SCHOOLS FOR A HEALTHY ENVIRONMENT

RESOURCES FROM THE ENVIRONMENT

Module 4

Educational Development Centre

unicef

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CONTENTS

INTRODUCTION

This Module is designed to be used by teachers and facilitators during relevant school and/or Environment Club activities. Each Module provides the curriculum linkages which would help the teachers in choosing activities when planning the lessons during the weekly meetings. Each section of the Module follows the similar format of a seven step inquiry model. The inquiry model is chosen to be followed in the activities because this method focuses on student centred learning. When applying the steps of the inquiry model the teacher will act as a facilitator and the students will:

- 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

The seven steps used in the Inquiry Model are as follows:

1. Tuning In
2. Deciding Directions
3. Finding Out
4. Sorting Out
5. Drawing Conclusions
6. Considering, Planning and Taking Action
7. Evaluation and Reflection

Each of the 6 Modules has been designed with subheadings for purpose, time, materials required and procedure. These subheadings have been included to guide teachers to plan and conduct the activities. The times provided with each activity are suggested times to help the teachers plan the class. This is a guide only; some activities may take less or more time. The inquiry process is based on developing critical thinking and problem solving skills, so the duration of activities should be related to the interest and development of the student's knowledge and skills. Each Module has also been designed with Student Resource Sheets and Teacher Information Sheets for each section, to assist in preparing for and conducting activities. Sample Student Resource Sheets have also been provided to guide teachers as to the kind of responses expected on each Sheet. Once again, this is offered as a guide and responses should not be limited to the suggested ones. Each Module has been written in plain English, however for some subjects it has been necessary to include more technical terms. A glossary has been included at the end of the Modules to explain these technical terms. Where possible photos and illustrations have also been included in each Module to explain or demonstrate specific activities.

These Modules are also accompanied by 2 toolboxes; one for indoor equipment and one for outdoor equipment. The toolboxes provide the physical materials needed to conduct the activities with the required materials being specified for each activity. The toolboxes also contain reference materials, posters and Flip Charts providing the necessary background for these Modules. The contents of the toolboxes and instructions for care and maintenance are included in the following pages.

OVERVIEW OF THE MODULES

There are 6 teaching and learning Modules in this series that are linked to themes in the Environmental Studies curriculum. Each Module provides instructions for a number of activities that might be used with a class to explore aspects of the issue that is being addressed. These Modules do not comprise a complete unit; rather they may be used to supplement other work being done within a topic area and what is found in the established syllabus.

Module 1:
Ourselves

1. Island Environment
2. Traditional Knowledge
3. Environmental Impact Assessment
4. Common Diseases and Prevention

Module 2:
Earth

1. Weather
2. Safe Drinking Water
3. Water Quality Monitoring

Module 3:
Life Around Us

1. Mangroves
2. Beaches
3. Coral Reefs
4. School Gardens

Module 4:
Resources from the Environment

1. Energy used at School and at Home
2. Conservation, Management and Reuse of Water
3. Managing Waste
4. Reduce, Reuse, Recycle
5. Composting Waste

Module 5:
Interdependence

1. Food Web
2. Exploring my Atoll
3. Ecological Footprints

Module 6:
Science and Technology

1. Wind Energy
2. Solar Energy

ENVIRONMENTAL STUDIES CURRICULUM LINKS

	MODULE	SECTIONS	GRADES 1 - 3	GRADE 4 - 5	NUMBER OF LESSONS
1	OURSELVES	Island Environment		x	3 - 4 lessons
		Living by Traditional Knowledge		x	3 - 4 lessons
		Environmental Impact Assessment		x	4 - 6 lessons
		Common Diseases and Prevention	x		4 - 6 lessons
2	EARTH	Weather	x		4 - 6 lessons
		Safeguarding Drinking Water		x	4 - 6 lessons
		Water Quality Monitoring		x	4 - 6 lessons
3	LIFE AROUND US	Mangroves		x	4 - 6 lessons
		Coral Reefs		x	4 - 6 lessons
		Beaches		x	4 - 6 lessons
		School Gardens	x		3 - 4 lessons
4	RESOURCES FROM THE ENVIRONMENT	Energy used at Home and School	x		4 - 6 lessons
		Conservation, Management and Reuse of Water	x		4 - 6 lessons
		Managing Waste	x		4 - 6 lessons
		Reduce, Reuse, Recycle	x		4 - 6 lessons
		Composting Waste		x	3 - 4 lessons
5	INTERDEPENDENCE	Food Web		x	3 - 4 lessons
		Exploring My Atoll	x		3 - 4 lessons
		Ecological Footprints		x	4 - 6 lessons
6	SCIENCE AND TECHNOLOGY	Wind Energy	x		4 - 6 lessons
		Solar Energy		x	4 - 6 lessons

