Science

A Curriculum Companion for Teaching Environmental Education in Eritrean Elementary Schools

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Contents

1 Introduction

Introduction

This book has been produced to support Science Education as part of the Elementary Schools Environmental Education Initiative in Eritrea (ESEE Initiative). The purpose of the initiative is building the capacity of elementary students to understand and respond to the environmental issues, which confront Eritrea, so that they can appropriately contribute to a more sustainable future.

The goal of the project is to ensure that Eritrean children have equitable access to quality educational experiences, which address relevant environmental, health and hygiene education issues. Towards this goal, a range of materials has been produced for use in Eritrean classrooms and by other stakeholders in the schools' community.

Specifically, these materials have been designed to:

1. Improve the knowledge, attitude and skills of elementary school children on environmental issues. To promote health and good hygiene behaviour, thereby ensuring that the children can demonstrate capacity to prepare for and manage the country's environmental issues.
2. Train teachers so that they can appropriately use the materials. In particular, the teachers will be supported to apply child-centred inquiry learning approaches that improve quality of teaching and increase student retention in schools.
3. Strengthen the capacity of PTA and community members to play key roles in preparing for and managing the environmental conditions.

2 Using the Environmental Education Curriculum Companion for Science

This book has been designed to help Science teachers in Eritrean Elementary Schools deliver their curriculum and meet their teaching objectives. At the same time, it introduces students to Environmental Education.

These materials are not intended to be additional to the requirements of the textbooks and teacher guides. Instead, they offer alternative ways of teaching parts of the curriculum that teachers may choose to use.

The alternative lessons offered here all include interactive child-centred activities that also contain environmental messages which help strengthen students understanding of the environment and environmental issues.

Several of the activities presented here incorporate mathematical skills. In particular they use graphing and number skills. Science teachers could perhaps benefit from discussing these activities with their colleagues who teach Mathematics. It may be possible that they will be able to work collaboratively with Mathematics teachers on some projects.

Overview

This Environmental Education Curriculum Companion for Science has four main parts.

1. Activities for you to use in your classroom together with background information so that you know more about the topic you are teaching.
2. Strategies to improve your teaching so that it is more effective and more child-centered.

3. Toolbox contents and maintenance.
4. More information about Environmental Education.

How to use these Resources

The Environmental Education Curriculum Companion for Science has been designed to be used by teachers during relevant school lessons. Each module provides the curriculum linkages that help the teachers in choosing the activities when planning during the weekly meetings and in carrying out the lessons with students.

Getting Started

- Read through the activities looking particularly at those for the grades you are teaching.
- If you are not used to working in groups it is a good idea to read the section on Working in Groups (page 99) before you start any activities.
- When you are next teaching a topic in the curriculum which relates to the environment, try out one or two of the activities. Make sure you read the background information before you do the activities.
- Either before or after the activities, read more about the philosophy of Environmental Education and what the activities have been designed to achieve. See page 110.
- Reflect on how the activities went in your class and plan for how you will incorporate more of them into your teaching. Read more about how to make your teaching more effective (page 93).

Integrating the activities into your teaching

These activities can be used instead of some of the activities in your textbook, or in addition to the activities in your textbook.

They are designed to help students meet the learning outcomes set out in the Science Curriculum and at the same time to introduce your students to Environmental Education. These activities provide additional options for you to draw on when you are planning your classes. You don't have to do every activity in this book but you will probably find that the students like this approach to learning and will want to use many of them.

Assessment

Environmental Education is already part of the Science Curriculum and does not need to be assessed separately for exam results.

Each of the activities includes ideas for formative assessment. There is more information about monitoring student progress on page 100.

The Toolbox

The Toolbox provides some practical resources to use in teaching Environmental Education. These resources can be used in all your teaching, not just on environmental topics. Use them wherever they are useful and relevant. It is important that the materials in the Toolbox are well stored and maintained. For information on Toolbox contents, use and maintenance, see page 89.

Overview of Environmental Education

Environmental Education is designed to engage students with issues and ideas connected to their environment. It encourages students to consider all aspects of the environment in an interrelated way and leads towards their being able to act in an environmentally sustainable way and to take positive action on environmental issues. A more detailed description of Environmental Education is included on page 112.

Integrating Environmental Education into Science

Environmental Education is an important cross-curricular activity. If a teacher is aware of what other teachers are doing in their subjects, this helps them to connect Environmental Education learning with the content in those other subjects.

A school garden is a good example of how you can work across the curriculum. Students can be involved with the garden in a variety of ways. They may be in the Green Club or Agriculture Club. The Science teacher might involve students in some experiments related to the growth of plants. The Social Studies teacher might work with students on soil quality in the garden and might also consider the social, cultural and historical significance of plant selections. The Mathematics teacher might involve students in measuring out an area to be planted. English can give students a way to bring all these things together in the form of simple stories or dramas. If you are aware of what other teachers are doing in the garden at each grade level, you can follow up some of the activities in your own classes and thereby provide a richer learning context.

Environmental Education in Science

The Environmental Education Curriculum Companion for Science is organised by grade levels. There are activities at each grade level for topics in the curriculum which deal with environmental issues. In addition, there are background materials for teachers on environmental topics covered in the curriculum. Teachers are encouraged to read the background materials as part of planning their lessons and preparing activities.

Curriculum Links

The following table shows you where in the Science curriculum environmental topics are covered. These resources will provide additional exercises to support your teaching of these topics.

**if a square is coloured in with green it indicates that the topic addresses outcomes in this level.*

Themes/Grades	Grade 1	Grade 2	Grade 3	Grade 4	Grade 5
Water					
Waste					
Soil					
Energy					
Biodiversity					

Each of the topics has a section on Curriculum Links to show the links between activities and year level.

3 Activities

Environmental Education within Science

Grade 1

Personal Hygiene

The activities have been designed with subheadings for purpose, time, materials required, and procedure. These subheadings have been included to guide teachers in planning and conducting the activities. The times provided with each activity are suggested times to help teachers plan the class. This is a guide only; some activities may take less or more time.

Background information for the teacher

Hygiene, sanitation and water storage habits affect people's health. Dirty water results in sick people. Water is important for daily life, as we use it for most activities. It is also vital in the environment as it supports our animal and plant life, which in turn supports our livelihood.

Why do we get diseases?

Reason number 1 - Not using toilets

Around the world, not using toilets has been shown to be the number one cause of diarrhoea.

Leaving faeces uncovered, due to not using toilets, (open defecation), can lead to the spread of parasites, bacteria and viruses. As shown on the opposite page, they are spread to human food or water supplies by insects, wind, animals or people.

Reason number 2 – Lack of hygiene practices

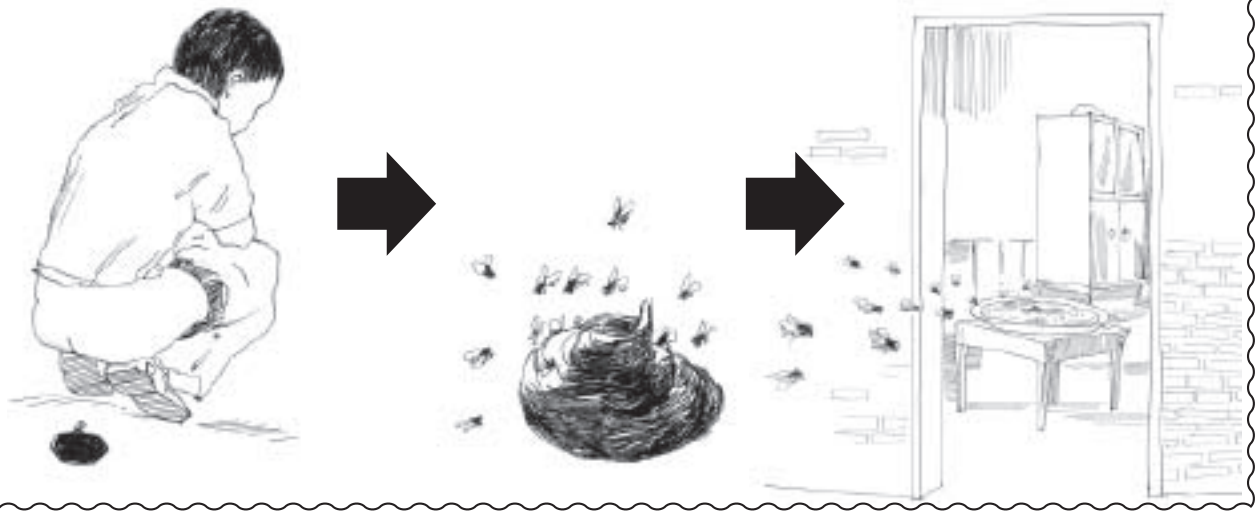
Another very important health issue is cleaning hands, particularly after going to the toilet. It is also important to keep our whole body clean.

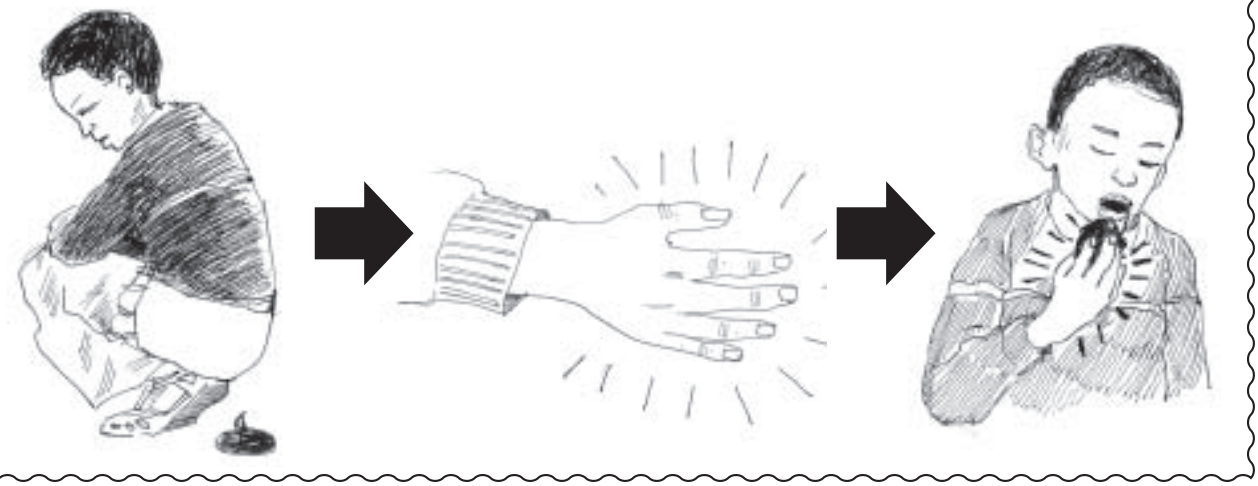
If your students don't wash their hands after going to the toilet, it is possible that they will swallow contamination when they next eat.

Also, when these students come in contact with other students they might pass small amounts of faeces on to them. Even very small amounts of faeces can contain large numbers of viruses, bacteria and parasites.

Many diseases, such as trachoma, can be caught through contact between children. Therefore hygiene in schools is particularly important for controlling diseases.

These are some ways that faeces can spread contamination:





The following actions have been shown to have the greatest impact on reducing disease:

1. Increasing toilet use.
2. Improving personal hygiene (especially face & handwashing) and hygienic food preparation.
3. Providing enough good quality, clean water (for cleaning).

Activity: Washing Our Hands

Curriculum Links: *This activity is suitable for students in Grade 1 and links with the Personal Hygiene Unit in Grade 1 of the Science Student Textbook. More student activities for Hygiene can be found in the WASH Activities Manual.*

Time:

Task 1: 30 minutes

Task 2: 30 minutes

Task 3: 30 Minutes

Purpose:

- To understand the importance of washing hands.
- To have the skills and knowledge to wash hands properly.

What you need:

- Toolbox: soap
- Water
- Hand towel
- Cooking oil
- Tea or ground coffee

Hand washing posters are included in the Toolbox.

Introduction:

Start by explaining to the students that diseases are caused by germs and that some germs can be spread by our hands. Such diseases include intestinal and stomach problems, and cold viruses. Through touch, micro-organisms are transferred from small amounts of faeces on our hands or the fluids in our nose and mouth to something (e.g., a pencil, food, a cup) or to someone else. When other people bring their hands or the object near their mouths, the bacteria or viruses may find a new home.

What to do:

Task 1: Shaking wet hands in a circle

- Ask the students to stand in a circle.
- Ask one student to pretend to sneeze and cover his/her mouth, then wet one of her/his hands with water.
- Ask this student to then shake the hand of her/ his neighbour.
- The neighbour then shakes the hand of the next student in the circle and so on.

The students will be surprised how many of them will still feel the wetness from the hand. **Students should wash their hands after this demonstration.*

- Remind students that many diseases are spread by our hands.
- Lead a discussion based on this experience, how many students felt a wet hand? What would happen if germs were in this wet hand shake? What would be the best way to prevent the spread of germs?
- Write on the chalkboard all of the suggestions made by your students.
- The next part of the activity is to test your students' hypothesis.

Task 2: What is the most effective way to remove bacteria from your hands?

Ask three students to volunteer for the experiment.

For the student volunteers;

- Rub 1 tablespoon of cooking oil all over their hands until completely coated. Then sprinkle 1 teaspoon of tea or ground coffee on hands and rub it around until it's evenly distributed. The tea or coffee will be like bacteria. It's all over!
- The three students then wash their hands as follows:
  - Student #1: do not wash your hands but shake them or rub them on a towel.
  - Student #2: wash hands by rubbing them briskly for 20 seconds with **water** and **no soap**.
  - Student #3: wash hands by rubbing them briskly for 20 seconds with **water** and **soap**

For the rest of the class:

- Observe the three hand washing methods.
- Record the results.
- Lead a discussion with students based on the results of the experiment;
  - *the method of handwashing that removed the most 'bacteria' was…,*
  - *the method that removed the least 'bacteria' was…,*
  - encourage students to suggest their own thoughts on good hand washing practice.
- Ask students when they need to wash their hands. The answers you are looking for include:
  - after using the toilet
  - before eating
  - after blowing your nose
  - after coughing or sneezing into your hands
  - after playing outside
  - after touching animals or animal waste
  - before and after preparing food
  - before and after changing a diaper
  - before and after treating wounds or cuts
  - before and after touching a sick or injured person

Task 3: Hand Washing Demonstration and Song

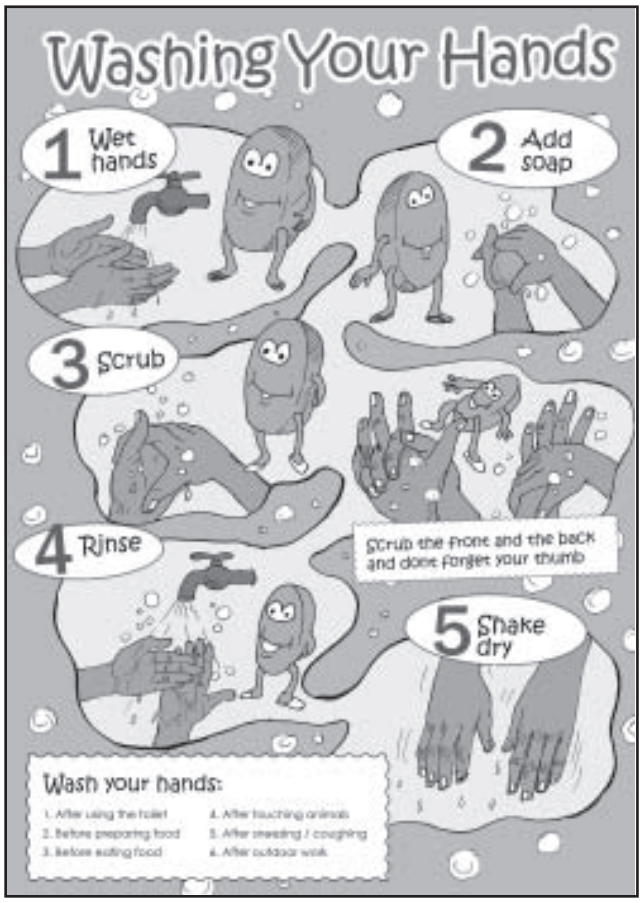
Remind students that our hands spread an estimated 80% of common infectious diseases like the common cold and flu. However, these disease-causing germs slide off easily with good hand washing techniques. Hand washing is easy to learn, cheap and very effective at stopping the spread of disease-causing germs.

To conclude these activities demonstrate the steps for good hand washing technique to your students.

1. Wet your hands with water.
2. Rub soap into the palm of one hand.
3. Rub your hands together for 20 seconds so you produce lather.
4. Make sure you scrub between your fingers, under your fingernails and the backs of your hands.
5. Rinse your hands well with clean water for at least 10 seconds.
6. Shake your hands dry.
7. Write the *Hand Washing Song* on the board and get students to copy it into their books.

Repeat the demonstration, this time have the students sing the *'Hand Washing Song'* (see page 15) or another well known local song while rubbing their hands together. This will teach them the amount of time it takes to clean their hands properly. To make washing hands more fun, you can have students create songs that are 15 seconds long.

You can repeat the activity; whenever hand washing is required ensuring students demonstrate the steps for good hand washing technique using soap encourage them to sing the song.



Hand washing posters are included in the Toolbox.

The Hand Washing Song

Sing to the tune of any simple local song

Wet, wet, wet your hands, wet with water clean
Wash them, wash them, wash your hands, to keep them always clean

Put, put, put some soap, rub it in your palm
Use the soap, use the soap, to make your hands all clean

Rub, rub, rub your hands, with soap and water too
Scrub them, scrub them, scrub between, your fingers all the ten

Rinse, rinse, rinse your hands well with water again
Clean them, clean them, clean them well, germs go down the drain

Dry, dry, dry your hands, dry them really well
Shake your hands, to get your hands all dry

Grade 1

Changes caused by heat

Background information for teachers

Energy is needed for anything to be able to work. Energy comes in many different forms and is essential for everything we do.

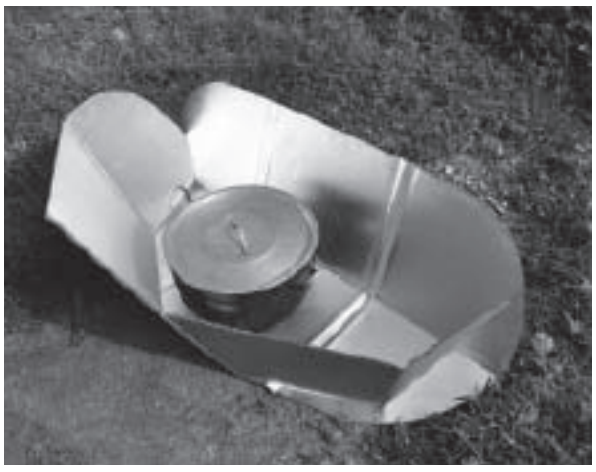
The sun is the main source of energy and plants need sunlight to make their own food and grow. This process is called *'photosynthesis'*. Animals gain energy from what they eat or drink.

Solar energy

Solar energy is the sun's rays (solar radiation) that reach the earth. The sun has produced this energy for billions of years. Solar energy is an environmentally friendly form of energy. Solar energy can be converted into other forms of energy, such as heat and electricity. Thermal (heat) energy can be used to heat water or heat spaces like buildings. Solar heating of spaces is passive or active. When no mechanical equipment is used for solar heating it is called passive space heating whereas active solar heating collects solar radiation using solar cells and fans and pumps are used to circulate the warm air or liquid. In some situations solar energy can be used to replace burning wood as a way of creating heat. In Eritrea most heating is done by burning wood and often involves cutting trees. The increasing loss of trees for firewood is a major environmental problem in Eritrea.

For further information on energy you can refer to page 52, in this book.

Solar panels to operate a water pump.



Solar cooker.

Activity: Heat of the sun

Curriculum links: changes, weather, physical properties of matter. This unit is suitable for Grade 1 students and links with the unit on 'Changes', specifically 'changes caused by heat' in the Grade 1 Science Student textbook.

Even though this was written for Grade 1, it can be used in a flexible way with other grade levels. You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.

The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activity provides a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Time: 30 minutes

Purpose:

- To explore their surrounds and identify the impact of the sun on different surfaces in the school compound.

What you need:

- Exercise book or paper
- pencils

What to do:

1. Take students outside into the school compound on a sunny day. Ask them to feel different surfaces that are in direct sunlight. Bring the students back together and discuss what they found by asking:
    - What did you notice when you felt different surfaces?
    - Were all surfaces the same? Why do you think some surfaces felt the same and others felt different?
    - What do you think is making the surface feel the way it does?
2. Explain to the class that they are going to try and work out why surfaces might feel different when in the sun. As a class decide on a rating scale for the degree of warmth for surfaces e.g.; cold (not warm), cool (some warmth), warm, very warm, hot (can't leave hand on it for any length of time).
3. Ask the students to list or draw a picture of surfaces (in the direct sun) in the school compound that they are going to rate using the rating scale they have decided on.
4. Ask the students to test and rate the surfaces.
5. After the class rates the surfaces using the rating scale, discuss why they think the surfaces are different when compared to one another. Prompt discussions by asking questions such as:
    - Are the surfaces in the direct sun for the same length of time? Can we rank how the

surface feels with the amount of time it has been in the sun?

- Are the surfaces the same colour? Does colour have anything to do with the feel of the surface? (dark colours absorb heat and light colours reflect the sun's rays and a therefore cooler).

6. Repeat this activity with surfaces in the shade.
7. Compare the results of the surfaces in the direct sun with those from the shade. What factors are the same? What are different?
8. Ask students why they think surfaces feel different depending on the amount of time it is in the sun and what the surface is made of? How can knowing this information be useful to them and their family?

Grade 2

Water

Background information for teachers

Water is one of the basic building blocks of all life. It is also one of the basic ingredients of our weather. About 75% of the Earth's surface is covered by water. It is present in oceans, rivers, lakes, the polar ice caps, clouds, rain or snow, groundwater and living things such as plants and animals.

Eritrea is an arid and semi-arid country without ready access to a rich water supply. Furthermore being part of Sahelien Africa it has been the victim of recurrent and devastating droughts. The majority of the population depends on groundwater as its main water supply source.

In order to overcome domestic water supply scarcity there is an urgent need to use systems that harvest the rain water for use by households and the local community.

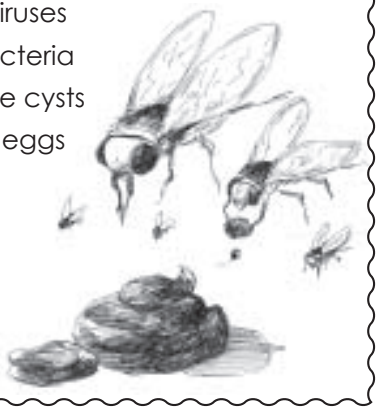
In this topic students explore the importance of water, learn about the water cycle and consider ways of harvesting water for use by members of school and the local community.

According to UNICEF (1999) one gram of faeces can contain 10, 000, 000 viruses, 1, 000, 000 bacteria, 1, 000 parasite cysts, 100 parasite eggs! Infectious diarrhoeas (including dysentery, cholera and typhoid) are caused by infectious agents like viruses, bacteria and parasites. These agents get into humans via the mouth and are passed out in faeces. So faeces are enemy no. 1! Ensuring that faecal material does not get into water supplies at the source is probably far more effective than boiling, filtering, and covering water tanks. We need to protect well water and rainwater from faecal contamination.

Open water sources can also be contaminated by freshwater snails that can carry a parasite dangerous to humans. This parasite can penetrate the skin of humans and develop into worms within the body. This disease is known as bilharzias or schistosomiasis.

One gram of faeces contains

- 10,000,000 Viruses
- 1,000,000 Bacteria
- 1,000 Parasite cysts
- 100 Parasite eggs



Children are particularly susceptible to contracting this disease as a result of playing in contaminated water. People using this water for washing are also at risk.

Traditionally in Eritrean culture, people washed clothes using soap made from the berries of a plant called *Phytolacca dodecandra*, ('Shibiti' in Tigriniya). The berries from this plant not only act as a cleaning agent, but also kill the snails that could potentially carry disease.

The berries are most potent to snails when picked unripe, green and dried in the shade. They should then be ground into a powder, mixed with water, left for 24 hours and stirred occasionally. This mixture should be filtered and used at 1 part per million. It is useful to note that this mixture has little effect on other plants and animals in the waterway.

Due to the introduction of commercially available soap products, the use of Shibiti as a soap has declined. Also, in treating waterways, people have more recently been using synthetically developed chemicals, but it is important to note that the Shibiti berries could still be used to treat small scale outbreaks.

Ref: IDRC Reports, October 1991, p16-18 Planting the Prevention of Schistosomaisis.

Curriculum Links:

This unit is suitable for Grade 2 students and links with the unit on 'Water in the Home' specifically 'dirty water' and 'how to keep water safe' in the Grade 2 Science Student textbook.

Even though this was written for Grade 2, it can be used in a flexible way with other grade levels. You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.

The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activities provide a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

The Shibiti tree has berries that can be used as a soap and as a pesticide.

Activity: What's in your water?

Time:

Task 1: 40 minutes
Task 2: 40 minutes

Purpose:

- To become aware of how water sources can be contaminated by faeces.
- To be able to identify some diseases associated with drinking contaminated water.

What you need:

- Note books / paper
- Pens or pencils
- Background information about diseases that can come from drinking contaminated water (check with your local doctor / health post).

What to do:

Start by showing 2 bottles of water one clear and one dirty (you can make one sample look dirty by adding dirt to a clean sample).

Task 1: On the Way to School Story Reflection

Read the following story to your class. If your class is made up of older students they might like to carry out a role-play.

On the Way to School

One sunny morning while walking to school a boy felt like he needed to go to the toilet, he was too far from home to go back and still too far from school to wait that long. He looked around for a private place to go; he noticed a clear area behind some bushes and found a comfortable position.

