for their livelihoods.
    - » Forests contribute to livelihoods and quality of life in many ways – such as by providing food and medicines gathered in the forest and forest-based jobs such as timber harvesting and forest management.
    - » Good forest management is essential for ensuring that forests remain healthy and productive over time – so that forest communities can maintain their livelihoods into the future.
    - » Sustainable forestry – maintaining enough forest, in good condition – is important for ensuring that forests can continue to be used by everyone.

LESSON 28

Play a forest livelihood miming game

28

Required materials



7 SHEETS OF PAPER (A4)
OR MANILA CARDS

Preparation for the lesson

- On one side of each sheet of paper, write one of the terms (in bold) from the list below. Each sheet of paper should have a different term on it.
- On the other side of the paper, write the explanation (the text not in bold).
  - **Food security.** Forests supply foods such as fruit, seeds, roots, nuts, edible mushrooms, tubers, vegetables, edible insects, honey and wild meat.
  - **Water security.** Forests protect rivers, lakes and other water bodies, help regulate the water cycle and increase the infiltration of rainwater into soils, where it is stored.
  - **Health and well-being.** Forests provide medicinal plants that can be used to treat diverse ailments. Trees and forests also add beauty and provide opportunities for recreation, with positive effects on human health.
  - **Energy and wood security.** Woodfuel is the main source of energy for cooking in the United Republic of Tanzania. Forests provide wood for a wide range of uses.
  - **Income.** Forests produce many goods that local communities can sell. Forest-related sectors such as wood production provide many thousands of jobs.
  - **Preventing natural hazards.** Forests help prevent flooding and shallow landslides and reduce the impacts of drought by storing water.
  - **Tackling climate change.** Forests help combat climate change by absorbing carbon dioxide, one of the gases responsible for global warming, and storing it as carbon.

1 Activity 1: Recap from the previous lesson

This activity should take **5 minutes**.

1. Ask the pupils to think about the content of the last two lessons.
2. Ask them:
   - What is the impact on livelihoods of losing forests?
3. Clap your hands to begin the time for thinking and clap again when the time is up.
4. Invite some pupils to share their thoughts.

2 Activity 2: Mime why forests are important for livelihoods

This activity should take **35 minutes**.

1. Organize the pupils into seven groups of equal size.
2. Explain the task:
   - Each group will receive a piece of paper with an important term written on it. The term is one of the reasons why forests are important for livelihoods. Tell the pupils that they will find an explanation of why it is important on the other side of the paper.
   - Each group will think about how they can present their reason to the other pupils by performing a mime. In other words, they must act out a scene without using words.
   - The mimes should last 2 minutes.

> **Note:** If there isn't enough space at the front of the classroom for the mimes, ask the groups to choose a few members of their group to perform.

3. Give an information sheet to each group.
4. While the pupils are working, write on the board:
   - How are forests a source of livelihoods for local people?
5. After 5 minutes, ask the groups to come forward, one at a time, to perform their mimes. Allow 2 minutes for each group.
6. Ask the rest of the pupils to guess the term that the performers are acting out. Help them, if necessary.
7. When all seven groups have performed, take a few minutes to summarize. **Explain:** Forests contribute to livelihoods in diverse ways. Losing forests, therefore, will destroy livelihoods. This means that people will no longer be able to harvest and use food, medicines and wood from the forest or earn income from selling forest products or by working in forest enterprises.
8. Ask the pupils to write this summary into their exercise books.

Notes

[1] **Sen, M.** 2020. *Forests: At the heart of a green recovery from the COVID-19 pandemic.* 4 p. UN Department of Economic and Social Affairs (DESA) Policy Briefs No. 80. United Nations. https://doi.org/10.18356/ca7463ff-en

[2] **FAO.** 2022. Wood Energy. Sustainable Forest Management (SFM) Toolbox. In: *FAO*. Cited 15 March 2022. www.fao.org/sustainable-forest-management/toolbox/modules/wood-energy/basic-knowledge

[3] **Gumbo, D.J., Dumas-Johansen, M., Muir, G., Boerstler, F. & Xia, Z.** 2018. *Sustainable management of Miombo woodlands: Food security, nutrition and wood energy.* Rome, FAO.

[4] **Kissinger, G., Herold, M. & de Sy, V.** 2012. *Drivers of deforestation and forest degradation: A synthesis report for REDD+ policymakers.* Vancouver, Lexeme Consulting. www.cifor.org/knowledge/publication/5167/

Glossary

Aquifer. An underground rock layer with cavities that are saturated with water.

Biodiversity. The variety of lifeforms and ecosystem levels, encompassing plants, animals, fungi and microorganisms and their arrangements in nature.

Carbon. A chemical element and a main component of all life on Earth.

Carbon dioxide. A greenhouse gas that occurs naturally in the atmosphere but is also produced during the burning of fossil fuels and vegetation.