TOOLBOX CONTENTS

DRY KIT		
	Item	Details
1	Plastic vials/jars screw top	100-300ml.
2	Hand lenses	Magnification x 3, lens diameter 90mm, plastic handle.
3	Long handled tongs	Jaws corrugated inside, length 150x200mm, stainless steel.
4	Insect catching nets	Hand net for insects, overall length 1.48m, diameter 250mm.
5	Plankton nets	Plankton net, nylon monofilament netting, with tough nylon collar, diameter 300mm, overall length 900mm, brass frame with 7m tow line and a PVC filter, aperture size 0.1mm and 0.3mm.
6	Thermometers	Mercury in glass, permanent amber markings, with anti-roll clip, range -10 to 110o Celsius, 6mm diameter with reinforced bulb, in plastic case.
7	Globe of earth	Rubber ball - globe of the earth, fully numbered meridian ring, diameter of globe 30 cm.
8	Twine	Brightly coloured nylon twine (20m).
9	Measuring tape	Sturdy, length 50m.
10	Measuring tape	Length 1 meter.
11	Student microscope	Monocular head rotates 360 degrees and has a 10x eyepiece. DIN 4x, 10x and 40x glass achromatic optics on the triple nosepiece.
12	Binoculars	Magnification 7×50, waterproof.
13	Litmus paper	Red and blue.
14	pH strips	Full Range pH from 1 to 14, colour reference chart with clearly printed pH values and instruction leaflet.
15	Low cost water monitoring kit	Provides simple and non-hazardous method of testing 8 basic water quality parameters: coliform bacteria, dissolved oxygen, BOD, Nitrate, pH, Phosphate, Temperature and Turbidity.
16	Water quality - H_2S	Bottle with hydrogen sulphide strip (H_2S water test kit).
17	Compass	90 mm in diameter and 22 mm high, and graduated in easy-to-read increments, waterproof.
18	Measuring staff	Metre pole sections in red and white.
19	Jars with screw top lids	500ml with wide lid.
20	Measuring containers	Clear plastic, capacity 1000ml, show divisions every 10ml.
21	Torch	Solar, kinetic, magnetic LED, waterproof.
22	Gloves	Cloth gloves (10 small and 10 medium).
23	Safety spectacles	Clear frames, should be able to wear over prescription spectacles.
24	Sediment sorting trays (3 sizes)	Diameter or length up to 30, Plastic sieve, aperture size 0.1mm, 0.3mm and 0.5mm.
25	Stopwatch	0.1sec, 30sec, 15min dials, diameter 45mm, housed in a plastic case, water proof.
26	Garden fork	Children's garden fork with plastic handle.
27	Garden spade	Children's garden spade with plastic handle.
28	Solar cell educational kit	Comprises of Solar cell module, solar energy introductory booklet; Small DC motor, screws and nuts, wire with motor clips; colour spinner discs; paper aero plane and bird models; plastic turnables with 4 sizes, 5/82, 1.52, and 22; plastic fan spinner.
29	Weather kit	Australian Geographic Weather Watch kit, comprises of rain gauge, thermometer, wind speed indicator flap and measuring cylinder. (www.australiangeographic.com.au)
30	Coral watch kit	Coral watch reef education package, The University of Queensland, Brisbane, Australia.
31	Cubic metre set and corner inserts.	A set of three alternately coloured dm triangle metre sticks, nine blank triangle metre sticks and eight corner blocks for the construction of an accurate internal dimension cubic metre.
32	Spring balance	Spring scale, calibrated in grams (to weigh up to 50kg).