Because he had to stop the boy was now late for school, when he was finished he quickly pulled up his trousers and continued on his way. The boy was in such a hurry that he did not stop to bury his waste or to wash his hands after. He also did not pay enough attention to see that the spot he had chosen was very close to a bore hole and hand pump.

When it next rained the faeces left unburied by the boy was washed along the ground and as the rainwater soaked into the ground so did the faeces. It made its way through the groundwater into the bore hole. The rainwater carrying little bits of the boy's faeces also added water to puddles that had formed around the hand-pump where there is no proper drainage channel to direct water away.

- After the story ask questions to help children to reflect critically on the scenario presented. For example:
  - Ask the students what are some of the problems (potential risks of contamination) in this story? Answers should include, open defecation, not burying waste, not washing hands, faeces run-off after rain, poor drainage at hand pump.
  - Does this kind of thing happen in your village?
- Ask the children for local names of diseases that may be transmitted by drinking contaminated water.
- Link the story with an overview and explanation of the diseases that can come from drinking contaminated water.
- Depending on age, include official names, symptoms, transmission, prevention and treatment. Invite questions from all children to get them to understand how many diseases can result from contaminated water.

Task 2: Contamination Investigation at your school

In your school grounds investigate whether your water storage may potentially be contaminated by faeces.

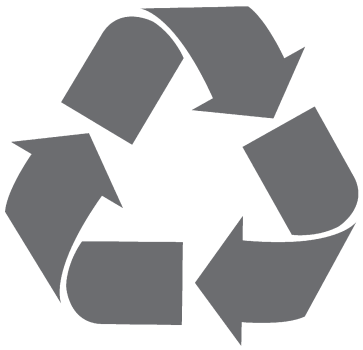
- As a class, walk into the school ground and locate your nearest water storage. Write answers to the following questions:
  1. What is the water used for (i.e. drinking)?
  2. Does the water smell or look unusual?
  3. Does open defecation occur near the water storage?
  4. Are animals kept near the water storage area (animal waste can also contaminate drinking water)?
  5. If you have toilets, how close is the nearest toilet or septic tank?
  6. Has anyone ever tested the quality of the water?
  - Return to the classroom. Discuss the answers to the questions.
  - Discuss with the students whether they think there is a possibility that their well water may be contaminated.
  - Speak to the local Health Clinic about testing the well water.

Reminder:

Remind the students that water is essential for life, but that well water can become contaminated by faeces from open defecation, diapers, soiled clothes, leaking septic tanks or animal waste. If we drink contaminated water we can become sick. There are many diseases associated with drinking contaminated water. We must all be careful not to let faeces (human waste) enter our water supplies. It is important to point out that even water that looks clear may be contaminated by germs that are too small to see, and that care must always be taken when handling water.

Grade 3

Waste Management



Background information for teachers

Environmental sustainability is the responsibility of all individual members of a community. Litter is waste of any type thrown where it doesn't belong and it is having a major impact on the environment. Significant progress can be made in caring for the environment when each community member takes responsibility with regard to the disposal of their unwanted materials.

Every person in Eritrea contributes a mixture of household waste created by things they buy or use. Waste disposal is a major issue for the government and the community. Minimising waste creation by reducing the amount of waste we generate, reusing, recycling and composting is the key.

Packaging is becoming a major source of waste and impacting on the environment in many different ways. Reducing waste is a behaviour which requires you to think before you purchase and buy products that are not wasteful in their packaging. A key part of waste 'reduction' is 'conservation' - using natural resources wisely, and using less than usual in order to avoid waste.

Reducing waste also reduces litter. Remember, everything you drop can find its way to waterways, farmland, bushland, and streets.

Composting is nature's own recycling system. It is one of the easiest ways of turning domestic waste and garden waste into something useful and beneficial to the garden. The process requires little effort, minimal attention and produces a quality garden fertiliser and soil conditioner relatively quickly.

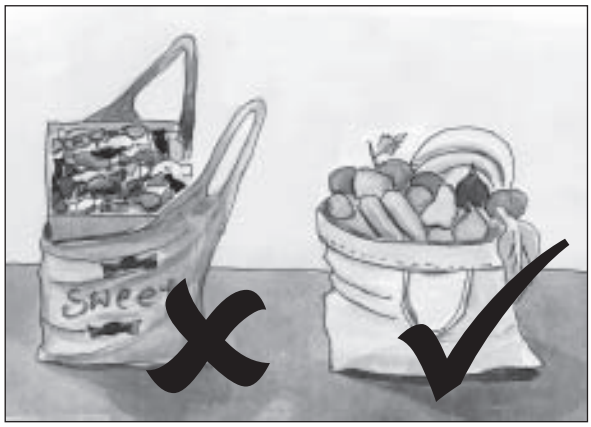
The three steps of waste management: the 3Rs - Reduce, Reuse, Recycle

Waste disposal is a major issue for the government and the community. If we minimise waste by avoiding and reducing waste, and re-using and recycling, we can cut waste by a large amount— and even more if we compost. With a little more thought, we can all change our habits so that each one of us throws out less garbage.

The 3Rs form a simple guide to help each of us to deal with our waste at work, school and home. In minimising waste, remember to first 'reduce', then 'reuse', and finally 'recycle' or 'compost' what is left.

The three steps

1. Reduce



Reduce waste — look for ways of producing less waste. Some ideas are:

- Shop more carefully by choosing products that have minimal packaging, which can be used productively or recycled.
- Think about how shopping is brought home e.g.; cloth or woven bag.

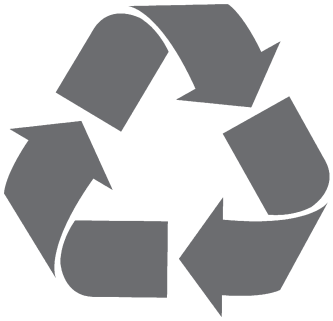
2. Re-use

Re-use containers, packaging or waste products. Reusing also means that the product doesn't go in the bin and end up in the sea, waste collection place or landfill for instance, reusing empty glass jars again for something else.

3. Recycle

Recycling means that a waste product is returned to a factory where it is remade into either the same product or something different. Recycling saves landfill space and also saves the resources that were used to make the product in the first place. Materials that can be recycled include:

- Paper and cardboard
- All glass bottles and jars
- Aluminum cans and foil
- Some plastic bottles



Compost heap

Background information for teachers

What is composting?

Composting is nature's own recycling system. It is simply the method of breaking down waste organic materials (kitchen and garden waste) in a large container or heap.

Everything you put into a compost heap is broken down by naturally occurring bacteria, fungi and small creatures such as earthworms and millipedes, which help to complete the process. Air and water also play a crucial role in the life of a compost heap, just as they are crucial to human life.

Composting can convert kitchen and garden waste into dark coloured soil in a matter of a few weeks or months.

Why compost?

The best way to reduce food and garden waste is to compost it. Much of our household rubbish is food scraps, garden waste and other organic matter that can be composted.

Compost returns nutrients to the soil, helps the soil to retain water better and improves the soil quality resulting in improved plant growth.

Requirements for making compost

For a compost heap to operate successfully it requires the correct moisture, aeration and organic materials. There needs to be some balance in the ingredients. The two broad categories of compost materials are: 1. high-carbon (woody, brown, dry) and 2. high-nitrogen (fresh, wet, green).

The micro-organisms are the workers that decompose the organic material into valuable compost. As the micro-organisms feed on the organic material they produce heat. If the inside of your compost heap is not warm it indicates the micro-organisms do not have ideal conditions for feeding and multiplication.

Your compost heap should let air in through the top, bottom and side if possible.

ADAM will help you remember the keys to making good compost.

Aliveness - Compost is a living system.

Diversity - Lots of different ingredients.

Aeration - Air (oxygen) is essential for fast-working, sweet-smelling compost.

Moisture - For the living compost heap to work well, it needs to be a little wet.

Soil from the compost heap is rich in nutrients and good for plants.

Essential steps that must be done when making compost

- Add roughly equal amounts of 'greens' (kitchen waste and fresh garden waste) and 'browns' (fallen leaves and shredded paper)
- Keep the heap moist, but not too wet
- Place on well drained soil for good drainage
- Turn it frequently to aerate the organic material

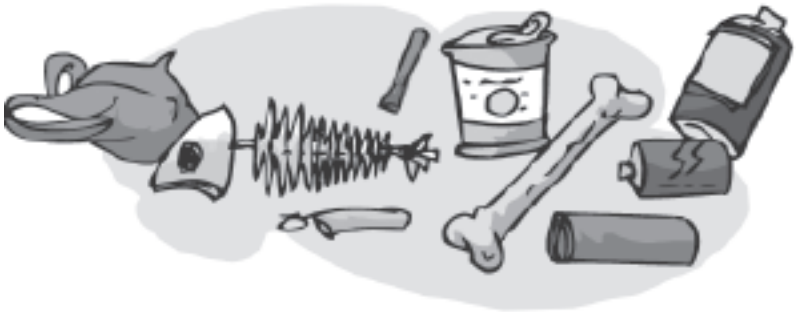
Organic materials that should NOT be composted include:

- Meat and bones
- Cooking fats and oils
- Plants which have been recently sprayed with pesticides or herbicides
- Weeds with developed seed heads or that have bulbs or tubers
- Disease affected plant material
- Non-organic materials such as metal or plastic cannot be used to make compost

✓

USE :

Food scraps, animal manure, grass, branches, ashes, paper, cardboard



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DON'T USE:

Plastic, tins, glass, stones, bones, batteries

How to Make Compost:

Step 1:

Choose the correct position – a shady, sheltered area to avoid too much evaporation, for example under a tree, is ideal.

Step 2:

First put a layer of coarse material such as broken–up palm leaves, sticks, twigs, dry leaves and torn newspaper on the bottom of the heap. This layer should be about the thickness of the width of one of your hands (8-12 cm). This step is important because it allows air to flow through the heap.

Step 3:

Then add a thin layer (1-2 cm) of rich soil or finished compost from a previous heap. Add enough water to make everything moist.

Step 4:

You are ready to start adding your food scraps to the heap. Each time you add kitchen scraps to the heap, also add a different thin layer (1-2 cm) of one or more of the following:

- grass clippings
- soil or compost from a previous heap
- coarse material, e.g., tree prunings, sticks, twigs and leaves
- shredded newspaper
- wood ash
- fresh herbs

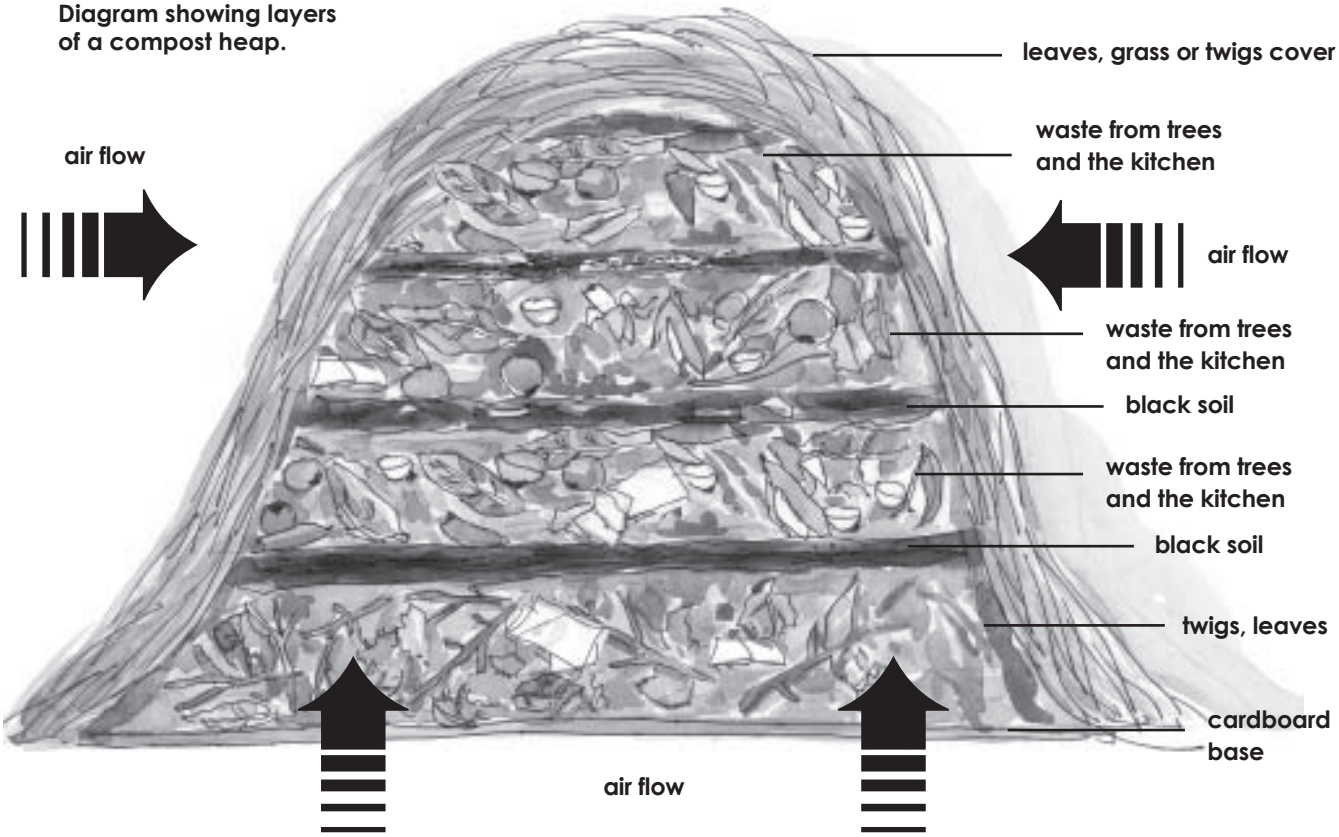
Step 5:

When you have finished layering, cover the heap with sacking, grass thatch or fallen leaves to protect it against evaporation and heavy rain as this will wash away all the nutrients.

Step 6:

Turn the heap often to get good quality compost quickly. You need to turn the heap every few weeks with a fork or shovel. If your heap is wet and smelly, then turning will help it dry out. If it's too dry, turn it and then add water.

Diagram showing layers of a compost heap.



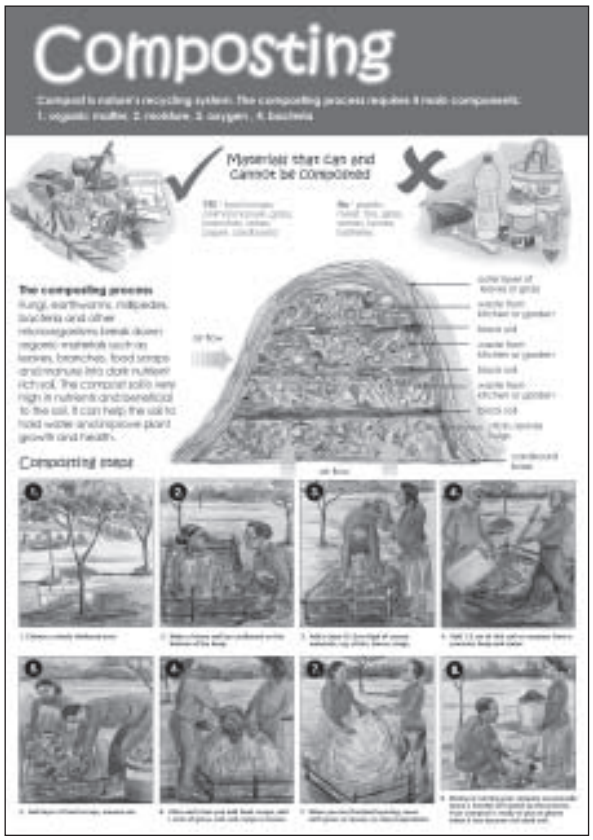
For additional information you can refer to the '*Green Club Manual*' or the Composting poster which is in the Toolbox.

Safety precautions

For health reasons, it is very important to take the following precautions when handling compost or soil:

- Wash your hands after handling compost or soil materials.
- Protect broken skin by wearing gloves.
- Avoid confined spaces for handling compost or soil materials.
- Keep compost moist to prevent the spores or bacteria in compost from becoming airborne.
- Gently add water to dry compost to allow dust-free handling.
- Avoid direct inhalation of dry compost.

The focus of this topic is on issues associated with the creation of waste, especially those related to packaging. They explore ways of making conscious decisions about ways to reduce, reuse and recycle waste and learn about how to compost waste. The Toolbox contains composting and waste management posters.



The Composting and RRR (reduce, reuse, recycle) posters can be found in the Toolbox.

Waste Management: Activities

What you will need for this unit

- Toolbox: seedlings (students can bring seeds from home when these run out)
- Soil
- Cooking oil
- Salt
- Detergent
- Plastic containers
- Rulers
- Toolbox: magnifying glasses
- Toolbox: measuring equipment such as measuring jugs and cups
- Toolbox: eyedroppers
- Toolbox: measuring spoons
- Waste cards - with different types of waste written on these
- A range of packaging types from everyday products (enough for each student or pairs) e.g.; cardboard, plastic bags, jars, bottles - plastic and glass, boxes, tins
- Three ropes, or lengths of string (large enough to form a circle with a one meter diameter)
- Plastic drink bottles (1 - 2 litre size)
- Toolbox: scissors
- Materials suitable for creating a compost heap such as twigs, leaves, grass clippings, fruit peelings, vegetable skins etc.
- Soil
- Pencils
- Paper

Curriculum links:

This unit is suitable for Grade 3 students to link with the unit in the Science Textbooks on 'Impact of living things on the Environment'.

Even though this was written for Grade 3, it can be used in a flexible way with other grade levels.

You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.

The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activities provide a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Activity 1: How much waste do we make?

This activity may also be adapted to suit any grade. This difference will be the degree of detail in the type and quantity of information and data that is collected. In the lower grades it may be conducted as a class activity with discussion, whereas in the upper grades, students can take full responsibility for gathering the data and information.

Curriculum links: cleanliness, materials, grouping and classifying materials, properties, classifying materials.

Time: 2 x 40 minutes

Purpose:

- To conduct a visual audit of waste/rubbish at school and home to determine the type, quantity and location of waste. Students classify the waste into biodegradable and non-biodegradable and consider the impacts waste/rubbish have on the environment. Biodegradable means that the natural processes of living organisms can break down the material into their natural components. Non-biodegradable materials are not affected by these natural processes.

What you need:

- Pencils
- Paper

What to do:

1. Introduce the activity by asking students to think about what happens to waste/rubbish at home and school asking questions such as:
    - What types of things do you dispose of regularly in your rubbish?
    - Is there a system for disposing of waste?
    - Are there similarities between home and school?
    - Where does our waste end up?
2. Students draw pictures showing types of waste/rubbish and what is done with it and where they think it ends up.
3. Explain to the students that they will be conducting an audit to identify different types of waste/rubbish/ at school, and on the way to and from school and waste/rubbish at home. To do this, students will need to develop a way of recording their findings. As a class discuss and decide on the best way to record audit information on the types of waste/ rubbish, where it is found and the quantity. A simple column table is appropriate. They will need two tables for collecting data - one for school and one for a home.
4. Students conduct the audit at school. They can do the audit in pairs. Collate student results and create a class table of waste/rubbish in the school compound. Analyse the results using questions such as:
    - What is the most common type of waste/rubbish?
    - Where was the most rubbish found? Why do they think that that part of the school

compound has the most rubbish?

- How do they think the waste/rubbish gets there?
- Where do you think it will end up?

5. Waste can be classified as biodegradable and non-biodegradable. Students are asked to look at the types of waste/rubbish they identified and group the different types into biodegradable and non-biodegradable. This could be done by putting a code (B = Biodegradable wastes, NB = Non-biodegradable wastes) next to each waste/rubbish type. Ask students these questions:

   - Which type of waste/rubbish has the most?
   - Why do you think this has happened?

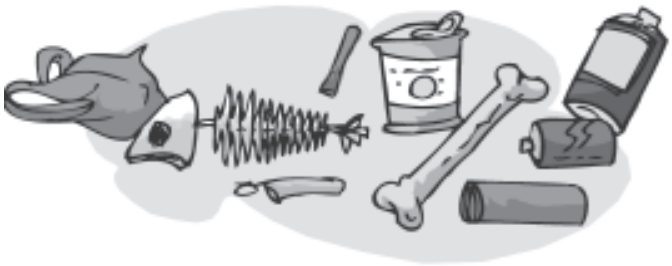
Biodegradable wastes decompose into soil.

- Biodegradable means that natural processes can break down the material into their natural components. E.g.:Wood
- Kitchen food scraps
- Garden waste
- Paper and egg shells
- Human and animal waste
- Cardboard boxes

Non-biodegradable wastes take a long time or never decompose.

Non-biodegradable materials would not be affected by natural processes that would break the material down. E.g.:

- metal cans
- bottles
- toxic chemicals
- plastic products
- metal scraps



6. Organise students into small groups. Explain that half of the groups will be creating a poster showing the different types of Biodegradable wastes and the other groups will be creating a poster showing the different types of Non-biodegradable wastes. Each group should discuss how this type of waste is impacting on the environment.

7. Refer students back to their original pictures about waste at home and school and compare these with their waste audit findings - What is the same? What is different to their original thoughts?

Assessment tip for the teacher:

Assess accuracy of data collection and interpretation.

Activity 2: Reduce, Reuse, Recycle

This activity may also be adapted to suit any grade. This difference will be the degree of detail in the type and quantity of information and data that is collected. In the lower grades it may be conducted as a class activity with discussion, whereas in the upper grades students can take full responsibility for gathering the data and information.

Curriculum links: cleanliness, grouping and classifying of the properties of materials.

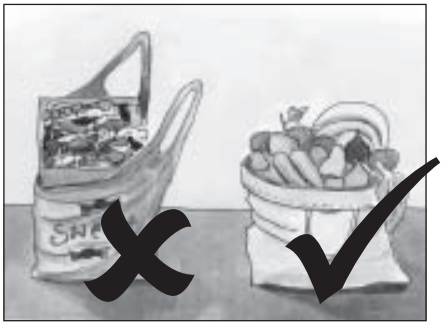
Time: 40 minutes

Purpose:

- To introduce the 3Rs - **R**educe, **R**euse, **R**ecycle as a way of managing waste.

What you need:

- Toolbox: **R**educe, **R**euse, **R**ecycle poster
- A range of packaging types from everyday products (enough for each student or pairs) e.g.; cardboard, plastic bags, jars, bottles - plastic and glass, boxes, tins)
- Three ropes or lengths of string (large enough to form a circle with a one meter diameter

Reduce Look for ways of producing less waste.		• Shop more carefully by choosing products that have minimal packaging, which can be used productively or recycled. • Think about how shopping is brought home e.g.; cloth or woven bag.
Reuse Re-use containers, packaging or waste products.		• Reuse empty glass jars again for something else. • Use small, empty plastic soft drink bottles as drink bottles for school or outings.
Recycle Recycling means that a waste product is returned to a factory where it is remade into either the same product or something different. It can also include composting.		• Take products that can be recycled to a collection site.

What to do:

1. Introduce the activity by holding up a few items and asking students why they think that the packaging type has been used for that product. Ask them what they think happens to the packaging once the product has been used.
2. Show the students the RRR poster and explain what is meant by the 3Rs as a way of managing waste.
3. Form the three ropes into circles (this activity could be done outside if more space is needed). Explain to the class that they are going to sort the packaging according to how the waste from the packaging can be managed using the actions of the 3Rs. One circle will be for reduce, one for reuse and one for recycle.
4. Position the students around the three circles. Each packaging example is held up and a decision is made as to which of the 3Rs is a way or the best way of dealing with the waste from the packaging. Students will need to decide what to do if the packaging will fit in more than one circle, which may mean that there is overlap.
5. Tally the results of the 3Rs classification. Which is the most common form of packaging? Which of the 3Rs is most popular for managing waste? Why?
6. Get each student to identify one type of packaging that they or their family use frequently. Ask the students to draw the packaging in their exercise books and describe why the packaging is important for that product. Ask them to indicate how they could use one or more of the 3Rs as ways to manage the waste.

Activity 3: Turning waste into compost

You may lead a whole class activity or students may do it individually.

Curriculum links: - living things and their environment, changes over time, survival of living things

Time: 40 minutes

Purpose:

- To learn about making a compost heap by making a model. Students consider the value of composting as way of managing waste.

What you need:

- Plastic drink bottles (1 - 2 litre size)
- Toolbox: scissors
- Materials suitable for creating a compost heap such as twigs, leaves, grass clippings, fruit peelings, vegetable skins etc.
- soil

What to do:

1. Introduce the idea of a compost heap by showing students the poster of a compost heap. This can be found in the Toolbox. Students are asked what they know about composting.
2. Students are organized into groups of approximately four.
3. Students will now make a model of a compost heap using the following instructions.

Instructions for making a model compost heap

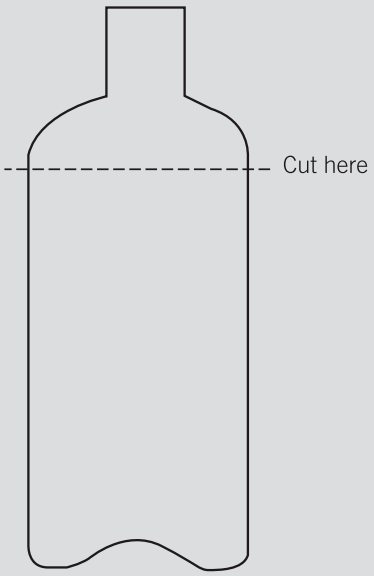
In order to assist students to understand how a compost heap is constructed they will make a model of one.

Explain to the students that they will be making a model of a compost heap using information in Compost heap information. Groups or individuals may make the model compost heaps.