Carnivore. An animal that only eats meat.

Charcoal. A material produced by burning wood in minimal oxygen to remove water and other substances. It burns at a higher temperature than wood and is commonly used for cooking.

Climate change. A change in the Earth's climate. The world is warming up because of increasing levels of carbon dioxide (and other greenhouse gases, such as methane) in the atmosphere. A rapid increase in the Earth's temperature is likely to have serious impacts on, for example, water availability, our ability to grow crops, habitats for plants, animals, fungi and microorganisms, and the health and well-being of people.

Deforestation. The conversion of forest to another land use, such as cropland and pasture land.

Domestication. The process of adapting wild plants and animals for human use. Domesticated plant species are grown to produce food, construction materials, clothing, medicines and for many other purposes.

Ecosystem. An ecosystem comprises all living things (plants, animals and other organisms) in a given area, as well as their interactions with each other and with their non-living environments (e.g. weather, sun, soil, climate and atmosphere).

Edible. Suitable or safe for human consumption.

Erosion. The accelerated removal of topsoil from the land surface, usually through the action of water or wind.

Exoskeleton. A hard "shell" on the outside of the bodies of some types of animals to support and protect them. Insects and certain other invertebrates have exoskeletons.

Forest degradation. A reduction in the capacity of a forest to provide goods and social, cultural and environmental services.

Fungi. Organisms which include yeasts, rusts, smuts, mildews, molds and mushrooms.

Glacier. A huge mass of ice that moves extremely slowly over land. Glaciers are also called "rivers of ice".

Grasslands. Areas of land where grasses are the dominant vegetation. Grasslands cover about 40 percent of the Earth's land area.

Gravity. The force that pulls everything to the ground on Earth.

Green jobs. Jobs that contribute to conserving or restoring the environment, such as work in sustainable forestry.

Greenhouse gas. A gas that traps heat in the atmosphere and therefore contributes to global warming. The most common greenhouse gas is carbon dioxide; methane is another powerful greenhouse gas.

Groundwater. The water found underground in the cracks and spaces in soil, sand and rock. It is stored in and moves slowly through aquifers, which are geologic formations of soil, sand and rocks.

Habitat. The natural environment (home) of a species.

Hardwood. Wood from trees that produce flowers and have broad leaves and the seeds of which are enclosed in seed-bearing structures or fruit.

Herbivore. An animal that eats only plant materials.

Ice cap. A mass of ice often found on very high mountain tops, and also in the Arctic and Antarctic regions. Larger ice masses are called ice sheets.

Illegal logging. The harvesting of timber in contravention of a country's national or subnational laws and regulations.

Invertebrates. Animals that lack a vertebral (spinal) column (hence "invertebrate"). Insects (e.g. beetles, grasshoppers, bees, termites, ants and mealworms), arachnids (e.g. spiders, scorpions, mites and ticks), crustaceans (e.g. shrimps and crabs), annelids (e.g. earthworms, leeches and lugworms) and gastropods (e.g. snails) are all invertebrates.

Livelihood. The means by which a person obtains the necessities of life, such as food, shelter and material possessions. Many people obtain their livelihoods by working in a job to earn money.

Pests. Insects and small animals that damage crops, livestock and forests or cause a nuisance to people, especially in their homes.

Pollination. The transfer of pollen from one part of a flower (the "male" part) to another (the "female" part) to enable the plant to produce fruit and seeds. This transfer of pollen may occur within the same flower, between different flowers on the same plant, or between different plants of the same species.

Pollinator. An animal that moves pollen from the male part of a flower (anther) to the female part (stigma). Many insects, such as bees, bumblebees, wasps, ants, flies, mosquitos, butterflies, moths and beetles, are pollinators.

Pupa. The immature form of an insect between the larva or egg stage and the adult stage.

Salinity. The amount of salt dissolved in water. It is measured in grams of salt per kilogram of water. Water that is safe to drink should have less than 0.05 percent salinity or less than 50 milligrams per litre of water.

Softwood. Wood from conifers, which are trees with needle- or scale-like leaves that produce seeds in cones and do not produce flowers or fruit.

Species. A group of organisms that can reproduce with one another in nature and produce fertile offspring.

Sustainable forest management. Forest management that maintains or enhances the economic, social and environmental values of a forest for the benefit of present and future generations.

Synthetic. Substance that has been produced artificially, usually through chemical synthesis.

Thorax. The middle section of an insect between its head and abdomen. An insect's legs (and wings, if it has any) are attached to the thorax.

Transpiration. The evaporation of water through the leaves, stems and flowers of a plant. In this process, the plant moves nutrients and water from the roots to the leaves and other plant parts, ensuring that it can survive and grow.

Woodfuel. Solid woodfuel includes fuelwood (also called firewood), charcoal and other wood products for producing bioenergy.

Zoonotic disease. A disease that can be transmitted from animals to humans.

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