DRY KIT		
	Item	Details
Identifications Guides:		
1	Plastic cards	Plastic card set containing pictures and names of fish and other invertebrates.
2	Field Guide	Field guide to Maldivian Birds & Beach Ecosystems (2008).
3	Field Guide	Field guide to Maldivian Plants (2008).
4	Field Guide	Field guide to Maldivian Mangroves (2008).
Flip Charts:		
1	Weather, Water, Waste and Energy	Weather, Water, Waste and Energy Flip Chart (2008).
2	Environment and Biodiversity	Environment and Biodiversity Flip Chart (2008).
Reference Books:		
	Subject	Author, year of publication, title, publisher and ISBN
1	Biodiversity	Krys Kazmierczak (2000) *A field guide to the Birds of India, Sri Lanka*, Pakistan, Nepal, Bhutan, Bangladesh and Maldives, Gopsons Papers Ltd, ISBN 81-87107-04-9
2	Biodiversity	Dr. R.C. Anderson, *Living Reefs of the Maldives*, Novelty Publishers, ISBN 99915-801-1-5
3	Biodiversity	Dr. R. Charles Anderson, (2005), *Reef fishes of the Maldives* Manta Marine Pvt. Ltd, ISBN 99915-5401-7
4	Biodiversity	National Centre for Linguistic and Historical Research, (2002), *Gasgahaagehi*, ISBN 99915-1-016-8
5	Biodiversity	National Centre for Linguistic and Historical Research, (2001), *Dhivehi raajjeygai hedhey baeh meyvaa*, ISBN 99915-1-009-5
6	Biodiversity	National Centre for Linguistic and Historical Research,(2002), *Maamelaameli*, ISBN 99915-1-025-7
7	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2004), *Dhivehi Raajjeyga Huri Aasaaree Thanthan*, 99915-1-063-X
8	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2002), *National Museum*, ISBN 99915-1-016-8
9	Traditional Knowledge	Naseema Mohamed and P.Ragupathy (2005) *Inscriptions of Maldives No 1*, National Centre for Linguistic and Historical Research, ISBN 99915-1-069-9
10	Traditional Knowledge	Naseema Mohamed, (2006), *Essays on early Maldives*, National Centre for Linguistic and Historical Research, ISBN 99915-1-083-4
11	Traditional Knowledge	Dr.Philos Egil Mikkelsen, (2000), *Archeological excavations of a Monastery at Kaashidhoo*, National Centre for Linguistic and Historical Research, ISBN 99915-1-013-3
12	Traditional Knowledge	National Linguistic and Historical Research, (2006), *Vihivana garunuge thereyga Dhivehi Raajje 1*, Novelty press, ISBN 99915-1-061-3
13	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2006), *Vihivana garunuge thereyga Dhivehi Raajje 2*, Novelty press, ISBN 99915-1-084-2
14	Traditional Knowledge	National Centre for Linguistic and Historical Research,(2006), *Vihivana garunuge thereyga Dhivehi Raajje 3*, Novelty press, ISBN 99915-1-085-0
15	Traditional Knowledge	National Centre for Linguistic and Historical Research , (2006), *Vihivana garunuge thereyga Dhivehi Raajje 4*, Novelty press, ISBN 99915-1-069-6
CD:		
1	Hygiene and sanitation	UNICEF hygiene and sanitation TV advertisement clips
2	Biodiversity	Coral Watch Reef Education CD, in the Coral Reef Education Package (see above)

WET KIT		
	Item	Details
1	Snorkel	Colourful, snorkelling - Ordinary
2	Masks	Colourful, snorkelling - Small 8 , Medium 12
3	Booties	Colourful, snorkelling - Small 5 , Medium 10, Large 5
4	Footwear / Gumboots	Rubber footwear, gumboots
5	Kick boards	Swimming boards for children (ages 6-13)

OPERATION AND MAINTENANCE OF TOOLBOXES:

- Toolbox Log – each time someone takes any equipment from the toolbox they should sign for which pieces they are using and sign again when they return them. An equipment log will be kept in each toolbox.
- Paper materials – it is important that books, posters, Flip Charts 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 that is free from insect or animal damage.
- Wet equipment – some equipment such as masks, snorkels, booties, etc are made for using in the ocean, but if you don't rinse them in fresh water after each use they will quickly become damaged. It is important to store this equipment in a dry, well aerated area that is 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. Binoculars for example need to be calibrated for use – different people may need it adjusted for their eyesight.
- Damage – if items are damaged beyond use it may be possible to get replacement items from your local Teacher Resource Centre. They only have limited replacement items so keep your toolboxes in good order.