Students use a clear plastic container with the neck area removed to make it straight sided. The container will need to be large enough for holding compost materials for instance a 1 or 2 litre liquid container. Students could be asked to bring their own plastic bottle from home. If clear containers are not available cut one face from a container and attach clear material in its place. The important aspect of this activity is to highlight the layers of a compost heap.

Have available a variety of materials suitable for creating a compost heap such as twigs, leaves, grass clippings etc.

Organic materials such as twigs, grass, banana leaves, clear plastic containers with neck and shoulder removed so that it has straight sides.



For the layers of the model compost heap which involve food scraps and other organic materials ask students to draw, color and cut out the examples for instances fruit peel, vegetable skin. These can be placed in the model so that they are visible.

Instruct students to label their model indicating what is in the various layers.

Students should develop an information sheet for maintaining the compost heap to accompany their model. Store the models in a dark place to allow for material in the containers to decompose.

4. Students can monitor what happens to model compost heaps over a number of days and weeks.
5. As a class, discuss the value of having a compost heap as a way of reducing waste and helping the environment e.g.; what food do families currently throw away that could be composted and used in gardens to improve soil. Students may plan to build a compost heap at home.

Activity 4: Impacts of waste on the environment

Curriculum links: - Effects of adaptation on survival of living things, adaptation and survival of living things

Time: 30 - 40 minutes

Purpose:

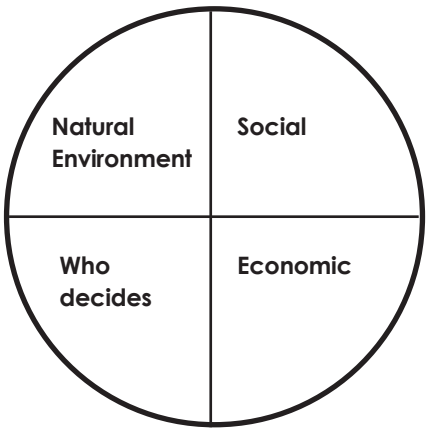
- To discuss and propose solutions to managing common waste.

What you need:

- A sheet of cardboard or paper for each group divided into four sections (see diagram below).
- Waste cards - make these by writing the names below on pieces of paper or cardboard.
- Bottle top and match (to make a spinner, use a metal bottle top, punch a hole in it using a nail, and then push the match through the hole).

Waste cards required:

- newspapers
- plastic bags
- soft drink bottles
- cardboard boxes
- wrappers and other packaging
- paper
- aluminum cans
- egg carton
- plastic containers of any types that are waste
- oils containers of different types
- clear cordial & juice bottles
- steel can
- plastic bottles
- detergent bottles
- aerosol can



Example of the Waste Issues sheet

Steps:

Divide students into group. Tell students to mark their paper with the following 4 sections. See example above.

Natural environment - In what ways does this waste harm our natural environment?

Social - What is the impact on the way people live because of this waste?

Who decides - Who can make decisions to change the situation? What can be done?

Economic - What is the cost (money, selling, buying) to our community of the waste.

What to do:

1. Introduce the activity by explaining to the students that they are going to play a decision making game about waste in Eritrea. They will be using a set of *Waste cards* and the *spinner* (made by putting a match through the bottle top) to consider the impact of waste on the environment.
2. Students will need to be in small groups. Each group member takes it in turns to take a card. Then the student spins the bottle top, on the Waste Issues sheet, to see which segment they land on. They then respond to the question asked.
3. Groups take as many turns as they wish in a period of time.
4. As a class, discuss and list key ideas students thought about for each of the four focus areas of the Waste Issues Sheet.
5. Develop possible solutions for protecting the environment from the different types of waste on the cards.

Activity 5: How waste affects plant growth

This activity may be adapted to suit any grade. You may lead a whole class activity or students may do it individually.

Curriculum links: Living things and their environment. Effects of adaptation on survival of living things, adaptation and survival of living things.

Time: 2 X 40 minutes

Purpose:

- To investigate and compare the effect of water pollution and compost on plant growth.

What you need:

- Toolbox: seedlings
- Soil
- Cooking oil (students can bring from home)
- Salt
- Detergent (students can bring from home)
- Plastic containers
- Rulers
- Toolbox: measuring equipment such as measuring jugs and cups
- Toolbox: measuring spoons

What to do:

1. To begin this activity ask the students what conditions plants need to grow into healthy adult plants? (sunlight, soil, nutrients and water) list the ideas on the board.

2. Explain to the students that the task will be to conduct an investigation into conditions needed for growing plants. The focus of this investigation will be about issues associated with plant growth and survival when plants are trying to grow in polluted conditions which are a result of humans not managing their waste effectively. Ask students why they think it is important to investigate what is needed for the growth of healthy plants?

3. To conduct this investigation, students will need to first plan their investigation. They will have salt, cooking oil and detergent or any other kitchen item that is known to be a water pollutant. Students will use the Science investigation planner (see next page) to plan their investigation. As a class go through the planner and discuss what could go in the boxes in the planner.

Planning their investigation.

The most important aspect of planning a science investigation is that the idea of a fair test which means that only one thing is changed. In the case of this investigation it will be the pollutant. You will need to decide on the ratio of pollutant to water e.g.; 1 tablespoon of salt in 150 ml of water, 2 teaspoons of cooking oil in 100 mls of water, 1 tablespoon of detergent In 150ml of water

A class discussion should take place about:

- The different ways data can be collected and recorded e.g.: tables, measuring
- The need for accuracy of data collection and recording
- How the data will be collected – regularly, at the same time and why this is important if working scientifically.

4. When the Science investigation planners are completed, students plant the seedlings in soil in containers brought from home or similar (remember to make holes in the bottom for drainage).

5. After a period of time and changes have occurred in the plants, students analyse and interpret their data. Students are asked to consider the following questions:

    - What did this experiment tell them about the effect of pollutants on healthy plant growth?
    - How could this knowledge be used by the community?
    - What measures can be taken to prevent bad waste management which causes polluted water and soil?

Science investigation planner

1. Ask students to draw this table in their exercise books.

<table>
<tr><td colspan="3">Student name:

Other members of team:</td></tr>
<tr><td colspan="2">What are you going to investigate?</td><td>What do you think will happen?
Explain why.</td></tr>
<tr><td colspan="3">Which variables are you going to:</td></tr>
<tr><td>Change?</td><td>Measure or observe?</td><td>Keep the same?</td></tr>
<tr><td colspan="2">Describe the conditions for your investigation.</td><td>What equipment will you need?</td></tr>
<tr><td colspan="3">Make a prediction about what will happen.
Results: Write and draw about your observations in your science journal.</td></tr>
</table>

Presenting my results

2. Ask students to draw a grid in their exercise books.

Can you show your results in a graph?									

Vertical axis - Height of plants growing.

Horizontal axis - Time the plant has been growing e.g. Day 1, Day 2.

Note for the Teacher:

The students will need to be supported to decide how to divide the vertical axis (up the side) into divisions so that each square is the same number of centimetres and their highest measurement is near the top of the graph.

The horizontal axis (across the bottom) is also divided into equal parts so that they can fit in all their recorded measurements.

Explaining my results

Ask students to draw this table in their exercise books.

Explaining my results	
What happened when you added (eg salt, detergent, oil) _____ to the water?	
Why did this happen?	Was your prediction accurate?
What problems did you have in doing this investigation?	How could you improve this investigation?

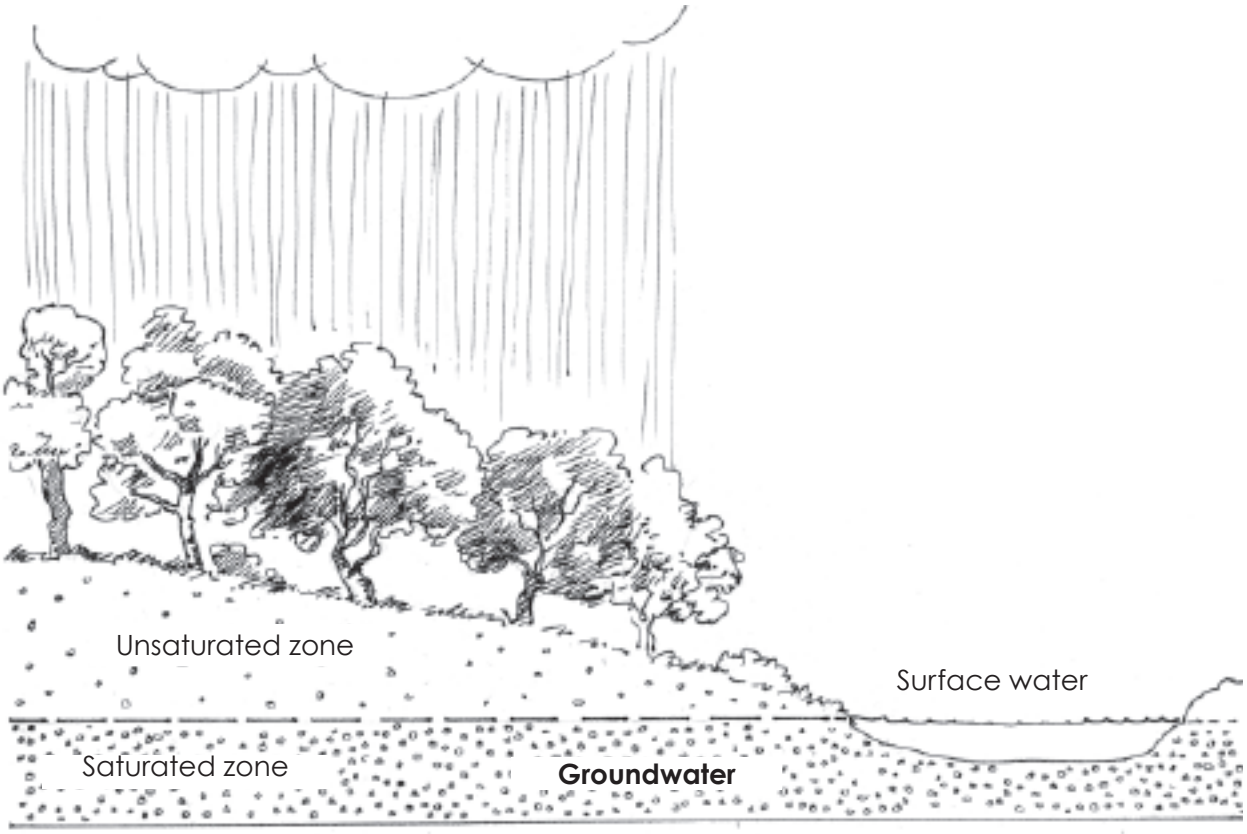
Grade 3

Water

Background information for teachers

Water is one of the basic building blocks of all life. It is also one of the basic ingredients of our weather. About 75% of the Earth's surface is covered by water. It is present in oceans, rivers, lakes, the polar ice caps, clouds, rain or snow, groundwater and living things such as plants and animals.

Eritrea is an arid and semi-arid country without ready access to a rich water supply. Furthermore being part of Sahelien Africa it has been the victim of recurrent and devastating droughts. The majority of the population depends on groundwater as its main water supply source.



Activity 1: Why is water important?

Curriculum Links: This activity is suitable for introducing the Grade 3 unit on 'Water'.

Time: 30 minutes

Purpose:

- To identify how water is used and why water is important.

What you need:

- Small container of water

What to do:

1. Draw a two column, two row table on the board with enough space to write in.

How water is used at school	How water is used at home
How water is used for livelihood	Other ideas

1. Ask students to discuss in pairs the different ways they think water is used in each of the categories. Collate student ideas for each category and tally how many different ways water is regularly used. Where is most water used?
2. Now ask students to think about where they think people are not being careful with water e.g.; throwing rubbish in water, wasting water, not being careful with how it is stored. Add their ideas in a different colour to show the different ideas.
3. As a class decide why everyone thinks water is important e.g.; for humans, animals, plants, the environment, communities, farmers.
4. Note: there is an opportunity to link the importance of water with hygiene e.g.; washing hands after going to the toilet.
5. Organise the students into a circle. If you have a large class you may need to make two or three circles. Show them the bottle of water. Explain that when each student is holding the bottle of water they will be saying something about the importance of water and/or why it should be looked after based on the class discussion. Provide an example to start it off e.g.; all plants need water to live, farmers use water to grow crops, we should be careful how much water we use.

Grade 4

Soil

Background information for teachers

All living things depend on the soil for life. Soil is very important for the survival of plants, humans and other animals. Without soil we could not grow food. With increasing world populations more food is needed to feed people. Knowing what is best for the soil is important if the best crops are to be grown. Plants are not only used for food but are also used to make fabrics and dyes, medicines and beauty products, fragrances, rubber and building materials, just to name a few.

It is important to understanding that soil cleans and stores the water we drink as well as providing a place to build houses, roads, schools and villages. Such understanding helps when making decisions about how the soil in the local area will be used for future projects.

Soil protects plant roots from exposure to the Sun's heat at the Earth's surface, soil filters pollution that comes from rain and water runoff from farms. Soil is used to build with and on, and soil is what plants need to grow and be supported while growing.

The purpose of this topic is to learn about soil and how important it is to look after soil for production of food and clean water. Through the activities in this topic students will use local soil to look at soil types, how soil filters water and consider why soil ecosystems are vital for good plant growth.

How is soil formed?

The different types of soil that form on earth are determined by five factors: Parent material, organisms, topography, climate and time.

1. **Parent Material-** Soil is formed when bedrock which is broken down by water, wind, or friction from other rocks or organic material, or deposits of soil occur from landslides or wind storms.
2. **Organisms**- Soil is also formed when organic matter (such as leaves and dead plants) decomposes and when animals in the soil change the chemistry of soil.
3. **Topography**- Where the soil is located on a landscape can affect how the climatic processes impact on it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not.

4. **Climate-** The parent material is broken down by heat, rain, ice, snow, wind, sunshine and other environmental forces and impacts on the speed of the soil formation processes.

5. **Time-** All of the above factors happen over time which is often hundreds or thousands of years.

Soils differ greatly from each other because of the way the five factors interact with each other and this will vary from one place to another. This means that soil in any place will have its own special characteristics. If you cut a section of the soil out of the ground it will be made up of layers called the soil horizon. The layers or horizons can vary in thickness depending on the location and it is these horizons which give the soil its unique profile.

Soil Fertility

Soil fertility is determined when and how each of the soil forming factors work together to make soil. Fertile soils have enough Nitrogen (N), Phosphorus (P), and Potassium (K), along with other nutrients for plants to grow well. Looking after soil is important so that it is fertile and healthy enough for good plant growth

Soil texture

Soil texture refers to the way a soil 'feels'. Soil is composed of mineral particles such as clays, silts, sands and gravels and organic materials. are names that describe the size of individual particles in the soil.

- **Sand** particles are the largest particles and they feel 'gritty.'
- **Silt** particles are medium sized particles, and they feel soft, silky or 'floury.'
- **Clay** particles are the smallest sized particles, and they feel 'sticky' and they are hard to squeeze.

What you will need for this unit

- Toolbox: small spades
- Toolbox: measuring spoons
- Toolbox: magnifying glasses
- Rulers
- Watering can (children to make from old plastic container)
- Cheese cloth or other fabric cut into small squares approximately 10cm X 10cm
- Toolbox: elastic bands different sizes
- Plastic cups or small container
- Cooking oil
- Toolbox: clock
- Toolbox: measuring cup 250ml
- Toolbox: measuring tape

Curriculum links:

This unit has been written for Grade 4 students and links with the unit on Soil in the Grade 4 Science Textbook.

Even though this was written for Grade 4, it can be used in a flexible way with other grade levels.

- You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.
- The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activities provide a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Activity 1: Discovering soil

This activity may be adapted to suit any grade. This difference will be the degree of detail in the type and quantity of discussion and information and data that is collected.

Teachers in the lower grades may choose to conduct this activity as a class activity with general discussion based on observations, whereas in the upper grades students work independently.

Curriculum links: living and non living things, looking for patterns, change in the surface of the earth, soil, mixtures

Time: 30 minutes

Purpose:

- To look at soil composition

What you need:

- Toolbox: small spades or trowel
- Soil from different parts of the school compound and other places (e.g.; brought from home)
- Water
- Jars with lids or reuse old plastic water bottles
- Spoon
- Toolbox: magnifying glasses
- Paper of any type

What to do:

To avoid mess it Is best to do this activity outside. This activity is best done in two parts over a few days.

1. Ask students to collect small amounts of soil from different parts of the schools yard. It is a good idea to get soil from a reasonable depth. Alternatively soil can be brought from home or other locations.

2. Ask students to fill a jar halfway with soil, then add water until nearly to the top of the jar and put on the lid securely.

3. Tell the students to shake the jar vigorously for a half a minute, and then set it down. Leave the jar to stand so that the soil and water can settle. The soil will need time to settle into layers. This may take some time and it would be best to do the next steps of the activity in a day or two.

4. Ask students to observe what has happened to the soil and water. Ask these questions:

   - How many layers are there?
   - Which layer is made of the biggest particles?
   - Which is made of the smallest?
   - Why do you think this has happened?

5. Get the students to draw a diagram of their jar and what they can observe.

   In order for students to examine the different layers in more detail, they will need to sort the layers of the soil out of the jar. To do this, students will follow this procedure:

   - Use a spoon to skim off anything floating in the water. Place these at the top of a piece of paper.
   - Carefully pour off the water on the top and scoop out the grains of the next layer and put these on the paper under what they skimmed off the top of the water. This way they will remember the order of the layers.
   - Repeat this process for any other layers in the jar.

6. After each layer has been placed onto the paper ask students to use a magnifying glass to examine the layers.

   - What do you observe about the different layers after further examination?
   - What are the key features of each layer?

   If soil from different parts of the yard or locations has been used ask students to compare their observations and discuss why differences or similarities may have happened.

7. Ask students to add additional information to the diagram of the soil layers in the jar based on this closer examination of the soil layers.

Activity 2: Looking at soil

You may choose to conduct this activity as a class activity or students can work independently.

Science: soil - components, use of soil

Time: 30 minutes

Purpose:

- To look at soil in the school compound and identify its texture using the ribbon method in order to determine the soil classes.

What you need:

- Soil from different parts of the school compound and other places (e.g.; brought from home)
- Water
- Ruler
- Toolbox: soil texture chart

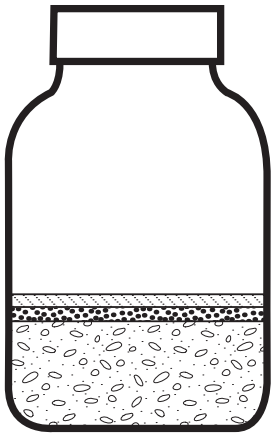
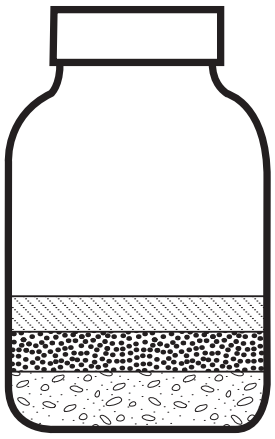
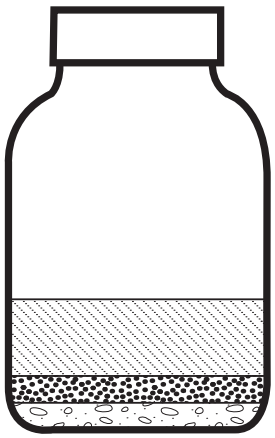
What to do:

This activity is best conducted outside in the school compound.

1. Begin by asking students how they think soil is formed. Explain that soil is composed of mineral particles such as clays, silts, sands and gravels and organic materials.
2. Ask students how they think soil could be classified. Students are shown the Soil Texture Chart. An example of this is on the next page.
3. Explain to the students that they are going to work out the texture of different soils by using the ribbon method. The ribbon method is used to determine the type of soil by seeing if moistened soil can be formed into ribbons (or lengths) without falling apart.
4. Tell the students to gather small amounts of soil from different parts of the school compound. They take a small handful of soil and gradually wet it until a ball of moist soil is formed in the hand.
5. Ask students to describe the feel of their moistened ball of soil. Then ask them to see if they can form a ribbon with their ball of soil by gently stretching the ball of soil out between their thumbs and forefingers. This may not always be possible, depending on the soil texture. Ask students to measure the length of any ribbons that could be formed.
6. Get the students to check the Soil texture chart. Ask them about the characteristics of each soil type? What soil class is your soil?
7. Students compare their results and discuss similarities and differences in results. See if they can offer explanations for different soil textures especially if soils are from different places other than the school compound?
8. Ask students why they think it might be important to know about different types of soil.

Soil texture chart

Soil structure affects the movement of air, water and plant roots through the soiil.

SOIL CLASS	SOIL CHARACTERISTIC
SANDY LOAM  **0-10% clay** **0-10% silt** **80-100% sand**	• Forms a ball • Feels gritty • Will not form a ribbon when pressed between thumb and index finger *Sandy soils are light and do not hold water well as have low organic content.*
LOAM  **10-30% clay** **30-50% silt** **25-50% sand**	• Feels soft, smooth and a little bit sticky • Easy to squeeze • Forms short ribbons of less than 2cm long *Loam soils are heavier than sandy soils but also do not hold water well, due to low organic content.*
CLAY  **50-100% clay** **0-45% silt** **0-45% sand**	• Feels extremely sticky and smooth when moist • Hard to squeeze • Easily forms a long ribbon more than 5cm long *Clay soils are heavy. Water takes a long time to infiltrate and tends to run-off.*

Activity 3: Soil erosion

You may choose to conduct this activity as a class activity or students can work independently.

Science: soil - components, use of soil

Time: 30 minutes

Purpose:

- To look at soil erosion and consider the consequences for the environment.

What you need:

- Soil from different parts of the school compound and other places (e.g.; brought from home)
- Leaf matter, grass clippings
- Water
- Watering can (children can make by putting holes in old plastic containers

What to do:

This activity is best conducted outside in the school compound.

1. Organize the students into small groups. Students dig soil from the school compound or use soil provided and form as tall a mound of soil as possible. They can include leaf matter in layers or on the top of their mound.
2. Students gently pour water over their mound of soil (simulating gentle rain) and observe what happens. What happens to the soil? What happens to the leaf matter?
3. Students then make a new mound with fresh soil. This time they quickly pour the water over their mound to simulate heavy rain. What happens to the soil? What happens to the leaf matter?
4. Each group of students draw two diagrams showing what happened in the two experiments.
5. Explain to the students that this activity shows how rain erodes soil. The groups discuss ideas for preventing erosion by water. They can add these ideas to their diagram. As a class, discuss the ideas e.g.: plant roots holding the soil together helps prevent erosion so planting trees helps the environment.
6. Ask the students if they think wind can cause soil erosion. What type of damage could it cause? What ideas do they have for helping reduce soil erosion caused by wind? Student groups draw their ideas.
7. Each group discusses the question:
   - What are some changes that might occur in the environment that could cause an increase in erosion?
8. Each group contributes their ideas to a class ideas bank. As a class decide which are preventable and suggest ideas for achieving these e.g.: deforestation - reduce the amount of forests being cut down.

Activity 4: Soil filter

You may choose to conduct this activity as a class activity or students can work independently.

Science: soil - components, how soil retains water, use of soil

Time: 40 minutes

Purpose:

- To investigate how soil filters water.

What you need:

- Toolbox: small spade or trowel
- Soil from different parts of the school compound and other places (e.g.; brought from home)
- Gravel, sand or similar
- Leaf matter
- Water
- Plastic bottles with the bottoms cut off (see diagram)
- Cotton or fabric cut into small squares approximately 10cm X 10cm
- Toolbox: elastic bands different sizes
- Plastic cup or small container
- Cooking oil (students to bring from home)
- Toolbox: clock
- Toolbox: measuring cup sets
- Toolbox: measuring spoons sets
- Paper and pencils

What to do:

This activity is best conducted outside in the school compound.

1. Organize the students into small groups. Each group will need a plastic 1 or 2 litre drink bottle that has had the base removed, some soil which students can dig from the school compound or have provided for them, cheese cloth square, elastic band, measuring cup, paper and pencils. Students can check the time on the class clock.

2. Explain to the students that they will be making a filter to test whether soil filters water. As a class discuss what they think about the idea of soil being a filter - is it possible? Ask each group to list some questions they would like to find out about soil as a filter.

3. Show the students how to make their filter using the diagrams.

4. Each group is asked to design their filter by deciding on the types and quantities of materials they will use in their soil filter. They will record the quantities of each material e.g.; 1 cup of soil, 1/4 cup of gravel, 1/2 cup of leaf litter and draw a diagram of the filter with the order that the materials. Each group then 'flush' their filter first with 250 ml of water.

Making a filter using soil, gravel and leaf litter.

Tell each group to mix 200 ml water with 50 ml of oil to a total quantity of 250 ml. Then tell them to pour the mixture through the soil filter. At the end of the experiment students will be able to compare their filter's results with other groups as the difference will be the filter.

5. Each group is asked to write down a question they would like answered by doing this experiment e.g.: How quickly does it take for the liquid to pass through the filter? How much of the liquid passes through and how much is absorbed by the filter? Does the water that passed through the filter contain any oil?

   The group will need to organise any other equipment they may need to answer their question e.g.: ruler, stop watch including a container to catch the filtered liquid. They also need to decide on how they will record their results.

6. Groups conduct their experiment and record their results in their exercise books or on paper.

7. Each group shares their filter design, question and results with class. These questions are written up for groups to discuss:

   - Why do you think the water moved through the materials at different speeds?
   - Why do you think that materials filter differently?
   - What does it mean for humans knowing that soil works as filter trapping materials? Is this good or can it be a problem? What can be good about this? What can be bad?