MODULE SUMMARY

This Module has been developed to complement the theme 'Resources from the Environment' in the Environmental Studies curriculum. The Module mainly looks at the availability and sustainability of resources available from the environment. Students will need to find out more about these resources and build up practical and investigative skills.

The world is constantly changing and will continue to change. As change is the basis for all development: human, social, economic and so on, this Module interprets these changes from the past to more recent times. It also brings into attention the impact of change on the environment, considering the management of both renewable and non-renewable resources.

The table below depicts the toolbox contents needed for the practical application of this Module.

Item	Details	Section
Spring balance	Spring scale, calibrated in grams (to weigh up to 50kg)	2, 5
Thick gloves	Cloth gloves (10 small and 10 medium)	2
Safety spectacles	Clear frames, should be able to wear over prescription spectacles.	2
Long handled tongs	Jaws corrugated inside, length 150x200mm, stainless steel.	2
Cubic meter & corner inserts	A set of three alternately coloured dm triangle metre sticks, nine blank triangle metre sticks and eight corner blocks for the construction of an accurate internal dimension cubic metre.	4
Flip Charts		
Water, Weather, Waste and Energy Flip Chart (2008)	Water, Weather, Waste and Energy	1, 2, 3, 4 & 5

1 ENERGY USE AT SCHOOL AND AT HOME

Grades: 1 to 3
Number of lessons: 4 to 6

Purpose

To raise students' awareness of the ways in which energy is used in their daily lives to a point where they consider and take action about energy use in all their activities. In particular they use energy wisely and to best advantage through applying conscious deliberation to choices concerning decisions about energy use and take steps wherever possible to conserve energy.

Key questions

Key focus questions for this section are:

- How do we use energy?
- How can we use it more efficiently?

Links with other Modules

Ourselves

Toolbox

Flip Charts
Weather, Water, Waste and Energy Flip Chart

Preparation

Read *Teacher Information Sheet 1.1 and 1.2* to familiarise yourself with the topic.

1.1 TUNING IN

The following activities help to engage and focus students' interest on the topic.

ACTIVITY 1: DISCUSSION

Purpose: To develop ideas about energy and how it is used.
Time: Approx. 20 minutes
Materials Required: A4 or A3 papers, markers and sticky tape
Resource/Information Sheets: 1.2 Teacher Information Sheet – Introduction to energy

Procedure

As a class, discuss what energy is, where students think it comes from and how we use it. The aim of this discussion is not to come up with a detailed definition, but rather to establish a framework within which to situate the activities to follow.

Candles give out light energy.

Ask students questions to prompt their thinking, such as:

- What is energy?
- Where do you think energy comes from?
- What are some things you can think of that use energy?
- Which appliances do you use the most?
- Which energy uses are essential and which ones could be reduced?
- What predictions can we make about the most energy intensive items and practices in our homes?
- How can we check our predictions? (Use this question to lead into the idea of conducting an energy audit.)

Refer to *Teacher Information Sheet 1.2* to help you with prompt questions.

Record the student's answers to these questions on a chart and display it on the wall. We will return to this chart in the reflection activity to see how student's thinking about and understanding of the concept of energy has developed.

Responses may be as simple as "helps us to do things", "power" or "helps to make changes". This is fine as a starting point.

ACTIVITY 2: HOW DO WE USE ENERGY IN OUR HOMES?

Purpose: To develop, represent and analyse ideas on the use of energy and its role in our lives.
Time: Approx. 1 hour
Materials Required: A4 or A3 papers and markers and Weather, Water, Waste and Energy Flip Chart
Resource / Information Sheets: 1.1 Teacher Information Sheet – Pictograph

Procedure

Now ask students to complete a four square sheet to answer the question 'How do we use energy in our homes?' Ask students to fold an A4 piece of paper to create 4 boxes. Students will then ask 3 other students to help them answer the question by writing or drawing one possible answer in one of the boxes.