8. Share group thoughts in a class discussion about the importance of soil as a filter.

Assessment tip for the teacher

You might like to assess student accuracy in measuring and using correct measurement units when recording experiment data.

Activity 5: Soil ecosystem

This activity may be adapted to suit any grade. The difference will be the degree of detail in the type and quantity of discussion and information and data that is collected.

Teachers in the lower grades may choose to conduct this activity as a class activity with general discussion based on observations, whereas in the upper grades students work independently.

Curriculum links: living and non-living things, living things and their environment, around us, soil, effects of adaptation on survival of living things, adaptation and survival of living things.

Time: 30 minutes

Purpose:

- To conduct a close examination of soil to develop an understanding of the soil ecosystem.

What you need:

- Toolbox: measuring tape
- Toolbox: small spades or trowels
- Toolbox: magnifying glasses
- Paper
- Pencils

What to do:

1. Organise the students into small groups of 5-6.
2. Ask each group to measure a square meter of the school compound and mark it by scratching the perimeter with a stick, laying sticks around the perimeter or some similar method. Note: some school compounds may not have a lot of diversity within them and you might want to as the students to measure a larger area.
3. Get the students to carefully observe the soil using general observation and magnifying glass looking for living and non-living things including:
    - Specific creatures
    - Analysing the soil for different particles (see Activity 2: Looking at soil)
    - Evidence of impact of weather, humans and any other activity
4. Have the students record their observations by drawing pictures of what they observed, naming and labeling if possible and recording numbers any creatures.

The teacher explains to students that scientists use observation skills to identify all aspects of their work. This means carefully looking at what they are observing and recording all details exactly such as colour, size, where it was, and seen, number, name if known.

5. Give each group the same size square of paper and get the students to record their findings. Ask them to note the location of their square e.g.; front of school compound near the gate and what was found. Have groups place their squares next to each other according to where they were located. This creates a diagram of all the square meters which shows what was found.

Examples of outdoor observations:

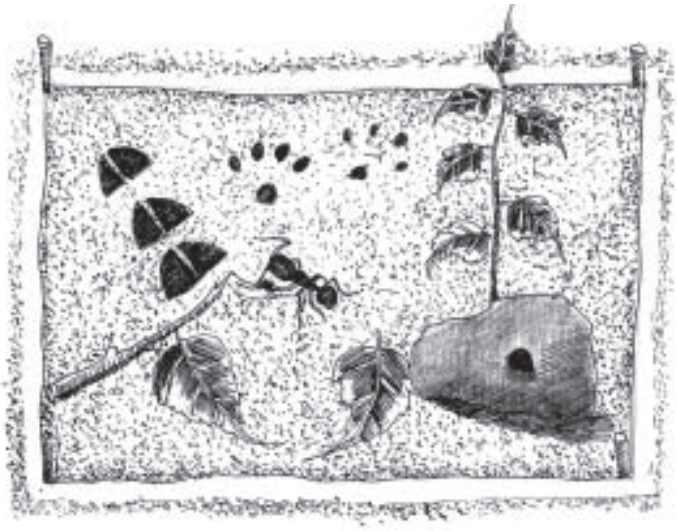
1. **Soil observation: soil -** black sand, red and black pebbles, 3 large red stones with black spots 20mm in width.
2. **Plants:** 20 dead leaves from tree unknown.
3. **Other Living things (animal prints, insects etc.):** 35 large ants with red pincers.
4. **Location:** front of school compound near the gate.

1. **Soil observation:** soil very pressed down, sand on top.
2. **Plants:** 2 living plants - weeds, 8 green leaves 20cm long.
3. **Other Living things (animal prints, insects etc.):** 6 animal footprints.
4. **Location:** Near pathway into classrooms.

6. As a class collate findings. What were the most common things found in the square meters? Discuss the impact of location on what was observed - were there places where there was more living things observed than others?
7. Students discuss in their groups how the living things survive in that square meter - what do they eat? What makes some square meters have more living things than others? What is the impact of humans on their square meter?
8. Each group develops a way of looking after their square meter to improve the likelihood of living things surviving.

Assessment tip for the teacher

Students can be assessed for their observation skills and ability to record accurately.



Grade 5

Renewable energy

Background information for teachers

Energy is needed for anything to be able to work. Energy comes in many different forms and is essential for everything we do.

There are two forms of energy: renewable and non-renewable.

Renewable energy comes from natural sources that can be replaced and used over and over again without harming the environment. The five most used renewable energy sources include solar energy (from the sun), hydropower (from water), wind power (from the wind), geothermal energy (created by underground steam) and biomass energy (e.g. Wood and wood waste, landfill gases at rubbish tips). Renewable energy is also known as 'green' energy because it will not run out and does not give out greenhouse gases which are contributing to global warming.

Non-renewable energy comes from sources that cannot be replenished in a short period of time. Once they are used up, they cannot be replaced. Most energy used by humans is from this type of energy which includes fossil fuels - oil, natural gas and coal. They are called fossil fuels because they were formed by pressure and heat from the Earth's core on the remains of fossils of dead plants and animals over many millions of years.

Solar panels to operate a pump and a solar cooker to heat food.

Renewable energy

Solar energy

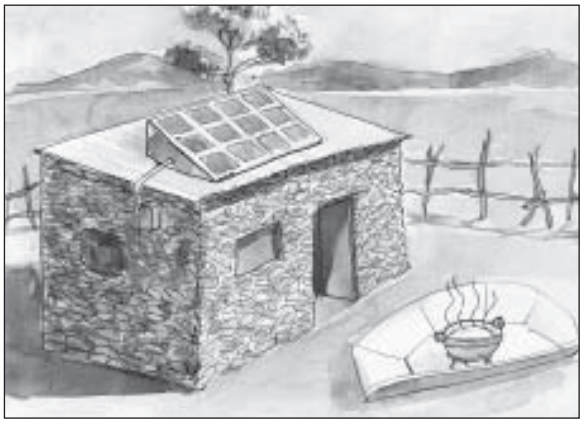
Solar energy is the sun's rays (solar radiation) that reach the earth. The sun is the main source of energy and plants need sunlight to make them grow. Animals gain energy from what they eat or drink. The sun has produced this energy for billions of years. Solar energy can be converted into other forms of energy, such as heat and electricity.

Electricity made using the sun changes sunlight directly into electricity using solar cells or photovoltaic cells (PV cells). Solar cells can be used when you are not connected to the electric grid.

Thermal energy can be used to cook food using a thermal collector box (a device that absorbs sunlight to collect heat). A thermal collector used to cook with is called a Solar Cooker (there is a solar cooker in the Toolbox). Thermal (heat) energy can also be used to heat water or heat spaces like buildings. Solar heating of spaces is passive or active. When no mechanical equipment is used for solar heating it is called passive space heating whereas active solar heating collects solar radiation using solar cells and fans and pumps are used to circulate the warm air or liquid.

Passive solar heating

Buildings can be designed for passive solar heating, and do not need a solar collector. Passive solar heating uses the sun to shine into the building to warm it up. The walls and floors are made with materials that absorb and store the sun's heat, and they heat up during the day and release the heat at night. Building designs make sure that the longest walls run east to west, to allow more sunlight to enter in winter than in summer, with shades and overhangs to reduce summer heat. With this knowledge buildings in very hot regions can be designed to keep them cool by reducing that opportunity for passive solar heating.



Why use solar energy?

Energy from the sun is renewable, costs nothing and its supply is unlimited. It is environmentally safe as it produces no greenhouse gases.

The problem with using solar energy is that amount of sunlight that arrives at the Earth's surface is not constant. It depends on location, time of day, time of year, and weather conditions and solar collectors can be expensive.

Wind energy

Wind is moving air. It is created when the sun heats the air and it rises. Cooler air moves in to replace it and this causes wind.

Over a very long time people have learned to harness the wind's energy and used it to help them. Sailing boats use the energy of the wind to help them move through the water. Windmills are used in many countries to capture the wind's energy. The moving sails or blades of the windmill are connected to wheels that turn to operate machinery. Different types of machinery can be used to do different jobs like grinding grains into flour or to pump the water from place to place to help irrigate the land.

Like the sun, wind can also be used to create electricity. The energy from turning windmills can be used to drive turbines which generate electricity. Wind energy is useful for making electricity because it is a renewable resource and does not create pollution or cause damage to the environment.



Examples of renewable energy sources: windmill, geothermal energy, cooking using dung and wood.

Why use wind energy?

Energy for the wind is renewable and won't run out. It is environmentally safe because it does produce greenhouse gases.

The problem with wind energy is that the speed of the wind changes and sometimes there is no wind at all and sometimes wildlife can be harmed if they fly into the windmills or turbines.

The activities in this topic are designed for students to learn about solar and wind energy and consider how they could be used in Eritrea.

Geothermal

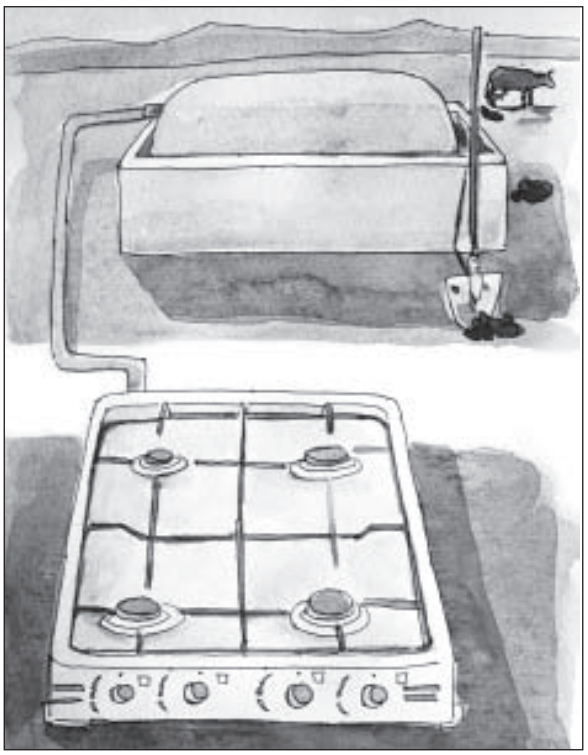
Geothermal power uses the heat that comes from deep rocks under the surface of the Earth. Hot water or steam that comes from deep within our planet can be used to make electricity.

Hydro-electric

Hydro-electricity is generated from running water. Water that is trapped in dams built across a lake or river in a valley flows through tunnels and turns turbines which make electricity.

Biomass

Biomass uses the energy from plants and waste materials to make electricity. Electricity can be made by using steam to turn turbines. The steam is made by burning wood or animal droppings.

Renewable energy sources: a water wheel and biogas (gas collected from decomposing animal manure).

Non-renewable energy

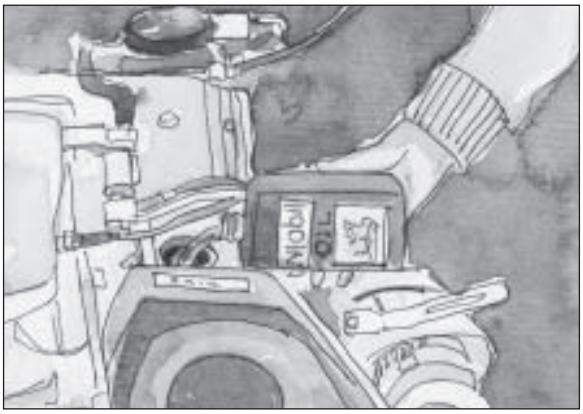
Oil & Gas

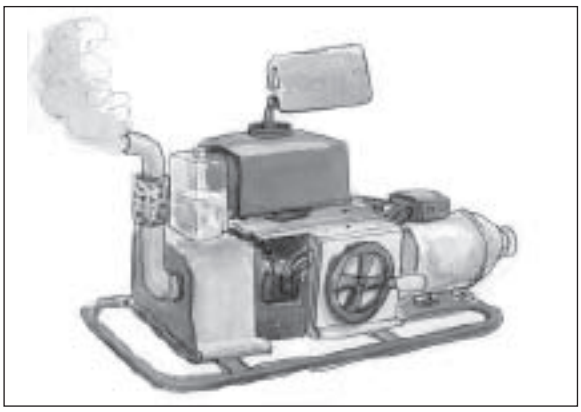
Oil and gas are fossil fuels. They were formed over millions of years when layers of tiny sea creatures and layers of sediment covered the sea creatures. They were crushed by the massive pressures and eventually turned to oil and gas. We burn oil and gas in power stations today.

Coal

Coal is a fossil fuel which was formed millions of years ago. When trees and plants die they become buried by many layers of clay, sand and rock. Over millions of years the layers have turned into coal which can be burnt to create energy.

Examples of non-renewable energy: petrol, kerosene and batteries, oil, gas, coal and diesel (to run a generator).





What you will need for this unit.

- Toolbox: solar cooker
- Toolbox: aluminium foil
- Toolbox: clear plastic bags - heat resistant
- Toolbox: paper clips
- Toolbox: plastic wrap
- Toolbox: masking tape
- Toolbox: measuring jugs and cups
- Toolbox: thermometers
- Toolbox: clock

Curriculum links:

This unit has been written for Grade 5 students and links with the unit on Renewable resources in the Grade 5 Science Student textbook.

Even though this unit was written for Grade 5, it can be used in a flexible way with other grade levels. You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.

The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activity provides a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Activity: Heat of the sun

Curriculum links: different changes, weather, physical properties of matter. This unit is suitable for Grade 1 students and links with the unit on 'Changes', specifically 'changes caused by heat' in the Grade 1 Science Student textbook.

Even though this was written for Grade 1, it can be used in a flexible way with other grade levels. By Grade 5 students should have more complex observations and be able to put forward ideas on why different surfaces absorb heat differently.

You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested. The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activity provides a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Time: 30 minutes

Purpose:

- To explore their surrounds and identify the impact of the sun on different surfaces in the school compound.

What you need:

- Exercise book or paper
- Pencils

What to do:

1. Take students outside into the school compound on a sunny day. Ask them to feel different surfaces that are in direct sunlight. Bring the students back together and discuss what they found by asking:
    - What did you notice when you felt different surfaces?
    - Were all surfaces the same? Why do you think some surfaces felt the same and others felt different?
    - What do you think is making the surface feel the way it does?
2 Explain to the class that they are going to try and work out why surfaces might feel different when in the sun. As a class decide on a rating scale for the degree of warmth for surfaces e.g.; cold (not warm), cool (some warmth), warm, very warm, hot (can't leave hand on it for any length of time).
3. Ask the students to list or draw a picture of surfaces (in the direct sun) in the school compound that they are going to rate using the rating scale they have decided on.
4. Ask the students to test and rate the surfaces.
5. After the class rates the surfaces using the rating scale, discuss why they think the surfaces are different when compared to one another. Prompt discussions by asking

questions such as:

- Are the surfaces in the direct sun for the same length of time? Can we rank how the surface feels with the amount of time it has been in the sun?
- Are the surfaces the same colour? Does colour have anything to do with the feel of the surface? (dark colours absorb heat and light colours reflect the sun's rays and a therefore cooler).

6. Repeat this activity with surfaces in the shade.
7. Compare the results of the surfaces in the direct sun with those from the shade. What factors are the same? What are different?
8. Ask students why they think surfaces feel different depending on the amount of time it is in the sun and what the surface is made of? How can knowing this information be useful to them and their family?

Activity 2: Solar cooker

Curriculum links: physical properties of matter, classifying materials, forms of energy, energy.

Purpose:

- To use solar cooker to test how the sun can be used to cook food.

What you need:

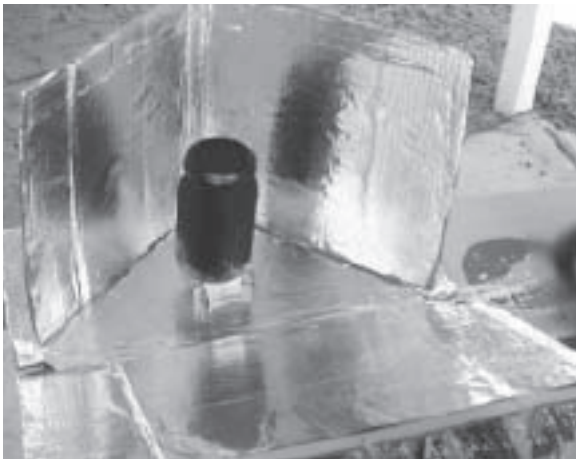
- Exercise book or paper
- Pencils
- cardboard boxes
- Toolbox: aluminium foil
- Toolbox: glue or tape
- Toolbox: rulers
- Toolbox: scissors
- Toolbox: black paper (or a black pot)
- Jar with a lid
- Water or food for cooking e.g. corn
- Heat proof gloves or thick fabric
- Toolbox: thermometer
- Toolbox: solar cooker
- Stones (to sit pot on)
- Toolbox: clock
- Toolbox: clear plastic heat resistant bags and string (to put the pot inside – creates an oven effect). Please reuse these after the class.

Safety note

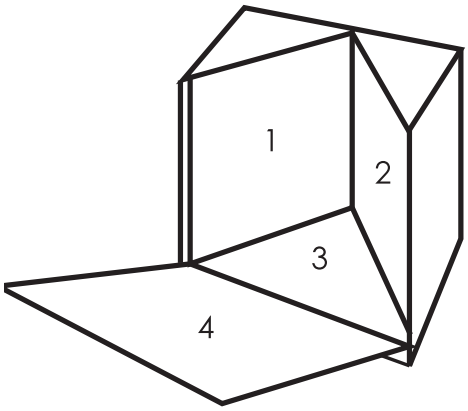
Solar cookers can heat food to a very high temperature so students should be cautious when handling anything to do with the cooker if it has been in the sun for some time. They should wear protective heat proof gloves or cover their hands with some thick cloth.

Solar cookers can cook just about any food that a conventional oven can. A basic cooker is an insulated box with a glass top. Heat from concentrated sunlight gets trapped in the box and can be used to heat food placed in the box.

Making the solar cooker



Faces 1, 2, 3, 4 all need to be covered with aluminium foil which is glued to the cardboard. A dark jar or black pot is used for cooking. The Reflective Open Box (ROB) in the photograph has the following over-all dimensions: Length: 46 cm, Width: 32 cm, and height: 42 cm.



What to do:

1. Explain to the students that they are going to make a solar cooker. They will design and make the cooker. Show them the pictures of possible designs (above). These are examples of a Reflective Open Box solar cooker (ROB).
2. Students will work in groups to design their cooker. They draw a plan with labels and measurements. As part of their plan they calculate the reflective area of the solar cooker. The dimensions using the dimensions suggested correspond to a reflective area of about 5,000 sq. cm.
3. Once they have designed their ROB solar cooker they make the cooker. They then plan what they will cook. Point out to all students that they will be using a blacked out jar or a black pot. Discuss why this is important (refer to Activity 1 about different surfaces and colors absorbing heat better than others).
4. As part of their experiment students should predict how long they think it will take for their cooker to:
   - get warm
   - reach a high temperature, and note what temperature they think it will get to
   - how long it will take until the food is cooked

Approximate time for cooking food:

Rice, fish, corn and chicken – 1-2 hours.

Potatoes, carrots, beans, lentils and meat – 3-4 hours.

Soups, hard beans, large piece of meat – 5-8 hours.

7. Create a class list of ways this type of cooking could be used in Eritrea and how it would help people and the environment.

Assessment tip for the teacher

You might like to assess student calculations of reflective area and accuracy of data collection. Plans could be assessed for detail and whether the finished cookers matched the plan dimensions.

Other suggestions:

- Assemble your cooker in the shade as the glare from the aluminum can hurt your eyes.
- Add only a little water to your food, if you add too much water it will take longer to cook.
- Make sure your food fits in the pot and the lid is on.
- Put your pot on stones or blocks of wood.
- Then put this all inside a clear / heat proof plastic bag. Fill this with some air and tie up. This creates an oven type situation and your food will cook quicker.
- You may need to move the cooker to follow the sun.

The benefits of solar cookers

- No smoke.
- No fire danger.
- You do not have to carry fuel long distances.
- Can be used easily to treat water for drinking – can reach temperatures up to 135 degrees celcius.
- Has economic benefits – e.g. don't have to buy fuel.
- Don't have to attend to the food – you just leave it.
- Saves cutting down trees!

Examples of solar cookers from Energy Research centre, Asmara.

Activity 3: Wind energy

Curriculum links: - forms of energy

Time: 45 minutes

Purpose:

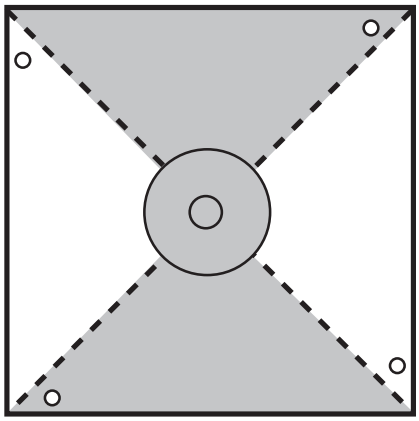
To make a pinwheel or turbine to test designs to decide which would be best for different wind speeds.

What you need:

- Exercise book or paper
- Pencils
- Pinwheel template
- Thick paper
- Recycled plastic drink bottle
- Ruler
- Scissors
- Pin or paper clip (open out paper clip)

What to do:

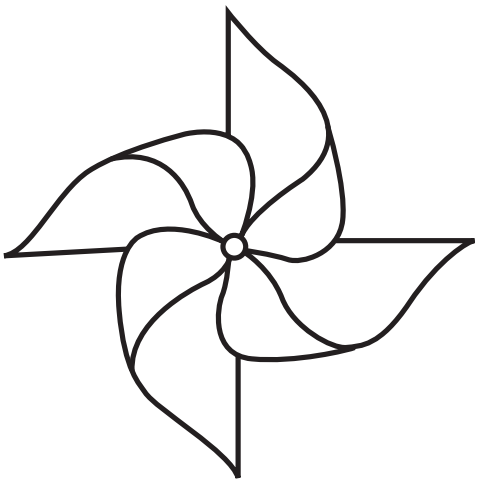
This activity can be done outside if the day is windy. You can choose to make a pinwheel or turbine or have some students doing each one as both will react to wind speed.



Instructions for making a pinwheel

Give the students the following instruction steps:

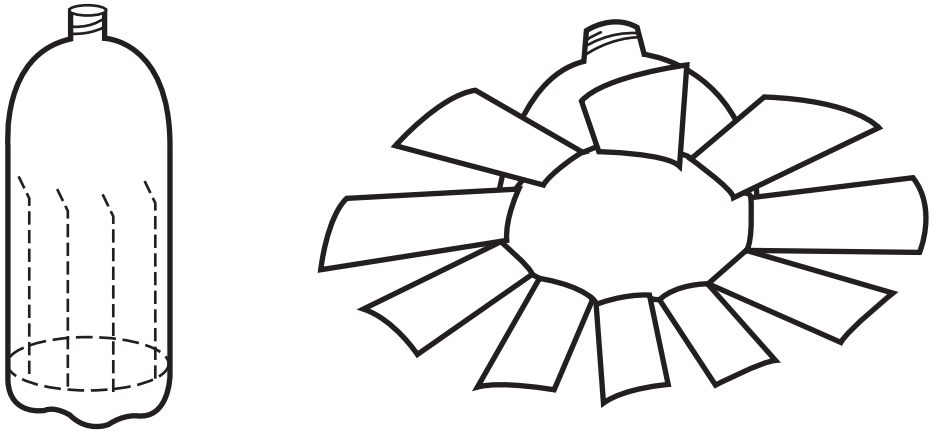
1. Cut out a square of paper (recycled paper is good - the heavier the paper the better, the results) with a side of 11 cm. Use the template to mark cutting and folding lines on the paper square.
2. Draw guidelines on the square and cut along the diagonal broken lines.
3. Make five small holes where indicated, then bend the paper to align the holes.
4. Pass a long needle or opened out paper clip through the five holes, then push the sharp end into a rubber.
5. If the weather is windy take students outside to test their pinwheel. If there is no wind, get several students to blow together to make the pinwheel turn.



6. Get students to count the number of revolutions per 10 seconds of the pinwheel, in different wind conditions. In strong winds It may not be possible to count Individual revolutions.

Instructions for making a turbine

- See turbine diagram below, for cutting lines
- Cut off the bottom of a recycled plastic drink bottle.
- Cut along the broken lines (as in the diagram) to make strips extending halfway along the bottle.
- Bend back the strips to form them into turbine blades.
- Put a peg, or your finger, into the mouth of the bottle.
- Hold the turbine blade outside in the breeze

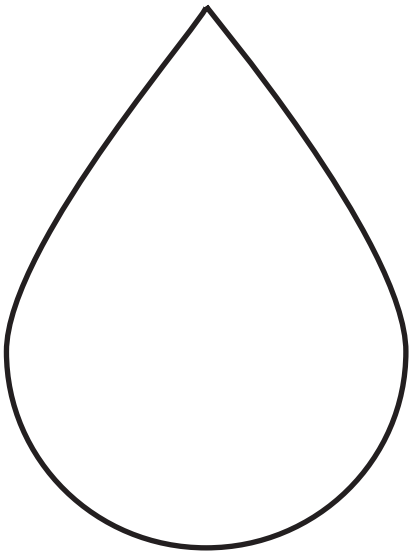


1. Provide students with materials to make a pinwheel or turbine.
2. Ask students to count the number of times the pinwheel or turbine turns in different wind strengths when outside or in different wind conditions. Ask them whether they can slow the speed of the pinwheel or turbine? Get them to collect data from their experiments. Discuss differences when blades are of different shapes and lengths. Which spins the fastest/ slowest?
3. Ask students how they think wind turning blades of a turbine or windmill could be used to turn something else to help their community e.g.; a windmill to crush corn, or pump water. Let them present their ideas and describe why this type of renewable energy could be good for their community.
4. Discuss whether there are any likely problems with using this type of renewable energy.