Encourage students to move around the room and find another person with whom to swap sheets. Discuss what they are each going to draw or write on the other's sheet before they do so to ensure that each person ends up with 4 different words or drawings on their page. Students should write their name under their text or drawing.

Next ask students to cut the 4 boxes on their sheet apart. As a whole class create a pictograph of the variety of answers (see *Teacher Information Sheet 1.1* for details about a pictograph).

Encourage students to analyze the information represented on the pictograph. To prompt this analysis, ask questions such as:

- What are the most common responses?
- What are the least common responses?
- Were people who provided one answer more or less likely to also provide another specific answer (use the names on the bottom of the pictures to conduct this kind of comparison)?

Energy can be used in many ways in our homes.

Once the graph as a whole has been discussed in this way, change the focus of the discussion to look at the specific themes represented. Ask questions such as the following to help students think more deeply about the role of energy in our lives:

- Can we do this activity without electricity?
- How has electricity changed the way we do this activity?
- How did our grandparents do this?
- If they could not do an activity without electricity, what did they do instead?

Encourage students to talk to their parents and grandparents about these issues. Or rather bring an elderly person to the class as a resource person, to give information to the students. Provide time for students to construct a list of the kinds of things they would like to ask. Questions might include:

- How did you cook?
- How did you light your house?
- What did you do without a TV?
- Would you be happy to live without electricity again?
- What are the best and worst things about living without electricity?
- What are the best and worst things about living with electricity?

Provide time for students to share the answers their families have given with each other. This could happen in the whole class or small group discussions, or could take the form of story writing or comparative drawings.

1.2 DECIDING DIRECTIONS

The following activities will assist students to decide on the directions they wish to take in their research.

ACTIVITY 3: ENERGY DIARY

Purpose: To maintain and share daily journal entries on energy use over a period of time

Time: 15 minutes per day for two weeks

Materials Required: Weather, Water, Waste and Energy Flip Chart, student 's exercise books and pens or pencils

Resource / Information Sheets: N/A

Procedure

Students should be able to write a daily journal of energy use in their exercise book. For example:

TIME	ENERGY USING ACTIVITY	ALTERNATIVES TO REDUCE ENERGY USE (IF POSSIBLE)
7:45 am	Turned on bathroom light	Checked to see if I needed the light on before turning it on
8:00 am	Heated water on stove for hot drink	
	Opened and closed fridge for breakfast	
1 pm	Turned on fan in classroom	Could have used a hand held fan
3 pm	Turned off classroom fan	Could have turned it off earlier
5 pm	Turned on TV	
8 pm	Turned off TV	Could have turned it off earlier as I wasn't really watching it after 7

Documenting should be conducted daily for several days if possible, in order to show the variation in appliance use.

Small group or whole class sharing of these sheets or journals should cover a range of energy uses for a variety of individual and group purposes.

Make sure all the following topics are covered but do not limit discussion to these points if students have other ideas.

- Cooking
- Lighting
- Appliances e.g. TV. radio, computer
- Cooling
- Transport

Motorbikes use energy to transport us from our homes.

Follow up with discussion of the Weather, Water, Waste and Energy Flip Chart; 'Energy Activities' pictures of a home and then later of a classroom/school to ensure that all the ways in which energy is used have been identified.

Identify the similarities and differences between types of energy used at school and at home.

Energy can be used in many ways in our classrooms.

1.3 FINDING OUT

The following activities involve students in shared experiences that provide new information about the topic and stimulate curiosity.

ACTIVITY 4: CLASSROOM ENERGY AUDIT

Purpose: To estimate, record and display how energy is used in the classroom
Time: Approx. 2 – 2 ½ hours
Materials Required: Pens or pencils and student 's exercise books
Resource / Information Sheets:
1.1 Student Resource sheet – Classroom Energy Audit and Example of completed Students Resource Sheet
1.1 Teacher Information Sheet - Pictograph

Procedure

Explain the concept of an audit as a monitoring exercise. In this case it is looking at how many things in our house or classroom use energy and for how long each day.

Make the connection between the individual patterns of behaviour in relation to energy use that has been established in the energy use diary and the context within which we make the decisions about our energy use behaviour. The audits will make clear the context for energy use.