   Wind speed is important for wind energy. Wind turbines – which are the machines that change the movement of the wind into electricity – need a constant, average wind speed of about 14 kilometers per hour before the wind turbines can generate electricity. That's why wind farms, where there are a lot of wind turbines grouped together, are located in windy locations.

Grade 5

Water



Background information for teachers

Water is one of the basic building blocks of all life. It is also one of the basic ingredients of our weather. About 75% of the Earth's surface is covered by water. It is present in oceans, rivers, lakes, the polar ice caps, clouds, rain or snow, groundwater and living things such as plants and animals.

Eritrea is an arid and semi-arid country without ready access to a rich water supply. Furthermore being part of Sahelien Africa it has been the victim of recurrent and devastating droughts. The majority of the population depends on groundwater as its main water supply source.

In order to overcome domestic water supply scarcity there is an urgent need to use systems that harvest the rain water for use by households and the local community.

In this topic students explore the importance of water, learn about the water cycle and consider ways of harvesting water for use by members of school and the local community. A large scale example of harvesting water is building dams. The Eritrean government is supporting a very large number of dam building projects of various sizes. For more information on water harvesting from rooftops you can refer to the '*Healthy Schools Manual*'.

The water cycle

The Earth has a limited amount of water. There will never be any more freshwater on Earth than there is now. No new water is being made and water can't escape from the Earth. The water we use is recycled over and over again. The water cycle is the simplest natural cycle on Earth.

This cycle is made up of a few main parts:

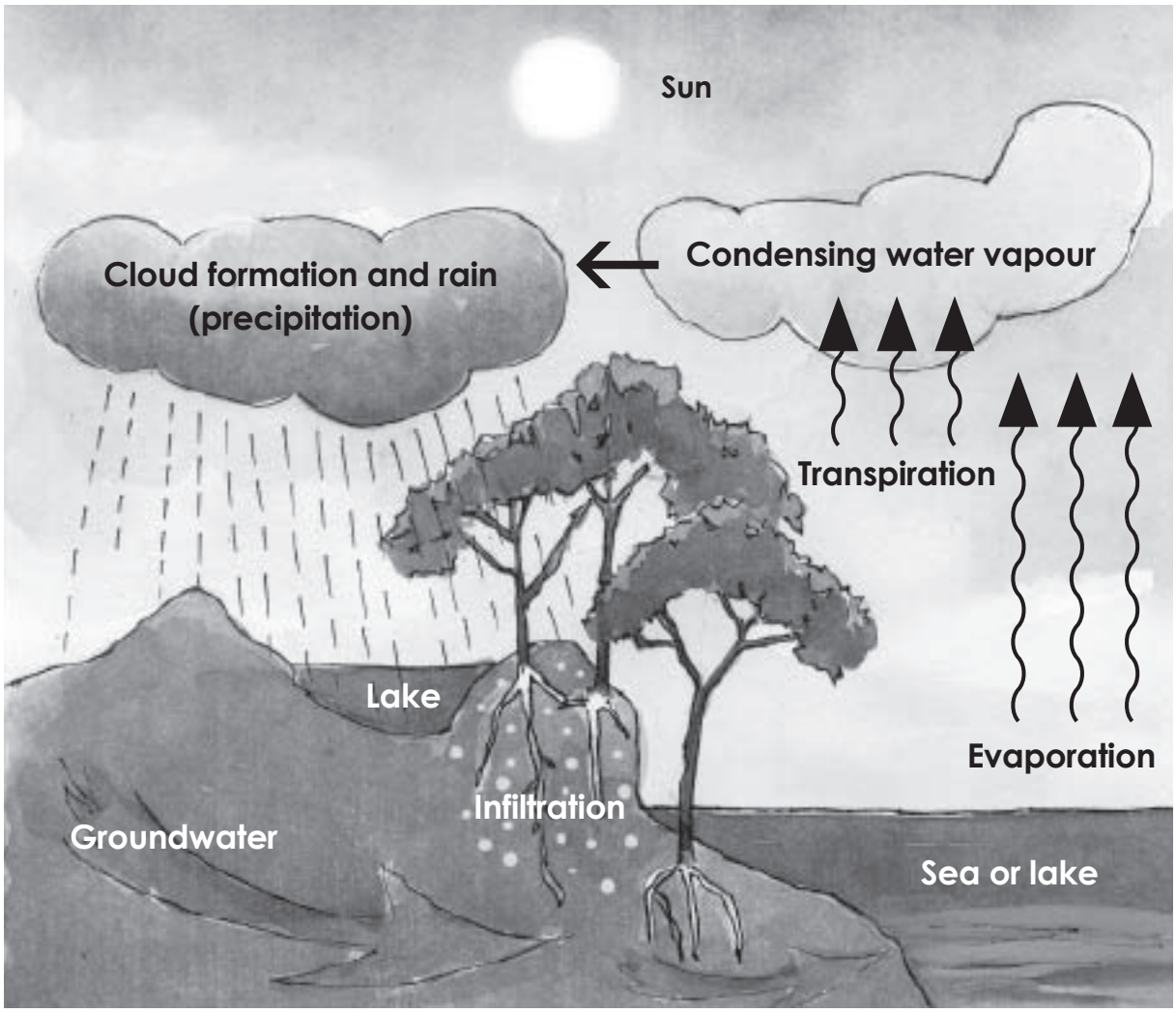
- Evaporation (and transpiration)
- Condensation
- Precipitation
- Collection

Evaporation:

Evaporation is when the sun heats up water in rivers or lakes or the ocean and millions of litres of water rise into the atmosphere as an invisible gas - water vapour.

Condensation:

As the water vapour is pushed over the land by winds and rises over mountains, the water vapour cools and turns back into tiny water droplets, forming clouds. The droplets joining together are called *condensation*.



Precipitation:

Precipitation occurs when so much water has condensed that the air cannot hold it anymore. The clouds get heavy and water falls back to the earth in the form of rain, hail, sleet or snow.

Collection:

When water falls back to earth as precipitation, it may fall back in the oceans, lakes or rivers or it may end up on land. When it ends up on land, it will either soak into the earth and become part of the 'groundwater' that plants and animals use to drink or it may run over the soil and collect in the oceans, lakes or rivers where the cycle starts all over again.

Curriculum Links:

Even though this unit was written for Grade 5, it can be used in a flexible way with other grade levels.

You may choose to demonstrate to the whole class or you may conduct the activity as a whole class rather than in groups where suggested.

The degree of detail in activity requirements e.g. discussions, drawings, diagrams will vary depending on the age of the students, however the activity provides a sound basis for a variety of grade levels and the curriculum requirements of those grade levels.

Activity 1: Water in the air?

Curriculum links: states of matter and the water cycle

Time: 2 x 40 minutes

Purpose:

- To develop an understanding of the water cycle and apply this knowledge to real situations.

What you need:

- Water cycle poster or water cycle image
- Large bowls or dishes brought from home
- Small bowls
- Shallow dish like a saucer
- Toolbox: plastic film
- Toolbox: masking tape
- Small stone
- Toolbox: measuring cups (1 cup capacity)
- Water

What to do:

1. Show a picture of the water cycle or draw a diagram on the board (see page 64 for example). As a class, discuss the water cycle as a simple natural cycle on Earth. Refer to the '*Backround information for teachers*' at the start of this unit to help explain the process.

2. Ask students if they can think of any way to prove that there is water in the air (water vapour). Explain to the students that they will conduct experiments to see if there is water vapour in the air.

Instructions for water vapour experiments

1. Pour some water into a large bowl and carefully place a small, empty bowl in the middle of the large bowl.

    - Cover the large bowl with plastic film. Place a small stone in the middle of the plastic film and position it over the inner bowl.
    - Leave the bowl in the sun and leave it there for some time. Observe and draw a picture of what is happening.
    - Students can measure the amount of water collected using a measuring cup.

2. Using a measuring cup, fill the cup to 200 ml mark with water. Carefully empty this water into a shallow dish or saucer and put it on a windowsill indoors.

    - Fill the measuring cup again with 200ml with water.
    - Stand it by the side of the saucer of water.
    - Observe and record what happens to the water after a day or so.
    - Measure how much water is left

3. The students draw labelled diagrams of their three experiments with space to record their observations next to the diagrams. Have them predict what might happen with the water in the experiments.

4. After students have collected the second set of measurements the students answer questions about their experiment and are challenged to link their ideas and explanations to the water cycle:

   - Why do you think you have collected water with the first experiment when an empty container is covered and put in the sun?
   - Compare the results of the two containers without covers? Why do you think this has happened?
   - What happened to the water?
   - What do you think would happen if we had covered the shallow dishes?

5. Ask students to think about the community especially grain and vegetable farmers. How could knowing about evaporation and condensation be used by farmers? Introduce the idea of **mulch** and ask them to explain how mulch is linked to the water cycle.

Mulching

Mulch is material that is used to cover the surface of a garden around plants. Mulching performs a variety of functions in the garden:

- Reduces moisture loss from the soil surface, thus aiding plant growth, and reducing the need to water. It also lessens the chance of the soil surface drying out and cracking.
- Suppresses weed growth, which reduces competition for water and nutrients, and decreases the amount of 'weeding time' the gardener has to put into maintenance.
- Many types of mulch add nutrients to the soil when broken down, and improve soil structure.
- Mulching also reduces run-off and soil movement from garden beds.

Mulch types

- Organic mulches breakdown and help improve the soil structure as well as add nutrients to the soil.
- Inorganic mulches such as pebbles, have no soil improving qualities, but will reduce moisture loss from soil.

6. Students can draw a picture showing the use of mulch in gardening and include an explanation of how it works in reducing water loss from the soil.

Activity 2: Garden with minimum water

Teacher background information

What's happening in the terrarium?

A terrarium is a small contained ecosystem. For an ecosystem to survive there must be micro-organisms in the soil and healthy plants.

A terrarium is like a small Earth and can show us how elements such as land, water, air, animals and plants interact and change together. It is a system, which is a group of elements that function together as a whole.

The survival of the plants and animals in this terrarium depends on the conditions inside the bottle. If the plants and animals can maintain their environment inside the bottle, they will be able to grow.

In a terrarium, the water cycle is easily observed. Terrariums recycle their moisture, so they rarely need to be watered, requiring almost no attention. Often, a closed terrarium can be left for a month or more between watering.

When the air in the terrarium warms, the water begins to evaporate from the soil. When the air cools, the moisture condenses on the walls and the top, and when enough water condenses and builds up, it 'rains' back down to the soil.

Plants are also part of the water cycle. Plants absorb water from the soil through their roots. This water moves up the stem to the leaves, where 90 percent is lost through the pores of the leaf. The loss of water through pores in the leaves is called transpiration.

Curriculum links:

Needs of living things, water cycle and minimising the use of water for plant growth.

Time: 2 x 40 minutes

Purpose:

To develop an understanding of transpiration and link this to the role it plays in the water cycle and consider implications for gardening using minimal water.

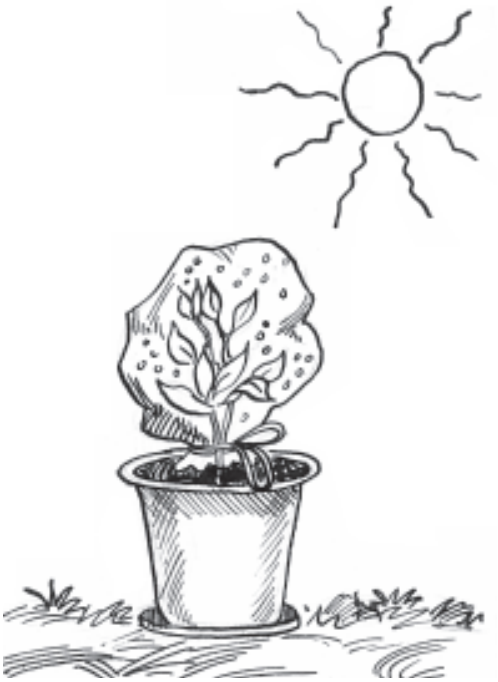
What you need:

- Plastic drink bottle with the top cut off
- Gravel
- Soil, sand or fine gravel
- Small plants
- A few worms
- Spoon and thin sticks or small spade
- Toolbox: clear plastic bags – 20 (please reuse these bags)
- String to tie bags

What to do:

The activities in Part A and Part B involve students setting up and then monitoring over a period of time. You may choose to do Part A or Part B only or both Part A and Part B.

Part A



1. Begin the lesson by asking the students if they think plants sweat. If the answer is yes, ask them how they think this happens? Does it have anything to do with the water cycle?

   People perspire (sweat) and plants transpire. Transpiration is the process by which plants lose water out of their leaves. Transpiration gives evaporation a bit of a hand in getting the water vapor back up into the air.

2. Ask students if they think there is a way to show that plants transpire. Explain that by putting a large plastic bag around the branch of a tree and sealing it carefully they will be able to see the water the plant is losing through transpiration. As a class go outside and find a number of trees, shrubs and plants with branches low to the ground. Secure the large plastic bags around a number of branches. It is a good idea to do this with a number of different plants in different locations to compare the results.

3. Ask the students to note the time and record their observation of the plastic covered branches. As a class decide on a roster for regularly making observations e.g.; when and where did the first signs of water vapour appear. Ask the students to describe exactly what they are observing over a period of time.

Part B

Part B may be a second lesson or a continuation of Part A.

1. Explain to the students that they will also be making a terrarium (a small contained ecosystem) which demonstrates the water cycle as a result of plant transpiration. Organise students in to small groups of approximately 4.

2. Provide each group with the instructions for making a terrarium and how to access the required materials.

3. When students have data collected from Part A and or part B, get them to describe through a labelled diagram what they observed. They should demonstrate links between plant transpiration and the water cycle.

4. When students understand that the plants are part of the water cycle ask them to consider are the implications for very dry countries like Eritrea. Such places have very high evaporation rates, causing many plants to die in dry conditions.

5. Challenge the students to design an evaporation minimizing system that would be environmentally friendly to help plant growth in Eritrea. Students can work in groups or individually for this task. An important aspect of this activity is for students to explain the features of their system and justify why they have included the feature.

6. Share the system designs as a class and decide which one the class considers would be the most useful for Eritrea. A part of the decision making process could Involve discussing things that could make the system to difficult to develop.

Instructions for making a terrarium

What you need:

- Plastic drink bottle with the top cut off (keep the top)
- Gravel
- Soil, sand or fine gravel
- Small plants
- A few worms
- Small spades

What to do:

1. Remove the label from your bottle. Cut the bottle about 1/4 the way down from the top of the bottle. Save the top section and the lid.
2. Place a layer of sand or fine gravel in the bottom of the bottle for drainage.
3. Using a spade, put the soil into the bottle and fill it until it is around 1/3 full.
4. Poke a hole in the soil with your finger or stick and add plants or seeds. Water the soil well.
5. Put in a few worms and other insects that help with decomposing.
6. Place the top of the bottle back on and seal with sticky tape.
7. Place your terrarium in a warm well lit spot. Make sure it is not in direct sunlight as it will be too hot.
8. Monitor the terrarium for need of watering (possibly once a month).

Grades 1-5

Biodiversity

Background information for teachers

What is biodiversity?

Biodiversity has been described as the 'web of life', 'the variety of living things' or 'the different plants, animals and micro-organisms, their genes and ecosystems of which they are a part'.

Biodiversity encompasses every living thing that exists on our planet and the environment in which they live. From the smallest one-cell microbe to the enormous majesty of the blue whale. From the depths of the ocean to peaks of the tallest mountains, biodiversity forms part of an intricate and interdependent web of life in which we are all a part.

Appropriate conservation and sustainable development strategies attempt to recognize this as being integral to any approach. Almost all cultures have in some way or form recognised the impact that nature, and its biological diversity has had upon them and the need to maintain it. Yet, human activity of all types has affected the important balance.

Why is biodiversity important?

Human beings are dependent for their food, health, well-being and enjoyment of life on biodiversity. We derive all of our food and many medicines and products from the wild and farmed components of biological diversity.

Preserving species and their habitats is important for ecosystems to self-sustain themselves.

Yet, the pressures to destroy habitat for wood, illegal hunting, and other challenges are making conservation a struggle. Rapid global warming can affect an ecosystems chances to adapt naturally.

Biodiversity boosts ecosystem productivity. Each species, no matter how small, has an important role to play. For example, a larger number of plant species means a greater variety of crops; greater diversity of species ensures natural sustainability for all life forms; and healthy ecosystems can better survive and recover from a variety of disasters.

Habitat, environment or ecosystem?

- An organism's habitat is the place where it lives (e.g. a desert, freshwater pond or a forest).
- Its environment is all the living and non-living features in its habitat which affect its survival.
- Its ecosystem is a system in which living organisms interact with each other and with the non-living parts of the environment.

Natural ecosystems

In natural ecosystems, matter is cycled with nutrients being returned to the environment. This is done by the action of decomposers. The matter is then ready for re-use by other organisms. Water, too is cycled.

Food Chains

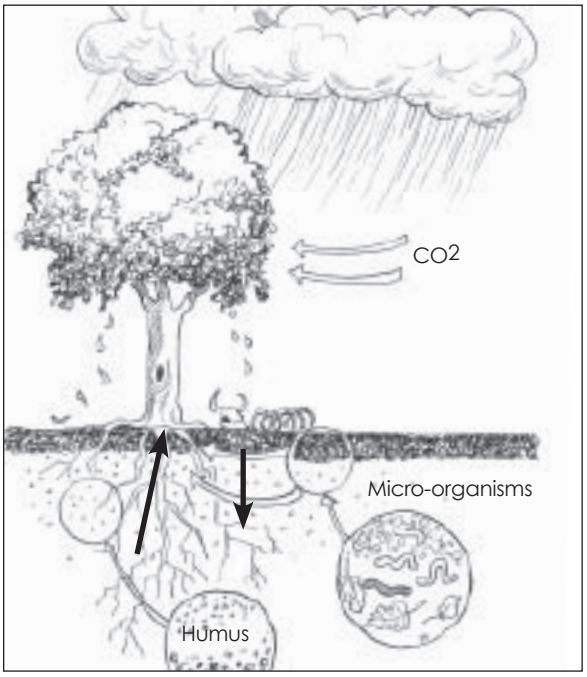
A food chain describes the way that the energy and nutrients required by living things pass from one living thing to the next. All food chains start with a *Producer* which can turn the Sun's energy into food. Most *Producers* are plants.

Food webs

A food web within an ecosystem shows how different food chains link together, since most animals eat more than one food type and are in turn food for more than one consumer.

An ecosystem

An ecosystem is not a static thing, but one in which components change through time. A pioneer ecosystem is a new ecosystem which develops after a major environmental incident such as fire, flood, drought or volcanic eruption which can destroy an area. Relatively soon, however, seeds will be carried in by wind, water or passing animals. Many will be unable to grow, but some simple plants may be able to germinate. As they grow they will perhaps change the nature of the soil and trap moisture so that other species can now also develop. Over time the organisms and environment change until finally the mature ecosystem is produced.



Producers and decomposers

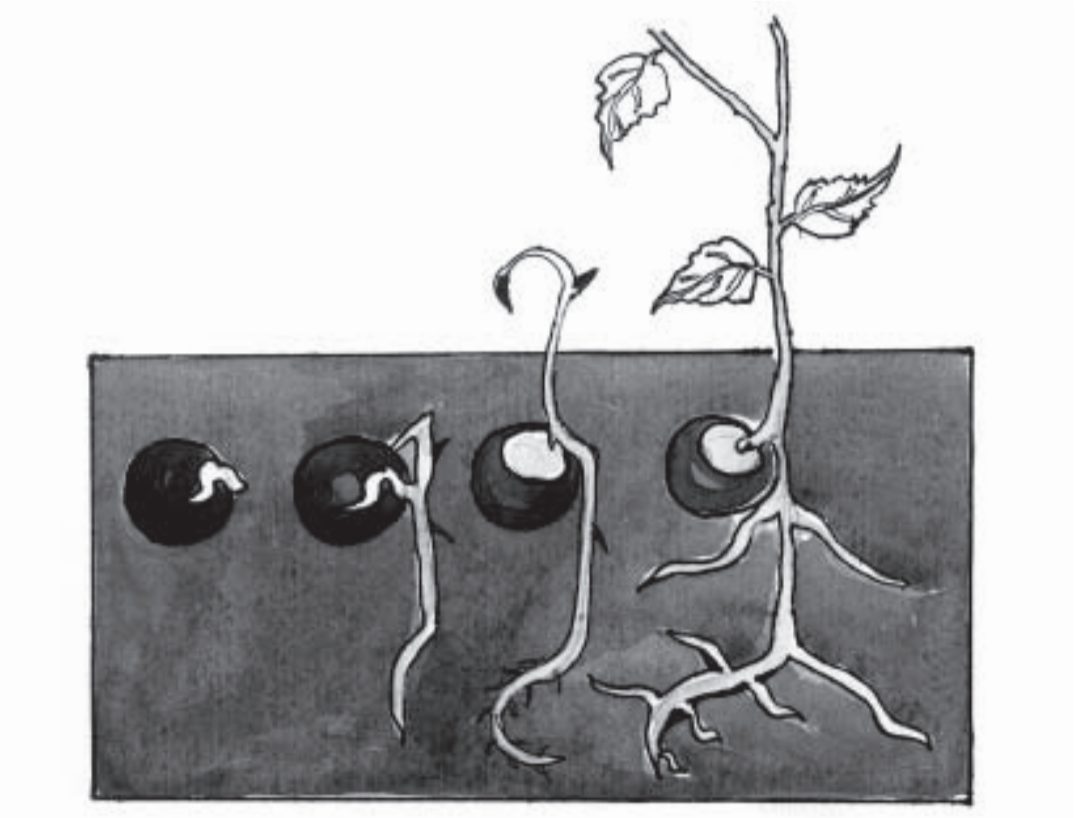
The life cycle of organic matter. Leaves and other organisms break down or decompose. Worms and other micro-organisms assist this process. They consume organic matter to produce humus. Humus then provides nutrients for plants to grow and is absorbed by their roots.

Plants

Flowering plants have systems to maximise efficiency of reproduction to ensure the species survives through time.

Seeds and germination

Seeds contain both a food source and a small embryonic plant in a dormant state. When given a supply of freshwater and sufficient warmth, the seed will germinate. During germination the plant root grows through the water-softened seed coat. It grows downwards because it is seeking water and also because of the pull of gravity. The shoot then grows upwards through the soil towards the source of light.



When the conditions are suitable; with warmth and water, a seed will germinate and grow into a seedling.

The germinated seedling continues to grow and uses up its stored food supply until it breaks through the soil surface, develops more roots and green leaves, and can use photosynthesis to harness the sun's energy and produce food. Photosynthesis is a process used in plants to produce food from carbon dioxide, water and light energy using chlorophyll to trap light energy from the Sun. The plant grows, matures and develops reproductive systems called flowers.

Pollination

Pollination is the name given to the way that male and female cells combine in plants when they undertake sexual reproduction. Most flowers produce both **pollen** (male sex cells) as well as **ovules** (female sex cells), but some species have separate male and female flowers.

The **stamen** is the male part of the flower. It has a filament with a large lobed tip (anther) which produces the pollen.

The **pistil** is the female part of the flower. It includes the **ovary** where the eggs are formed, and the **sticky stigma** on top of a stalk-like style.

Some plants rely on other organisms, wind, or water to transport the pollen to other flowers. Flowers that rely on other organisms for pollination are brightly coloured, have curious shapes, are scented, and contain nectar and plenty of pollen to attract insects and birds. These insects and birds become pollen carriers getting excess pollen on them which wipes off onto the broad, grooved, sticky stigmas of other flowers they visit.

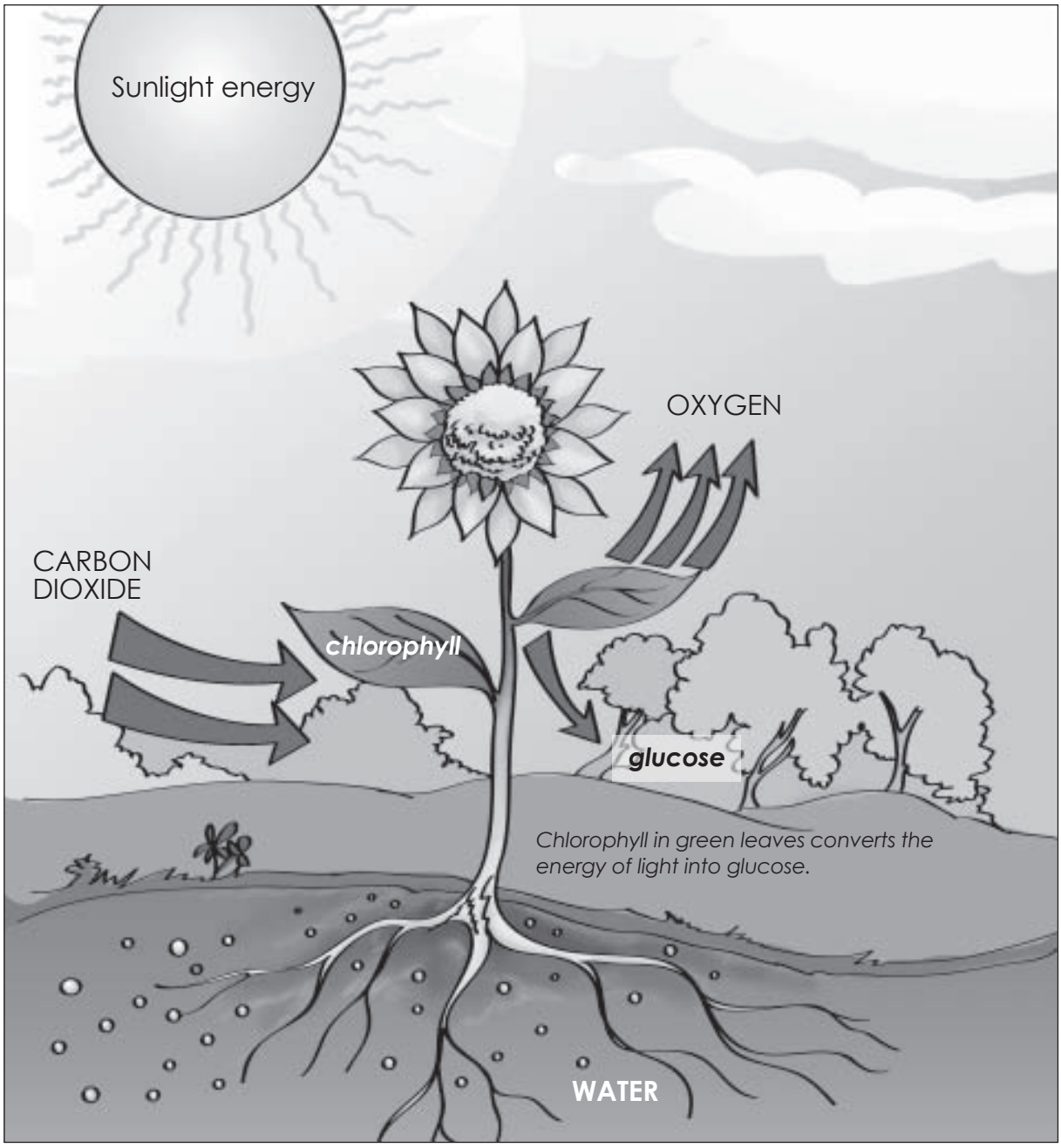
Flowers which use the wind for pollination produce abundant pollen on long dangling stamens, from flowers well above leaves (e.g. grasses) or flowers which emerge before

the leaves (e.g. many deciduous trees). The stigmas are long and feathery to catch the wind-blown pollen thus increasing the chance of pollination.

When the pollen grain lands on the stigma of another flower of the same species, a pollen tube grows down to fertilise the ovule, forming the embryonic seed plant. The ovary area develops into a fruit enclosing the seeds. Thus an apple with six seeds is formed from one flower which was successfully pollinated by at least six pollen grains fertilising six ovules.

Seed dispersal

Seeds must be carried to other areas to reduce competition between new seedlings for resources (light, space and water). This may be on animal feet or fur, by water or wind, or via animals eating the fruits and dropping the indigestible seeds elsewhere or in faeces. Seeds are shaped to help with this process.



Photosynthesis: The process by which plants use sunlight, water and carbon dioxide to produce oxygen and carbohydrates (to feed the plant).

Biodiversity Activities

What you will need for this unit.

- Toolbox: small spades or trowel
- Toolbox: spoons different sizes
- Toolbox: magnifying glasses
- Toolbox: rulers
- Watering can (children to make)
- Cheese cloth or cloth cut into small squares approximately 10cm X 10cm
- Toolbox: elastic bands different sizes
- Cooking oil
- Toolbox: clock
- Toolbox: measuring cup sets
- Toolbox: measuring spoons sets
- Toolbox: measuring tape
- Toolbox: endangered animal cards
- Toolbox: bird identifier cards
- Large paper
- Toolbox: twine or yarn
- Toolbox: insect identifier cards
- Toolbox: binoculars

Curriculum links

Biodiversity is included in all grade levels of the Science Student Textbooks. This unit has an activity written to suit each of the Grade levels. This is an example also of a unit that can be used in multi age classrooms; it is a common theme that can cater for different grade levels within the classroom.

Activity 1: School compound nature walk

Grade 1

Curriculum links: This unit links with the unit on Living and Non-living things in the Grade 1 Science Student Textbook.

Science - living and non-living things, living things around us and living things and their environment.

Time: 40 minutes

Purpose:

To observe what plants, animals and insects are in the school compound.

What you need:

- Pencils
- Paper
- Toolbox: magnifying glasses
- Toolbox: binoculars
- Toolbox: insect identifier cards
- Toolbox: bird identifier cards

What to do:

1. Talk about the idea of variety in nature by giving the students a one minute challenge to write, draw or contribute to a class list the names of all the plants, animals and insects they know. Explain that 'diversity' is the name that we give to this variety. Explain to the students that the variety in nature is called biodiversity (short for biological diversity).
2. Explain to the students that they are going on a school compound walk to identify what plants, animals, (particularly birds and bugs) live in the school compound.
3. Explain to the students that the correct science term for looking at something is to observe. When identifying anything explain to the students that they will need to observe the features. When on the school compound walk, students observations may include shapes, colors, numbers, markings, the way animals and insects move, shape of leaves, texture of trunks of trees and plants. A magnifying glass will allow students to look more closely and observe greater detail.
4. Organise students into pairs so that they can discuss and record their observations. As a class discuss how observations may be recorded e.g.; drawings, words, names, numbers of what they see, how the texture feels - rough, smooth, the smell if appropriate. Pairs may walk in different parts of the yard so that a variety of observations are collected.
5. Take students outside for 20 - 30 minutes and allow them to record their observations.

6. Back in the classroom ask students to share what they have observed listing these on the board. As a class categorise these into groups e.g.; animals, plants, insects. Count and record the number of each in each category. In each category how many different examples were observed by the students e.g.; how many different plants, what were the features of the different plants? What is the same? What is different? Why?
7. A class or pair could create a graph to show the results.
8. Discuss why there are many/some things living in the school and why there are few of others.

Looking at insects

Teacher information

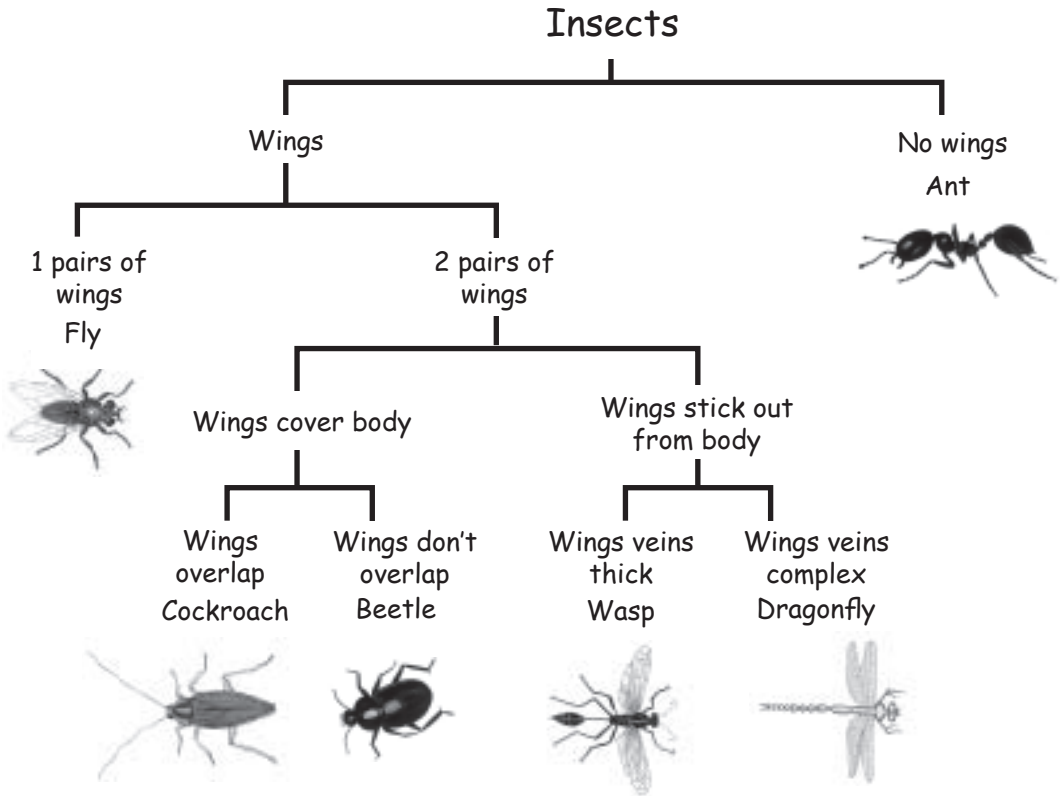
Looking at insects

Insects are by far the biggest group of animals. There are probably about 900,000 different types of insects.

Insects may look very different from each other but they have a lot more in common with each other than with any other invertebrates. The insect group includes animals such as silverfish, mayflies, dragonflies, grasshoppers, crickets, cockroaches, termites, earwigs, lice, thrips, bugs, cicadas, beetles, weevils, wasps, ants, bees, fleas, flies, mosquitoes, moths and butterflies.

No-one could possibly identify and name every single insect so a key is really useful. Using a key to help to identify different kinds of insects as well as observing an insect in its environment.

This key is an example that can be used to identify some insects.



What is an insect?

You can probably recognise and name a large number of insects, but what is an insect? What do all insects have in common?

Insects are invertebrates which means that they do not have an internal skeleton. Invertebrates do not have bones but grow a hard outer covering called an exoskeleton. Insects shed this hard covering at times and grow a new larger one. Sometimes they change suddenly, like caterpillars change to butterflies, and sometimes they change slowly over time, shedding their skin or molting several times.

There are basically four features of insects that make them different from other animals - the body, eyes, antennae and legs.

The insect body

An insect has an interesting body. It is divided into three distinctive parts - head, thorax and abdomen.

Insect eyes

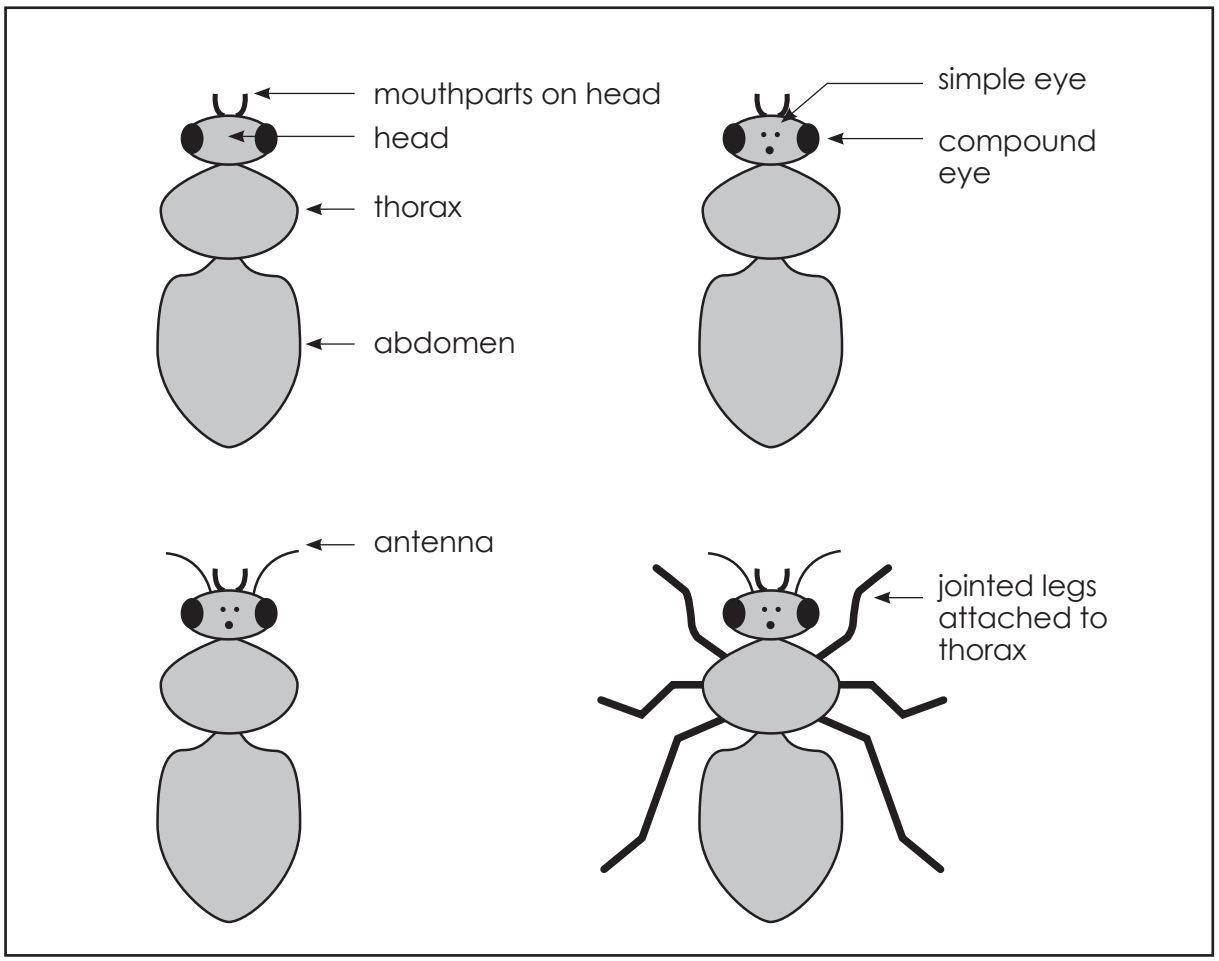
The second identification feature of insects is the eyes. Insects can see in all directions at once because they have two large eyes known as compound eyes. This is why insects such as flies are so hard to catch! Some insects even have another three simple eyes. These are smaller and on top of their heads.

Insect antennae

The third feature of insects is the hair-like antennae. Some insects use their antennae for smelling!

Insect legs

The last feature of insects is the easiest to observe – the legs. If a creature is an insect then it must have six legs. These six jointed legs are all attached to the thorax.



Activity 2: Looking at Insects

Grade 2

Curriculum links: This unit links with the unit on Things around us in the Grade 2 Science Student Textbook.

Science - living things around us and living things and their environment.

Time: 40 minutes

Purpose:

- To explore the world of insects from their environment to their features.

What you need:

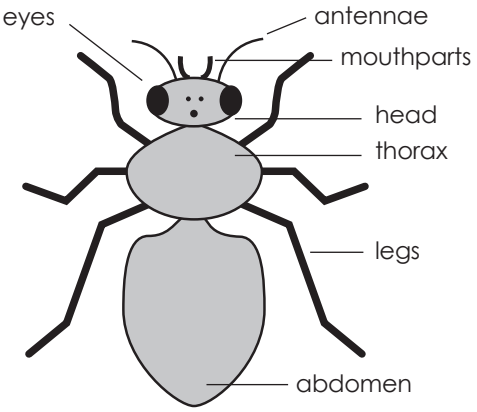
- Toolbox: magnifying glasses
- Bug catching jars with lids
- Pencils
- Paper
- Toolbox: insect identification cards

What to do:

1. Ask students how many different types of insects they can think of and see if they can write down or draw at least five.
2. The students are shown the insect information on the picture cards. The class discusses the four main features of insects. Students then compare this information with the insects they wrote down or drew. Students may not be sure and that is alright as it is the discussion about the four main features that is important.

The four main features used to identify insects are:

- three body parts - head, thorax (middle part) and abdomen
- two large compound eyes
- a pair of antennae
- six legs attached to the thorax



1. Go outside into the school compound ask students if they remember where they have seen insects in the yard. Visit some of the locations. What does an insect habitat look like? What are its features? Are they the same for different insects?
2. Using bug catchers or jars capture some insects. Note: it is important to be careful when capturing insects to make sure that care and safety should always be observed, especially making sure that any potentially harmful insects are not handled or collected.
3. Back in the classroom show the students the insect key and explain that it is scientific way of identifying different types of insects.
4. Ask the students to look at the insect they have brought inside and use magnifying glasses, insect cards and the insect key to identify the features of their insect. Students should draw their insect, color and label the parts. The location of the insect's habitat could be noted as well.
5. Ask the students to take insects back outside and release into the location where they were found.
6. Back in the classroom discuss what where the features of the different insects habitats e.g.; dark, damp, under leaves, on the bark of trees. What features of the insect suited living in that habitat e.g.; color and texture of insect, shape of body, length of antennae.
7. Ask pairs of students to create a slogan which promotes looking after the habitats of insects e.g.; *Watch your step, insects are home, look after trees, it's an insect's home*.

Assessment tip for the teacher

Assess student's ability to identify different types of insects and draw a diagram of an insect with labels the four main features.

Activity 3: Habitats - why are they important?

Grade 3

Curriculum links: This unit links with the unit on Living things and their environment in the Grade 3 Science Student Textbook.

Science - adaptation of living things to survive, effects of adaptation on survival of living things, adaptation and survival of living things.

Time: 40 minutes

Purpose:

- To simulate the complexity of habitats and demonstrate how each component of a habitat relies on each other.

What you need:

- Toolbox: balls of twine/yarn
- Large pieces of paper
- Pencils
- Toolbox: Ecosystems of Eritrea, map

What to do:

1. Show students the map which shows different habitats in Eritrea. As a class discuss the features of each habitat.
2. Explain to the students that they are going to play a game which shows how everything relies on each other in a habitat. Each species of plant and animal, no matter how small, has an important role to play.

Instructions for the habitat simulation game

1. Groups of up to 12 students stand in a circle. There can be a number of circles playing the game at the same time. If space is a problem the game can be played outside. Each student represents one of the 6 habitats. Explain to students that each habitat includes everything in it, plants, animals, bacteria etc.
2. One student will hold the end of a ball of yarn and tosses the ball of yarn to another student in the circle.
3. That student holds onto that section of the yarn while tossing the ball to another student.
4. Repeat this process until each student is holding a section of the yarn and the circle is criss-crossed randomly with yarn.
5. The yarn will go continuously across and around the circle.
6. Ask students to image what happens if one habitat is disrupted, for example: trees are cut down, water becomes polluted, or one species becomes extinct. To show this, ask one student to let go of their section of yarn.
7. NOW: The remaining students must tighten their strands of yarn.
8. Suggest to students that there is another disruption to the environment. Ask a second student to let go their section of yarn.
9. Again, ask students to tighten their strands of yarn.

During the game and while students are still holding their yarns ask them:

- What happened at the beginning when everyone had hold of the yarn?
- What happened after one person dropped their yarn and then the next?

Explain that this game is similar to the interdependence of plants and animals and their habitats. What can they infer from this?

3. Divide the class into small groups and allocate each group a habitat shown on the poster. Ask each group to discuss and record on large pieces of paper more detailed aspects of the habitat.

    - living and non-living things
    - features of plants, animals, insects how they are suited to that habitat e.g.; colour, claws, eye shapes
    - Draw and show links between them and describe why they have been linked e.g.; food source, shelter.
    - Discuss what would happen to habitat if one was removed. Think about the game: what would happen to other habitats? What might happen to plants and animals?
    - What are the threats to these ecosystems? What impact do humans have on the habitat?

Activity 4: What do plants need to grow?

Grade 4

Curriculum links: This unit links with the unit on 'Growth in Plants' in the Grade 4 Science Student Textbook, including adaptation of living things to survive, effects of adaptation on survival of living things, adaptation and survival of living things.

Time: 2 x 40 minute sessions

Purpose:

To grow seeds and understand the life cycle of plants. This is a two part activity. Both parts can be done or you can choose the most appropriate part for student learning.

What you need:

- Variety of seeds - bean seeds are ideal
- Scrap paper
- Toilet paper
- Water
- Toolbox: magnifying glasses
- Toolbox: masking tape
- Toolbox: ruler
- Seeds
- Dark paper or paper bag
- Soil

What to do:

1. Provide students with a few different seeds. Have students examine their seeds using magnifying glasses. Ask them to draw and label each seed with its features.

2. Ask students what they think their seed will need to germinate. List their ideas on the board.

> Water is the trigger for seeds to germinate. When the seed soaks up water, the seed coat loosens and the embryo is activated by moisture. If the embryo has enough warmth and air it will start to grow.

3. Each student will need a clear plastic bottle with the top cut off and scrap paper. Ask the students to:

   - Fold some paper and line the bottle.
   - Fill the rest of the bottle with more crumpled pieces of paper.
   - Place seeds between the paper lining and the glass about 2cm from the bottom.
   - Water the paper in the bottle until the paper is completely wet.
   - Use masking tape to label the bottle with their name.
   - Put the bottle into a warm, sunny place, on a window ledge for example, and check it every day to see that the paper is moist and check what is happening to the seed.

   Students will need to keep a seed diary to record their seed's germination. This should include a date and time of measurement, diagrams of growth and measurements of various parts of the seed.

4. After a period of time and when the bean seeds are of a good size students can transplant their germinated seed into pots with soil to continue their growth.

Part 2

1. The second part of this activity involves monitoring plant growth in different conditions. Students can use their germinated seed if it is of a suitable variety or seedlings can be provided and second investigation conducted.

2. Discuss with students the important things plants need to grow into healthy adult plants. Water, soil and sunlight are critical for healthy plant growth. It must be pointed out that nutrient rich soil is the key and that plant growth can be affected if the soil doesn't contain the right nutrients for that plant.

3. Students plant their seedling in soil using a plastic cup. Each student needs to name their cup. The class will conduct a class investigation based on the needs of plant for growth. The class needs to be divided in to three groups. Each group will deprive their plant of one of the key plant requirements for growth. E.g.

   - water
   - soil
   - light

4. The class will need to discuss and decide on how the investigation will be organised.

   - soil - e.g.; no, some, nutrients - how will it be measured?

- water - different quantities and different rates
- light - total darkness, some light, full light

Students can be organised into one of the three groups and the groups decide on what each group member does with their seedling to contribute to the investigation for their area. They will need to collect data about growth at nominated times (measurements, look of plant - color of leaf, stability of plant etc.) using their exercise book. A time needs to be decided upon for the investigation e.g.; 10 days.

5. Once the investigation is completed the class collates the investigation results. As a class discuss compare the plant growth and discuss the ideal conditions for plant growth using the data from the investigation to support the discussion. Ask students if the result could be applied to all plants why or why not?

6. Using the knowledge from this two part investigation students plan a school vegetable garden.

   - Which plants would be the most suitable? Why?
   - Where would it be located?
   - Who would have responsibility to ensure the plants were looked after? What would need to be done?
   - Are there any likely problems? e.g.; pests.

Assessment tip for the teacher

- Assess student ability to design a fair test with accurate measurements.
- Assess student ability to present and interpret data from an experiment and present an argument based on data.

Activity 5: Eritrean endangered animals

Grade 5

Curriculum links: This unit links with the unit on 'Adaptation and Survival of Living Things' in the Grade 5 Science Student Textbook. Including adaptation and survival of living things, inheritance.

Time: 40 minutes

Purpose:

To build awareness of endangered animals and consider ways of conservation.

What you need:

- Toolbox: Endangered animals cards
- Map of Eritrea
- Large sheets of paper
- Pencils

What to do:

1. Explain to the students that they will be looking at Eritrean animals that are in danger of extinction at a national and global level.

2. Organise students into groups. Provide each group with a set of endangered animals cards. Have students look at the animals on the cards and identify where they are found in Eritrea. Discuss what their habitats are like e.g.; mountainous, forests, treed plains.

3. Have groups look at the features of the animals and decide what features are designed to help them survive in their habitat e.g. colour for camouflage, big ears, and large horns.

4. While students are doing this, write the list below of wildlife decision words on the board.

List for wildlife decision words

- farmers
- herder
- human beings
- future generations
- knowledge
- plans and programs
- animal information
- destruction
- limited numbers
- one locality
- crops for food
- distribution
- illegal killing
- manage
- tourism
- Ministry of Agriculture
- our heritage
- conflict
- government
- habitat
- food
- conservation
- protect
- Semenawi Bahri (Green Belt) National Park
- Gash-Setit Elephant Sanctuary (upper Gash area around Haikota, Augaro and Antore)
- Buri Peninsula Biodiversity Conservation Area (Northern Red Sea Zone)

5. Draw this chart on the board and ask students to copy this on to a large piece of paper. This type of chart is designed to help students to think about issues from a number of different ways.

   Students select an animal from their set and use the wildlife decision words to help them think about the questions. Encourage students to list their own ideas and add details to their ideas.

Our animal	
Why is it endangered?	Why protect this animal?
What do we need to do to protect it?	What might stop us from protecting it?

Have groups share their ideas: How do they think this animal can be protected and why do they think it is important.

6. Extension activity: Ask the students to think about concerns they have for animals (including birds) and habitats in the local area. Challenge them to think of ways to protect these just like they did with the Eritrean endangered animals. A poster could be created with their ideas.

Assessment tip for the teacher

Assess student ability to identify the impact of human activity on the protecting or further endangering already endangered animals in Eritrea and consider the outcomes for future generations.

Animals on the Cards

1. The African Wild Ass

This species lives in the dry areas of the Horn of Africa in Eritrea, Ethiopia and Somalia. Because Eritrea has the biggest number of these animals, it is particularly important that they are preserved here. The African wild ass is found in Northern and Southern Red Sea. It is critically endangered.

2. The Nubian Ibex

This species lives in the north-western Sahel around the Kerkebet area.

3. African Elephant

There are many African elephants in other parts of Africa but in Eritrea there is only a small number and they are found only in Gash Barka. Elephant population grows slowly because the elephant reproduces only every four years so they are at high risk of extinction in Eritrea.

4. The Greater Kudu

Greater Kudu is found in Gash Barka and on the eastern escarpment.

Other animals which are becoming scarce or 'vulnerable' to extinction in Eritrea are Soemmerring's gazelle, dorcas gazelle, ostriches and leopards.

ENDANGERED AND VULNERABLE!

Wild Animals of Eritrea

Elephant

African Wild Ass

Leopard

Greater Kudu

Ostrich

Nubian Ibex

Soemmering's Gazelle

Glossary

Biosphere: the realm occupied by living things.

Biodiversity: the number and variety of organisms that are found in a specified geographic area.

Carnivores: meat eaters.

Consumers: the animals that eat plants and other animals.

Cross pollination: the transfer of pollen from one plant to another to create fertilised seeds.

Decomposers: organisms that help other things rot. For example, fungi and mould.

Deforestation: the cutting down, clearing, burning and removing of trees from the land.

Domestic animals: these are animals that live with people, for example, goats and sheep.

Ecosystem: a system in which living organisms interact with each other and with the non-living parts of the environment.

Endangered animals: these are animals which are in danger of becoming extinct.

Extinct animals: these are groups of animals who have all died out and there is no representative of their species left alive anywhere.

Food chain: a series of organisms that depend on one another in turn for food.

Food web: a complex of interrelated food chains in an ecological community.

Germination: the process whereby a seed starts to grow.

Habitat: the place that an organism such as a plant or animal is usually found.

Herbivores: animals that are plant eaters.

Indigenous animals: these are animals which occur naturally in an area.

Introduced animals: these are animals which have been brought into an area from somewhere else. Introduced animals are sometimes called exotic animals.

Native animals: this means the animal is native to the country but may have come from another part of Eritrea.

Non-renewable energy: comes from sources that, when they are used up, cannot be replenished in a short time.

Omnivores: meat and plant eaters

Photosynthesis: the process by which leaves make food for the plant by capturing sunlight.

Pollination: the process of sexual reproduction in plants when male and female cells combine.

Pollution: contamination of the environment.

Pollutants: the substances that cause pollution.

Producers: green plants that make food through photosynthesis

Renewable energy: comes from natural sources that can be replaced and used over and over again without harming the environment. For example solar energy from the sun.

Seed Dispersal: the process whereby mature seed is scattered. This allows plants to spread to new places.

Scavengers: clean up the kill from other animals

Self pollination: the transfer of pollen from the male to the female parts of the plant to create fertilised seed.

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Toolbox 4

Contents of the Toolboxes

The Toolbox provides some of the physical material needed to conduct the activities. Where materials are needed from the Toolbox for an activity, this is noted under '*What you need*'. If items in the Toolbox run-out, or need replacing, the PTA could assist in raising money to replenish these items. Other items such as seeds or aluminum foil could be bought from home by students.

Using a Toolbox to integrate Environmental Studies

Operation and maintenance of Toolboxes:

- ***Toolbox log.*** Each time someone takes any equipment from the toolbox, they should sign for the pieces they are using and sign again when they return them. An equipment log should be kept in each Toolbox.
- ***Paper materials.*** It is important that books, posters, student resource materials and pictures be kept in a dry place that is well aerated and free from insects. If these materials do get wet, it is important to dry them immediately and not to put wet items back with the dry items.
- ***Outdoor equipment.*** If any equipment is used outdoors, it is very important to ensure that it is clean and dry before it is put away. It is important to store this equipment in a dry, well-aerated area free from insect or animal damage.
- ***Specialist equipment.*** Some items don't just need care in storage, they need skill in setting them up for correct use. For example, instructions for the H_2S water testing kits need to be followed carefully to maximise the accuracy of results.

Toolbox contents

The materials are supported by a Toolbox of items to use with activities.

Item (Alphabetical order)	QTY
• **1 Metal box for storage of the items.** • **2 padlocks.** The box can be locked if your school does not have a safe storage room, but if you choose to lock the box, please ensure all teachers can have access.	
Aluminium foil –large rolls (to make solar cooker) 150m x 44cm, or 150x 30cm.	5 rolls
Animal pictures, series 1: A4 size, 20 cards in each set (cat, dog, bird, camel, goat, cow, horse, hen, fish, lion, monkey, rabbit, snake, leopard, ostrich, tortoise, zebra, elephant, hyena, fox).	10 sets
Animal pictures - ENDANGERED AND VULNERABLE, series 2: A4 size, 7 cards in each set, (African wild ass, nubian ibex, African elephant, greater kudu, Soemmerring's gazelle, ostrich, leopard).	1 set
Animal pictures – African Animals, series 3: A4 size, 16 cards in each set, (rhinoceros, chameleon, lizard, aardvark, buffalo, eland, impala, crocodile, Arabian bustard, hedgehog, hippopotamus, giant golden mole, green turtle, Egyptian goose, gorilla, dolphin).	1 set
Animal Food Pictures: A5 size, 13 cards in each set, (meat, seeds, mice, bananas, hay, hen, insects, lizard, tree, fruit, bird, water, milk - with words).	1 set
Ball of nylon string (for web of life game) about 50 metres long	2 balls
Bird Identifier: Picture Card	10 sets
Brightly coloured twine (for hanging up artwork) roughly 80 metres	2 balls
Chalk, assorted colours, calcium carbonate, in box of 100	13 boxes of 100
Clear plastic bags –Polythene (plain) (for tree transpiration activity) - approx A3 size (297*420mm). 60/ kit *(please re-use for each class).*	60
Clear plastic bags - Heat resistant (for solar cooking). A4 size (210 × 297 mm) 50 / kit. *(please re-use for each class).*	50
Clock with a second hand for a classroom. Analogue display. 350mm diameter. - Battery for clock. 1xAA. 1 Pack of 4	1
Clothes pegs (for hanging up artwork in classroom) 40/kit	40
Colouring pencils, Set of 12 assorted colours. Metal box.	12 packs
Composting poster: Simple Steps to Making compost	1 poster
Crayons, wax, 8 colours per pack/box of 10 packs.	6 boxes of 10 packs.
Deforestation Information Cards	10 sets
Drawing pad white, A3, 50 sheets. pack of 10	2 packs of 10
Ecosystems of Eritrea: Map	1 poster
Elastic bands: packet of 100 *(please re-use for each class).*	2 packets
Eye dropper (Pippet) 155 mm. Plastic. graduation 1 mm	2
Marker, flip chart, assorted colours (tip-4.5mm)/pack of 4	6 packs
Glue, classroom use, bottle, approx. 170 ml.	10 bottles

Greenhouse information cards	10 sets
Hand washing poster: Steps to wash your hands	1 poster
Hand washing poster: Don't spread germs	1 poster
Hygiene, sanitation, water, health Information Cards	10 sets
Inflatable globe, (diameter of 42cm), without stand	1
Insect identifier: Picture Cards	10 sets
Plastic binoculars for kids. Magnification 3 x.	10
Magnifying glass: Magnification x 4, or x 5, plastic handle	8
Masking tape (for making a solar cooker) 50mm x 50m. auto grade	4 rolls
Measuring containers (PP beaker) measurement 10ml . 1 of each/set Capacity 1000 ml (1), 100ml (1) and 25ml (1).	1 set
Measuring spoons (for waste activity and soil activity) 1 of each/set • tablespoon approx. 15 mil (1) • 1/2 tablespoon approx. 7-8 mil (1) • teaspoon (1/3 tablespoon) apprx. 4-5 mil (1)	1 set
Measuring tape – length 5 metre, retractable	10 pieces
Paint, black, for blackboards. 500 ml per tin NB: The inside lid of the metal box can be painted with blackboard paint and used as a blackboard. The blackboard paint can also be used on a smooth surface e.g. wood or on a wall.	4 tins
Paint brushes for blackboards 50-60mm	2 brushes
Paper, white, A4, 1 ream – 500 sheets	3 reams
Paper, black, A4, 1 ream – 500 sheets *(please re-use for each class)*.	1 ream
Pencil, black, HB grade. Box of 10	13 boxes of 10
Plant information cards	10 sets
Red food dye – small bottle 100ml	1 bottle
Red Sea Zoo	10 copies
RRR - Reduce, Reuse, Recycle Poster	1 poster
Plastic wrap (for experiment to understand the water cycle and condensation) 300 mm X 300 m. catering size. *(please re-use for each class)*.	1 roll
Ruler, plastic, 30cm. Pack of 10	5 packs of 10
Scissors, blunt, safe for school use. 135mm. Box of 10	7 boxes of 10
Seeds: packets of corn and beans	1 set
Seed Poem	10 copies
Gardening equipment: 5 of each • Hand trowel (Green club), 285*87mm, carbon steel (5) • Weeding fork (green Club), 285*80mm, carobon steel (5) • Spade (Green club). Wooden shaft and plastic handle 940mm Blade (235*140mm) (5)	1 set
Soap: toilet bar, approx 110g. Wrapped.	50 bars
Soil Texture Chart	10 copies
Solar cooker kit	1 kit
Stapler: metal base half strip accepts 26/6 staples.	5
Staples: 26/6. 5000 per box	2 boxes

Sticky Tape: transparent 1,5cm x 10m/box of 20	2 boxes
Thermometers: spirit filled - 10 degree C + 100 degree C. Child safe easy to read (for measuring temp of weather and water)	3
Water cycle definition cards	10 sets
Water cycle picture cards	10 sets
Water testing kit: Bacteriological H_2S field testing kit	40 kits
Web of life cards: A5 size, 19 cards in each set. (hyena, vulture, cheetah, hunting dog, lion, baboon, giraffe, impala, seeds, wildebeest, tree, grass, bacteria, dung beetle, fungi, sun, water, bird, insects).	1 set
What is climate story	10 sets
Weather picture cards: A5 in size, 7 cards in each set, (rain, windy, cloudy, sunny, hot, cold, storm).	1 set
Zoo Pictures	10 sets

Books

These books can be stored in your school library to allow all students access.

Title/ISBN	Quantity
Book of Eritrean medicinal plants ISBN 99948-53-00-7	1
Jaws Discovery series- 8 books *Deserts : The driest places in the world* ISBN:9780435898564 *Disaster! Natural disasters of the world around us* ISBN: 9780435898939 *In Danger! Endangered species of the world* ISBN 9780435898595 *It Works! Jaws Discovery* ISBN 9780435898908 *Patterns in Nature* ISBN 9780435898588 *Sensation JAWS Discovery* ISBN 9780435898526 *Shapes in the world around us* ISBN 9780435898557 *Water: Nature's liquid miracle* ISBN 9780435898571	1 of each
Africa's most amazing animals ISBN: 1410930920	1
The oceans most amazing animals ISBN: 1410930971	1
My First Book of Southern African Insects ISBN: 9781770072138	1
Let's Go Picture Dictionary, Monolingual English Edition, Paperback ISBN 9780194358651 **Using the Picture Dictionary** Pictures are a great help when you are teaching new vocabulary. Use the Picture Dictionary to show students a picture of what you are talking about, rather than always translating from Mother Tongue. The Picture Dictionary is based on high frequency words so you should find all the vocabulary you need at the grades 1 to 5. The Picture Dictionary is based around topics, for example family, and weather. The illustrations, vocabulary and exercises all focus on the topic. There is also an alphabetical index so that you can look up individual words to check the page on which they are illustrated.	1

Effective teaching methods for Environmental Education in Science

5

The following section has suggestions to support teachers with a learner-centred approach to teaching Science that integrates the learning of Environmental Education.

A Problem Solving Model: An Inquiry Approach to Teaching and Learning Environmental Education

The Problem Solving Model has been chosen to be followed in the activities in this book because this method focuses on student-centred learning and leads to social action to resolve some of the environmental issues in Eritrea. When applying the Problem Solving Model, the teacher acts as a facilitator and the students should:

- Gain a deep understanding of the subject matter.
- Develop thinking and reasoning skills.
- Develop problem-solving skills.
- Have their intellect challenged.
- Take greater responsibility for their own learning.
- Understand the relationship between what they are studying and the real world.
- Have varied and interesting learning experiences.

To incorporate environmental issues in the schools, we need to recognise some basic characteristics of these issues:

- Environmental issues are often complex as they involve economic, social, cultural and political circumstances.
- There are always two sides to an issue and multiple perspectives.
- It takes more than knowledge and facts to understand environmental issues. It requires seeing the problem from different angles and awareness of values and beliefs.

- Taking action and solving environmental problems in Eritrea, as in all countries, is an ongoing process. As positive changes are made, new challenges and access to new information will emerge so that continual reassessment and revision of strategies is required.

It is important that teachers allow students to claim ownership of environmental problems and to develop their own responses and ideas about solutions without imposing their own views. The Problem Solving Model aims to protect this process.

Component 1: Identifying a problem

Students are asked to identify problems associated with their local school environment.

The task could include an Environmental Audit of the school environment using practical processes of learning. During an environmental audit of the school, environment issues will present themselves to the students.

Important points!

- It is important that the teacher does not select the issues for the students as this often causes students to lose interest.
- The students will often jump straight to the 'Take responsibility and action component'. It is important that the teacher protects the process and encourages the students to fully understand the problem.

Teachers will know a problem is well-defined and understood when the students can:

- Identify the people and organisations with an interest in it.
- Explain how those people/organisations perceive the problem and what assumptions they have made about it.
- Identify their own interests and concerns about the problem.
- Understand the issue well enough to be able to frame it in several ways based on the different assumptions and perspectives.

Component 2: Search for solutions

Searching for solutions involves understanding alternative views and the range of alternative solutions. It requires time to understand the scope of a problem and to experiment with several solutions. It means encouraging great creativity and then going back to the identification stage to learn more about what the solution might entail. This often happens by giving examples and changing ideas.

The teacher may want to consider the following:

- Decide exactly what you want students to learn (student learning outcomes and levels).
- Locate or develop a suitable problem/question or a series of problems/questions that can be used to help students achieve the desired learning outcomes.
- Normally, these problems/questions will be built around an important concept or principle (for example, the concept of water conservation). The problems/questions should also be built around some realistic situation that the students think important, such as the need to conserve water in the home.
- Identify what prior knowledge the students will need in order to try to solve the problems or find answers to the questions. If necessary, teach the needed prior knowledge.
- Decide how you will motivate the students to engage in the inquiry (i.e., how will you make the problem/question one that they will want to resolve).
- If necessary, teach the students the inquiry skills that they will need, or structure the problem-solving or question-answering process so that these

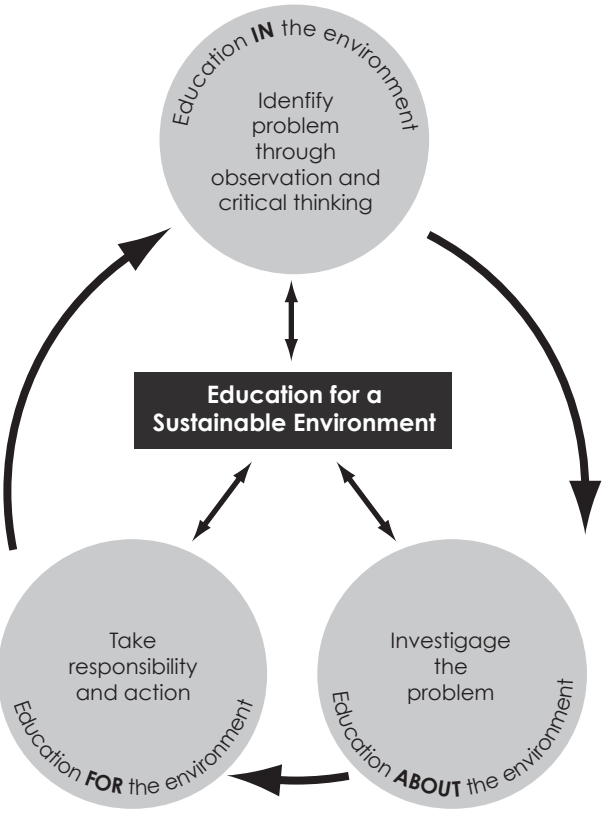
skills will be learned as students work through the process.

- Do not forget that thinking skills are very important.
- Identify parts of the problem and questions that are likely to cause the most difficulty for the students.
- Decide why this might be the case. Help the less able students through those parts.
- Try to identify a number of strategies that will help students learn as they attempt to solve this problem/question.
- Use this information above to plan your lesson or series of lessons. (Often, problems/questions that will help students to gain real insights into the subject matter have to be investigated over an extended period of time.) Make sure that your plans give the students the freedom they need to think, explore ideas and experiment. If you are using inquiry for the first time, do not be too ambitious – try it with one class and refine your approach until you feel comfortable that it is working successfully, then try it with other classes.

Problem Solving Model in Practice

The teacher's main roles in inquiry learning are to:

- Frame the inquiry situation so that students understand what they have to do.
- Guide students to resources that will help them to solve the problem.
- Facilitate group processes as the students work on the problem.
- Encourage student participation.
- Help to keep students on track.
- Challenge students' logic and beliefs.
- Provide constructive feedback to correct erroneous student reasoning.
- Assume the role of fellow learner.



Problem Solving Model in Practice

Throughout this manual, the different components of the Problem Solving Model ***'about'*** – ***'in'*** and ***'for'*** – are identified to support teachers with inquiry teaching.

Scientific Literacy

The Organisation for Economic Co-Operation and Development's (OECD) Programme for International Student Assessment (PISA) define Scientific literacy as:

'the capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.'

Daily we read and hear stories about global warming, cloning, genetically modified foods, space exploration, the collection and use of DNA evidence and new drugs that will improve the quality of life and make us look years younger. As a consumer, and as a citizen, we need to critically evaluate the

claims made in the name of science and make informed decisions and choices about these and other science based issues. In short, we need to be scientifically literate and more importantly we need to develop scientifically literate students.

A scientifically literate student is able to apply their knowledge of scientific concepts and processes to the evaluation of issues and problems that may arise and to the decisions that they make in their daily life, about the natural world and changes made to it through human activity.

Students who are scientifically literate:

- Know and understand the scientific concepts and processes required for participation in society.
- Ask, find, or determine answers to questions derived from curiosity about their world.
- Describe, explain, and predict natural phenomena.
- Read with understanding science articles in the popular press and engage in social conversation about the validity of the conclusions.
- Identify scientific issues underlying national and local decisions.
- Express positions that are scientifically and technologically informed.
- Evaluate the quality of scientific information on the basis of its source and the methods used to generate it.
- Pose and evaluate arguments based on evidence and apply conclusions from such arguments appropriately.
- Investigating scientifically is the process of inquiry that utilises a systematic procedure to;
    - Examine phenomena
    - acquire new knowledge
    - correct and integrate previous knowledge.

How applied learning can improve the teaching and learning of science

Teachers have observed that classroom activities with application to real-world situations are the lessons where students seem to learn most and really appreciate. Students are more motivated to learn when the scientific concepts have a personal connection to their own lives.

Brain research demonstrates that:

- The more senses used in instruction, the better the learners will be able to remember, retrieve and connect the information in their memories.
- Physical experiences or meaningful contexts can provide learners with strong blocks for building knowledge.
- If new knowledge is connected to what the learner already knows, it improves the acquisition of new knowledge.

Information about memory creation and storage, learning, and complex connections provides an explanation for the success of students' learning through hands on contextual activities.

'I hear and I forget; I see and I remember; I do and I understand'

By incorporating realistic, integrated, or interdisciplinary activities that build on established knowledge and skills and more than one sense (seeing, hearing, or touching), memory pathways become more easily accessed and cross-referenced for future use. As the learner ages, the ease of access of learning pathways is directly dependent on stimulation from prior learning. Learning becomes embedded.

Students can turn around and form a group with the students at the desk behind them.

Group Work

Why is group work important?

Large classes are a big challenge for teachers. Environmental Education activities work best when all students are involved, so group work is ideal for teaching environmental topics.

What if my students are not used to group work?

Both students and teachers need time and practice to get used to working in groups. Here are a few tips for getting started:

Start simple. The first time you do a group activity, pick a short simple task. Just do one group activity with your class.

Give all the instructions for the activity first before you move the students into groups. Once students are clear about their task, give them clear instructions on how to form groups.

Choose the simplest way of forming groups when you first start using group work. This will be to form groups of six – three students turn around to face the three students in the desk behind them. Check the classroom before you start. If some students need to move to make up numbers for groups, be ready with instructions for them. See below for more ideas on how to form groups:

Make sure the students quickly get any materials they need for the activity. You can use a couple of students to hand things out if necessary

Keep the activity short and make sure there is something for each student to do in the group.

Move around the classroom while the students are doing the activity. Help students who are not sure what to do, but don't spend too much time with any single group.

Stop the activity when most students have completed the tasks. Students will get bored and restless once they have finished, so stop the activity even if not every student has finished. As students get used to group work, you can be more flexible about when you stop an activity.

Pick an activity to start with that you are sure students will enjoy. Once students decide that group work is fun, they will want to do group work more often.

What size of group works best?

Many of the activities in the Environmental Education Curriculum Companions are designed for groups of six. This is a good number to allow individual participation. It also suits groups working at desks. The Toolbox has material sets based on a class of 60 – 10 sets for groups of 6 students. If your classes have a bigger or smaller number of students, make sure you adapt the group numbers. Don't forget about working in pairs. Students can work with their neighbour without moving the whole class around, or you can try other ways of forming pairs.

Are there other ways of organising groups?

There are many ways to organise groups. In fact, getting into groups can help students practice their English. Here are a few ideas:

- ***Organise by numbers.*** Count from one to 10 around the room. It is good practice and can be done quickly. All the ones form a group, all the twos form another group and so on.
- ***Organise by birthdays.*** Get the students to line up in order of their birthdays. Again, this is good English practice. You can then divide into groups of six or form a group for each month, depending on the activity (for example, those who were born on 1st to 5th form one group, 6th to 10th form another group or else organise by months and then by dates in each of those months).
- ***Organise by animal cards*** *(see the Toolbox).* Give out cards of animals and ask students to find the others with the same animal. You could give them a question they have to ask, for example, a student has a card with a rabbit and she has to ask other students 'Are you a rabbit?' If the answer is 'No', then she has to move on and ask another student. Remember to tell students that they must not show their card to other students.

When working together, children can achieve great things!

- ***Select the group members yourself.*** For some activities you might want to put the students into particular groups. You might want to put the more advanced students together so they can do some more challenging practice. You might want to put weaker students together so you can give them a bit more help. You might want to split up noisy students. Whatever your reason, make sure you have done the student lists in advance.

Remember, if you choose to put students into groups, it needs to be done fairly quickly and without too much fuss. If students are moving from their usual desk, make sure you give clear instructions about where each group will be sitting. When students first start working in groups, it is best to keep it simple.

Are students really learning when they work in groups?

There is a lot of research to show that group work is a very effective learning strategy. For

language learners, the amount of time they spend independently producing language is directly related to their progress. Group and pair work is the most efficient way to do this.

How do I get shy students to participate?

Sometimes students are shy about speaking in class, especially when they are learning a language. They are afraid they will make a mistake and look foolish. Often, the same good students will answer all the questions in class. Group work is especially helpful for shy students. It is much easier to speak in a small group than it is to speak in front of a large class. So make sure that you regularly use pair work and small-group work so that shy students will have more chances to speak.

If you want to have a whole class discussion or activity, it is a good idea to start out with small-group work. Get students to discuss the topic in pairs or small groups first. This way, they have a chance to try out their ideas before speaking in front of the whole class. You can do this at two levels if necessary. Start first with pair work or groups of three, then move to groups of about six and then move to a whole class discussion.

How do you get students to work well together in a group?

You need to make sure that the group activity is well structured. Every student should have a role in the activity and the success of the group should depend on each student making a contribution. The students need to clearly understand their academic task. You should also be clear about what social behaviours you expect. Tell students what the behaviour will look like, for example, if you want students to work together on a drawing, explain that each person will do part of the drawing and that the group needs first to agree on who will do what. Make sure you are clear with students about whether they can use mother tongue in the group or whether you want them to work in English only.

Make sure you give students positive feedback for working well together as well as for completing their tasks successfully.

Teachers need to make sure students with special needs are catered for in their groups. Those students with visual impairments need to be seated closer to the blackboard, poster, flashcards, etc. In an activity where the students go out outside to the school compound, students can be encouraged to support peers with moving difficulties as well as to take actions to remove pebbles, and make their path more accessible.

How do I know if a group is working well?

For most group work, you will be moving around the classroom keeping an eye on what is happening and helping where necessary. There are a number of things you should watch for:

- Are all the students actively engaged in the task? All the students should be busy. They should not be looking bored, or be doing something other than the set task.
- Are all the students participating in the group interaction? You can tell this by their eye contact with each other and the flow of their conversation. Students usually enjoy group work and there should be a happy hum of conversation and activity.
- Is one student dominating the group? If the same student is talking each time you glance at a group, it is worth moving closer to monitor what is happening. If necessary, you may intervene to remind students of their task and of the need for everyone to have their say. If you find one student often dominates a group, then you need to think carefully about the group in which you place this student.

Is group work too noisy?

Experienced teachers who use group work are well organised. Their classes are busy and productive. There is certainly more talking from students than in a teacher-led class, but this is a healthy sign.

Encourage students to develop their own set of rules for group work. You can do this in the mother tongue so that students understand the process and can participate. Agree on some simple rules, such as talking one at a time, allowing each student to have a say and moving quietly if they shift from one place to another. If the classroom is getting noisy, remind the students of their rules.

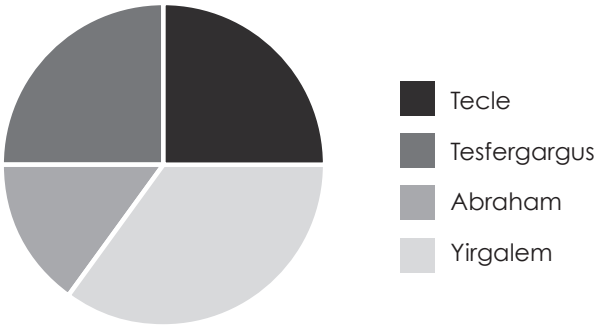
Activities

The Environmental Education Curriculum Companion for Science has lots of suggestions for group work. Once you have tried some of these, start designing your own group-work activities. Your students will be more motivated, make better progress and both you and they will enjoy classes more.

Activity: Reflection on group work

Students could record their responses to the following questions in their exercise book.

1. How well did your group share the responsibilities for completing the task? As a group, fill in a pie chart to show the contributions of individuals in the group. You must all agree on the final chart.



2. Now think about the way you worked as a group and give yourself a score out of ten for each of the following areas:

Taking turns	/10
Listening to others	/10
Giving each other feedback	/10
Keeping to time	/10
Sharing the responsibility	/10
Solving problems	/10
Producing good work	/10

Monitoring student progress

One of the most important tasks of a teacher is to monitor student progress. For example, when teaching Environmental Education in the English Language classroom, a teacher will want to know several things:

- How well are students progressing with English in the four skill areas of speaking, listening, reading and writing?
- Do students understand the Environmental Education concepts you are teaching?
- Are students developing environmentally sustainable attitudes and behaviours?
- How are student progressing in relation to the *Expected Learning Outcomes* for the grade they are in?

Formal assessment of learning

You will be formally assessing student learning in relation to Expected Learning Outcomes when you conduct exams each semester. This assessment process provides formal feedback to parents, students and the School Director about student progress. Exam results will identify both individual and class problems in understanding. They will also help you to monitor your own success as a teacher.

Environmental Education in Science is assessed as an overall part of the curriculum. When you examine students on the topics

in the curriculum you will be covering the environmental content as well as the science content. You will not need to make any separate formal assessment of Environmental Education.

Using assessment to guide learning

In order to know how well students are learning, teachers are constantly monitoring their students. In order to plan your classes you need to know how individual students are progressing and also how the class overall is progressing. Monitoring student progress on the Environmental Education topics in the curriculum is no different. You will want to monitor both content and language progress. You can do this by observing students' participation in class, marking written work including homework and by giving regular quizzes and exercises in class.

Using assessment as a form of learning

Assessment activities can actually help students learn. Giving students feedback on their work is an important part of their learning. You do this when you correct student work, for example, marking their homework. You also give students immediate feedback when you praise them for something they have done well or when you correct their mistakes in class.

One of the most difficult challenges for students is learning the amount of vocabulary they need to master at each grade. Frequent assessment of vocabulary helps students to learn. You can easily prepare a variety of oral and written vocabulary quizzes about environmental topics. These can be activities that students enjoy, such as team competitions, or there can be more formal written quizzes or exercises. Students have word lists in their textbooks. This is the core vocabulary they need to know by the time they complete a grade. Encourage students to check the words they get wrong in their word lists rather than simply correcting them yourself. You want your students to be independent learners and helping them to use the word lists is an important strategy for independent learning.

Assessing Environmental attitudes and behaviour

It is not possible to directly assess attitudes, but we can work out what students' attitudes are by the way they behave. To take an example: if students throw their rubbish on the ground in the schoolyard, then you can work out that they do not have an environmentally sustainable attitude to waste. Changing behaviour is a difficult process. Students first need to be informed about an issue such as waste. Then they need to understand why it is important for them to behave in a certain way. Then they need to take the step of acting differently.

In the case of students who throw away rubbish in the school grounds, they may not have enough information on the consequences of their action, or they may not be acting on the information they have.

Some of the things that encourage students to change behaviours are:

- ***Good role models***. It is important that teachers demonstrate environmentally sustainable attitudes themselves.
- ***Peer groups.*** Students are more likely to change their behaviour if other students are also changing their behaviour.
- ***Participating in practical activities with an environmental theme.*** Activities which students enjoy and learn from will have more success than just talking to students. Life Skills Education also focuses on behaviour change. Make sure you talk to the teachers trained in Life Skills Education to see what strategies they are using to develop positive behaviours in students.

Activity: Self-reflection

Students could record their responses to the following questions.

1. Three things I have learned about _____ are:
   *
   *
   *
2. The most important thing I have learned about _____ is:
3. During the unit I felt _____ because _____ .
4. Something I have learned about myself as a learner is:

   _____

   _____

   _____

5. The best activity we did was _____ because _____ .
6. Something I need to improve on is _____ .
7. I would like to find out more about _____ .

Organisational Framework for Environmental Education

Environmental Education is not only *what* we learn but ***how*** we learn and ***how we know*** it is learnt. A popular framework for organising learning experiences in Environmental Education is ***'about', 'in'*** and ***'for'*** the environment':

- Education ***about*** the environment refers to the important understandings of facts, concepts and theories developed by students.
- Education ***in*** the environment refers to students' direct contact with the natural environment such as a beach, a mangrove, a forest, grassland, or even the schoolyard. This helps students to develop an awareness about and concern for the environment.
- Education ***for*** the environment is directed towards action, and aims to motivate behaviour change towards lifestyles that involve more compatible and sustainable use of environmental resources.

Students as learners for a sustainable future should be encouraged to be:

- Reflective and deep thinkers who have the capacity to understand the complexity of environmental issues.
- Interested, enthusiastic and capable of learning about the world around them.
- Autonomous learners who are self motivated with a real interest in learning about the environment.
- Ethical and responsible citizens who have the capacity to make ethical decisions and who consider the views of others when making decisions, imbued with the skills necessary to work with others towards collaborative goals.

Student knowledge and understanding should include the three pillars of sustainability 1. environment, 2. economy and 3. society – supported by the skills and capabilities of critical thinking and reflection, systems thinking, future thinking, participation skills and the capacity to plan and manage change.

Education *about* the Environment

- Provides understanding of how natural environments work.
- Provides understanding of the impact of human activities.
- Develops environmental investigation and thinking skills.

Integrating Environmental Education Across the Curriculum

Environmental Education is an important cross-curricular activity. If a subject teacher is aware of what other teachers are doing in their subjects, this helps them to connect Environmental Education learning with the content in other subjects.

A school garden is a good example of how you can work across the curriculum. Students can be involved with the garden in a variety of ways. They may be in the Green Club or Agriculture Club. The Science teacher might involve students in some experiments related to the growth of plants. The Social Studies teacher might work with students on soil quality in the garden and might also consider the social, cultural and historical significance of plant selections. The Maths teacher might involve students in measuring out an area to be planted. English can give students a way to bring all these things together in the form of simple stories or dramas. If teachers are individually aware of what other teachers are doing in the garden at each grade level, they can follow up some of the activities in their own classes and thereby provide a richer learning context.

If possible, it is desirable to plan activities with other teachers to create learning that

goes across the curriculum. A Social Studies teacher might agree, for example, to follow up a Science activity about animals by doing some research on their distribution in Eritrea. Students can be helped to make the connections between subjects by reference to what they have already learned in other subjects.

Critical Thinking

Critical thinking is an important approach to be introduced in the teaching/learning process in the elementary schools. Critical thinking is about asking questions, challenging prior knowledge and learning, and challenging assumptions (what you believe/think is real or true) and what is already known. Critical thinking is about not taking anything at face value. It is about uncovering assumptions and finding the underlying meanings and causes. Critical thinking can question external issues in society such as water-use practices and resource management. Critical thinking is also about students looking inward to challenge their own assumptions, beliefs, values and attitudes.

Why should we be doing this?

As the world changes and we are exposed to new experiences, new learning, new ways of acting and working, we need to engage in critical thinking as we try to understand what these changes mean for us. Questions to ask when experiencing social change (for example in a township an example could be the introduction of a new industrial plant in your community) may include:

- How will this change affect my life? My family? My community? The environment?
- Are my values changing as a result of this new aspect of life?
- How has it affected my life? Is this what I want? Is this what is best for the environment in which we live?

Critical questions that could be asked about litter could include:

- Where is this pollution coming from? What must occur so that the local environment is not polluted?
- Who or what is polluting the community? Why are they polluting the community? What would make them change?
- What is the best way to address this issue? What would happen if the local environment continued to be polluted?

These are the sort of questions – challenging, uncovering, discovering – that are asked when using critical thinking. This is so that we can uncover and discover what is occurring in our world, how we feel and what we are going to do about it.

- Students must make choices, evaluations and judgments every day regarding:
- Information to obtain, use and believe.
- Plans to make.
- Actions to take.

Findings from research indicate that:

- There needs to be a shift in many classes from a teacher-centred classroom to a student-centred classroom, in which students can be involved in collecting and analysing information, paired problem solving, cooperative learning settings, simulations, debates and critical reporting sessions.
- Providing experiences in real-life situations or situations that simulate real-life situations increases the probability that skills will be used.
- Providing modelling of the skills, ample opportunities for practice and feedback on the effectiveness of the student's thinking are also important considerations.

Selection of experiences should be based on the developmental levels of the students.

Environmental Education *in* the Environment

Education **IN** the environment – Environmental interpretation:

- Direct contact with the environment provides reality, relevance and practical learning to the student.
- Develops aesthetic appreciation.
- Develops skills for data gathering and analysis.
- Fosters environmental awareness and concern.

Teaching Outside in the Environment

Learning outside the classroom will be an important part of Environmental Studies. Providing students with high quality learning activities in relevant situations beyond the walls of the classroom is extremely beneficial for helping students appreciate their first-hand experiences from a variety of different perspectives. An experience outside the classroom also enhances learning

Education research over 30 years has developed to strongly suggest that teachers should take advantage of these 'live' examples and not limit their teaching to textbooks and in-class examples.

by providing students with opportunities to practice skills of inquiry, values analysis and clarification and problem solving in everyday situations.

Local area investigations are useful, not only because they can be linked to meet student outcomes of subject areas, but also because they can be most enjoyable. They can provide the thrill and satisfaction that stems from discovery and recognition. They can be extremely motivational with school children of all ages. A range of very useful skills can be developed and practiced in the course of a local-area investigation. Local-area studies or investigations are sometimes referred to as excursions or field trips.

The great thing about any excursion is that it provides FIRST HAND EXPERIENCE that is a REAL, AUTHENTIC EXPERIENCE.

Such experiences can be used as a base upon which to build. Students invariably experience excursions as a relaxed, enjoyable approach to learning and as a result are more

engaged. The chief skill associated with an excursion is OBSERVATION, although most teachers emphasise inquiry, an approach based on data collection and interpretation. Furthermore, any excursion does not restrict learning to observation at a specific site but can provide a wealth of information en route to the particular site. Hence, excursions can be very meaningful and, although sometimes awkward and time consuming to prepare and manage, invariably they have a great impact on the children.

Education research over 30 years has developed to strongly suggest that TEACHERS SHOULD TAKE ADVANTAGE OF THESE 'LIVE' EXAMPLES AND NOT LIMIT THEIR TEACHING TO TEXTBOOKS AND IN-CLASS EXAMPLES.

Points to remember:

1. You are responsible for the safety of the children.
2. Seek to have well-prepared parent helpers to accompany the children on excursions and consider a number of competent adult helpers for any excursion.
3. Always check numbers regularly BEFORE and AFTER segments of the excursion.
4. Use the 'buddy system': get children paired.
5. Ensure all Ministry of Education and school regulations are met.
6. You can never be TOO CAREFUL when in charge of children.

Reference: Live & Learn Environmental Education, Best Practice Guidelines for Environment Education, Maldives, 2008.

Environmental Education *For* the Environment

Only education FOR the environment offers teachers the theory and practice that can link knowledge to environmental improvement and this therefore remains an essential component of Environmental Education.

Education **FOR** the environment – a sustainable environment:

- Links knowledge to change.
- Develops concern and responsibility for the environment.
- Develops environmental ethics.
- Develops the motivation and skills to participate in environmental improvement.
- Promotes a willingness and ability to make lifestyle choices compatible with the wise use of environmental resources.

Values Education

To incorporate environmental issues in the schools, we need to recognise some basic characteristics of these issues:

- Environmental issues are often complex as they involve economic, social, cultural and political circumstances.
- There are always two sides to an issue and multiple perspectives.
- It takes more than knowledge and facts to understand environmental issues. It requires seeing the problem from different angles and awareness of values and beliefs.
- Taking action and solving environmental problems in Eritrea, as in all countries, is an ongoing process. As positive changes are made, new challenges and access to new information will emerge so that continual reassessment and revision of strategies is required.

- It is important that teachers allow students to claim ownership of environmental problems and to develop their own responses and ideas about solutions without imposing their own views. The Problem Solving Model aims to protect this process.

Values are an internalised set of beliefs or principles of behaviour held by individuals or groups. Clarifying student values is an important aspect of Environmental Education, as it helps students to self-reflect and increase their awareness of their own values.

Children involved in values education are encouraged to:

- Identify their own value positions and/or attitudes of the groups they belong to.
- Talk about what they believe in and why.
- Take the opportunity to hear opposing points of view and to defend their own.
- Respect the value position of others.
- Feel free to change, modify or reject their own value position.
- Realise that people's value positions change as a result of reflection, new experience, maturity, or other factors.
- Make choices and make them freely.
- Discover and examine available alternatives.
- Take action to affirm their values.
- Act, behave and live in accordance with their values.

Values education can be incorporated in daily activities across the curriculum through role-plays, storytelling and indigenous knowledge. Here are some examples of activities to engage students in the exploration, identification and clarification of values:

1. ***Surveys and opinion polls.*** Lifestyle surveys can be carried out and analysed. Students can design their own lifestyle surveys and to gather data from others.

Analysis of poll or survey results helps students to develop the understanding that people view issues in different ways and that decisions made for a community of people need to take into account the various values and beliefs they hold.

2. ***Significant moments.*** Ask students to recall a particular moment in their lives that involved making an environment-related decision. Once they have identified a 'significant moment', they must brainstorm the factors that influenced their thinking about the issue at the time. Students might write a reflective piece to read to one another, re-enact the decision through drama, or represent the decision-making process in a comic-strip form. Share the significant moments and isolate the various values that played a role in the decision-making process.

3. ***Physical continuum.*** Place signs around the room (for example, 'strongly agree', 'partially agree', 'partially disagree', 'strongly disagree') in four corners or spread across a line. Read out controversial statements to students who must place themselves in the area that reflects most closely 'where' they

stand on a particular issue. For example, 'city life is better than country life'. Once students move to their preferred position on the statements, conduct some roving interviews asking them to justify their reason for choosing a particular viewpoint. After the activity, talk about the influences that affected the decisions made.

4. ***Directed Reading and Thinking Activity.*** Select a piece of writing that deals with a contentious environmental issue, such as a newspaper report. Read the first part of the piece and then ask students to predict what they think the author might say next – in keeping with the point of view already evident in the writing so far. Read the next section, stop, predict and confirm. Consider the values held by the writer and the way those values influence choice of language used to report or describe the situation.

5. ***Moral dilemmas.*** Moral dilemmas involve the presentation of a hypothetical situation in which a central character is faced with two choices, both of which are feasible and produce a mental conflict or dilemma. Dilemmas may be very simple at first and then become more complicated as additional factors are presented. The technique is a way of showing that there are usually a range of reasonable and feasible views about any one issue. Once the dilemmas have been explored, it is vital to assist students in the analysis of the discussion that has taken place. What values underpinned the various arguments in the discussion? How would this dilemma be resolved if conservation of the environment was the dominant value? What decision would be made?

6. ***Role-play/simulations.*** Role-plays encourage students to understand the range of values that are held by people involved in the decision making. One strategy is to provide students with a scenario and then to allocate role cards to individuals who must argue out their

case at a group meeting. Allocate roles to students and then allow them time researching, organising and thinking about their arguments. After the meeting, discuss the following:

- How did you feel when you had to play a role that you didn't agree with?
- Which arguments were the most convincing and why?
- Who felt like they didn't get a fair say? Why?
- What could you do next?

Futures thinking

Educating for a sustainable future includes a futures perspective: presenting the role of Environmental Education in working towards ecological sustainability. Some possible strategies that teachers can use with students to encourage them to consider their own future includes:

1. ***From here to there.*** This activity requires a large area or floor space and a set of blank cards:
    - One card depicts a current problem, event or situation for example, polluted waterway. This is placed at the left hand end of the space
    - Another card depicts a resolution to the problem for example, clean waterway. This is placed in the far right corner end of the space.
    - The space in between the cards is regarded as the pathway. Each blank card becomes a stepping stones in the pathway.
    - On one of the pavers, students write or draw events, actions that would help move the problem closer to the solution.
2. ***Possible futures.*** Students are given a timeline. Along the timeline they plot significant events that have occurred in relation to the topic being studied. On each arm of the timeline, students plot, first probable, then preferable, outcomes for the future. The timelines are compared between groups or individuals. At the end, the class discusses what could be done to make the probable more preferable?
3. ***Future wheels.*** An event/problem or situation is placed in a circle in the middle of a page. Students must then identify the key consequences (positive or negative) of that event and the consequences. Additional lines used as consequences become more remote. Sample starting points could be:
    - More trees planted in the school grounds;
    - Reduction in water availability.
4. ***Diamond ranking.*** Students are given a set of different viewpoints about a particular issue. Their task is to organise the viewpoints according to, for example, the extent to which they agree with them. The views are organised into a diamond shape indicating the priority given to them by the student. Criteria for ranking can be varied. Discuss the ramifications of each view for the 'future' in relation to a particular topic.

6 More about Environmental Education

Environmental Education — What is it?

'Environmental Education' is broadly defined as encompassing the raising of awareness about environmental issues *and* the development of new perspectives, values, knowledge and skills with regard to managing those issues. Environmental Education includes both formal and informal processes that lead to *changed behaviour* in support of a sustainable environment.

1. Environmental Education must involve everyone.

Media, educational institutions and community groups — as well as individuals – can contribute to the environmental well-being of the planet.

2. Environmental Education must be lifelong.

New environmental issues and new solutions are continually evolving. To move closer to achieving ecologically sustainable development involves continually refreshing the knowledge and skills, which are being applied to the environmental challenges faced.

3. Environmental Education must be holistic and about connections.

Environmental challenges are complex and involve multiple systems, connections, patterns and causes, all of which have social, scientific, cultural, economic, political and ethical aspects. All of these factors must be considered for effective management of environmental challenges. Thus a multi-disciplined approach, as well as specialist knowledge, is essential for the solution of environmental issues.

4. Environmental Education must be practical.

Better Environmental Education outcomes are achieved through action, and action-based approaches are fundamental to Environmental Education. Such approaches enable effectiveness to be more easily measured.

5. Environmental Education must be in harmony with social and economic goals and accorded equal priority.

One of the objectives of Environmental Education is to develop acceptance in the community that the nation's environmental objectives have the same priority as its social and economic objectives.

The teacher resources have been developed with an emphasis on 'Best Practice' in Environmental Education, which is based on three aspects:

- What and how are teachers teaching?
- What learning outcomes are students gaining?
- Is the environment likely to improve from the learning outcomes?

This manual outlines practices that engage students and enhance learning in ways that result in successful environmental outcomes.

Environmental Education for a Sustainable Future

The ESEE Initiative holds the view that it is important for the design of Environmental Education in Eritrea to be informed by international best practice. Environmental Education has evolved from being a response to the environmental crisis coming from increased contamination of land, air and water, growth of the world's population and the continuing depletion of natural resources. There is now a much stronger emphasis on integrating thinking and action around ecological, social, political and economic systems. It has become critical to acknowledge the complex relationships between these four systems if we are to achieve a sustainable future.

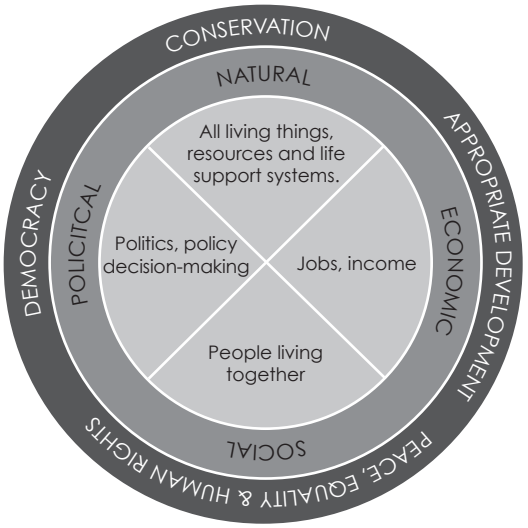


Diagram 1: UNESCO's model of the interlocking dimensions of sustainability

Education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues. It is also critical for achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development, and for effective public participation in decision-making. (Agenda 21, paragraph 36.3)

The United Nations Decade of Education for a Sustainable Future began in 2005 (2005–2015). Fundamental to the framing of this initiative is that a sustainable future requires transformational change of values and behaviour at all levels from the individual to the global.

Whole-School Approach

Effective Environmental Education includes curriculum but also requires the involvement of the whole school. Successful Environmental Education influences all aspects of school operations, curriculum, teaching and learning, physical surroundings and relationships with the local community.

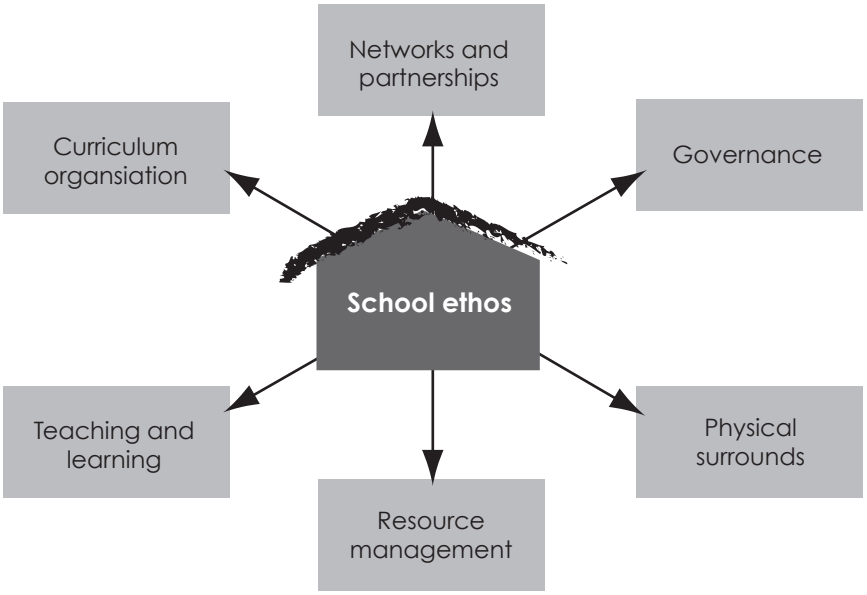
A school with effective Environmental Education practice has a vision and goals for the contribution it can make to Environmental Education that encompasses the following components:

- Inclusion in the curriculum and the teaching and learning.
- Skills, values and actions that support sustainability of people and natural resources.

Education for sustainable development can be taught in all school subjects in such a way that the learning objectives of the subject are achieved whilst keeping students talking about and planning ways of living sustainably as citizens in a local and a global community. This can be done either through infusion into each subject area or through interdisciplinary modules.

The richness of learning activities made available to children is of utmost importance. How students learn is often more important than what they learn. This is because different students have different abilities and learning styles and so a variety of strategies and methods are crucial to ensure that all students have opportunities to learn. Teacher oriented expository approaches such as questioning, explaining and demonstrating are effective for covering a large amount of information and if done well can be very exciting and motivating for students. These approaches can be enhanced when followed by collaborative learning, which provides further opportunities for learning and sharing with and among students in the classroom.

Alternative approaches for structuring classrooms can be utilised to further enhance learning. Such approaches include: small groups, individual, pairs and larger groups. These approaches can maximise opportunities for students to learn from each other, developing mutual respect and cooperation on various tasks and projects. Collaborative learning through learner-centred interactive approaches such as inquiry, problem solving, storytelling involving students, brainstorming, using surveys and work sheets along with learning outside the classroom can help students feel responsible for their own learning, developing thinking skills and fostering independent social and group processes.



School organisation and operation

Schools can undertake environmental audits of resources such as water and energy used and the amount of waste produced in the school. If environmental auditing is done carefully and methodically, reliable information can be gathered about problem areas and the associated costs. Auditing and the consequent saving of resources can save schools money by reducing the cost of resources such as water and electricity. Schools can also save by re-using and recycling resources such as paper.

School design

The design of the infrastructure in the school is essential to harvesting water, storing water and providing fresh water and clean toilets to students so that the school community can maintain healthy water, sanitation and hygiene practices.

In planning for the future, consider installing natural sources of energy that can be utilised through solar panels and wind turbines to replace electricity and other non-renewable fuels.

Development and management of school grounds

School grounds and the local environment can be an important resource for many learning experiences. The school grounds can be used in a number of different ways, including local studies of plant and animal life found in the school grounds. This could lead to local action projects such as a school vegetable garden, mini-forest or recycling project in the school.

- Maximisation of the harvesting of water and management of the use of precious resources such as water, energy and wood, as well as management of waste.

Action projects in the school grounds and local community by a class or club can provide valuable learning experiences. Projects can include: maintaining school compost heap, visiting and accompanying elders, caring for a garden, cooking with elders, making gifts of preserved food and handicrafts for friends and relatives away from home, monitoring local air or water quality and so on. One of the many educational benefits of action projects is the self-esteem that young people feel from being successful in planning and conducting a project that benefits others.

Enhancement of connection with the broader school community and other education institutions

Perspectives developed in school learning materials often do not reflect knowledge that has direct local relevance. The school curriculum can be enriched with local stories, history and community experiences of change and of how people lived in the area in earlier times. The local environment provides students with opportunities to put what they have learnt to immediate use by planting areas where there is high erosion, to shelter the local village from winds, to conserve local waterways, plants and animal life.

Conservation and protection of heritage values in the school and its grounds

Programmes that enable students to interact with local people and to find out about early history and change are essential to successful education processes. Children often have an intuitive capacity to distinguish between fact and fiction when listening to the stories of older people. This critical capacity can be enhanced through teaching with stories in ways that reveal and yet respect local cultural traditions as valuable sources of rich ideas for sustainable living. Teaching processes that include local and traditional knowledge are also useful ways of contextualising the school in the community.

Overview of the Resources

The Environmental Education Curriculum Companions for elementary schools provide practical examples of how Environmental Education can be integrated across the subject areas of:

- English
- Science
- Social Studies

A manual has been developed to provide teachers with practical ideas for extra-curricular activities, including suggested activities for Green Clubs and Health Clubs.

A resource has also been developed to support the School Directors, School Staff and PTA about ways in which they can contribute to ensuring their school operates as a sustainable school environment.

There are additional resources provided in the Toolbox which includes posters, information cards and reference materials.