Guide a class discussion about how to conduct an audit of the classroom using the following questions (and others as appropriate):

- What are the most common ways we use energy in our classroom?
- How many lights are there in our classroom? How long are they on for? Who turns them on and off?
- Do we use any appliances? (e.g. Computer? Radio? TV?) How often? How long are they on for? Who turns them on and off?

Have students complete *Student Resource Sheet 1.1* and compare results. Ensure that everyone is clear on what to count and how to record the information. Ask students about how they estimated how long lights and fans are left on for each day. Talking about this will help students when they come to audit their homes individually.

In small groups have students graph the findings of the classroom audit. Display these graphs and give the students time for a Gallery Walk (see *Teacher Information Sheet 1.1* for details on this) in which everyone can view the graphs made by other groups.

ACTIVITY 5: SCHOOL ENERGY AUDIT

Time: Approx. 2 hours

Materials Required: Pens or pencils and student 's exercise books

Resource / Information Sheets:

1.2 Student Resource Sheet – School energy audit and Example of completed Student Resource Sheet

Procedure

Ask students to conduct an audit of the school in small groups. Give each group a copy of *Student Resource Sheet 1.2* to fill in. Findings can be similarly graphed and tabled to give students more practice with these forms of visual presentation of information.

ACTIVITY 6: HOME ENERGY AUDIT

Purpose: To estimate, record and display how energy is used at home

Time: Approx. 2 ½ hours

Materials Required: Pens or pencils and student 's exercise books

Resource / Information Sheets:

1.3 Student resource sheet – Home energy audit and Example of completed Student Resource Sheet

Procedure

Students are now prepared to conduct individual household audits. *Student Resource Sheet 1.3* provides a form to guide a home energy audit. Older students can create their own format for a household audit, or can modify the form provided.

If creating their own audit form, encourage students to consider the following:

- What kinds of things will you be looking at? (use ideas generated in the 'tuning in' activity as a starting point)
- What kinds of appliances will you need to look at?
- What kinds of measures will indicate the amount of energy we use? (e.g. how many lights in the house and how long are they on for each day?)

Students can then graph their home audit information and display for others to see. Class tallies can be made which will allow comparisons between the different households represented to be made. You can use the audit form in *Student Resource Sheet 1.3* to facilitate the tallying process. Questions such as the following may help you guide this discussion:

- What is the most popular time of day for lights to be on?
- What kind of lights do most homes use?
- What are the most commonly used appliances?
- What is the least used appliance?
- What is the appliance that is on for more hours than any other appliance?
- What appliances are least likely to be turned off properly?
- What mode of transport do most people use?

1.4, 1.5 SORTING OUT AND DRAWING CONCLUSIONS

Students at this stage will be collating, processing, analyzing and presenting the information in a variety of ways. Students will have the opportunity to further explore any questions that may have arisen when they were investigating. This would also be a good time to revisit some of the initial activities from Tuning In or Deciding Directions sections, for the students to witness how their knowledge has increased.

The following activities will also help students to interpret information, establish connections and confirm/reject or modify predictions.

ACTIVITY 7: HOW DO WE USE ENERGY?

Purpose: To identify differences in energy use between different homes and to determine factors that contribute to different levels of energy use.
Time: 1 ½ hours
Materials Required: A4 or A3 papers and pens or pencils
Resource / Information Sheets: N/A

Procedure

Whole group discussion of the following questions and activities should lead to students being able to recognize differences in energy use between different homes, reasons for these differences and, in some instances, how energy use might be reduced through behaviour change.

What did you find? Did your family use more or less energy than you anticipated?

Compare the graphs of different student's homes. What are some of the factors in each of our lives that contribute to different levels of energy use? e.g. number of people in the family, age of people in the family, number of appliances different families have, etc. Talk through the differences in different families that result in different patterns of energy use.

Why are some appliances used more than others?

Encourage students to think about what impacts on our energy use. Compare energy use at school and home and help students think about what the differences are between how we use energy in these two locations. Topics to cover in discussions may include:

- Energy helps us create good studying conditions at school
- We do not eat at school so we do not need cooking facilities or a fridge
- At home we use energy for entertainment – e.g. TV, stereo
- More people benefit from the energy used at school as there are more people in the classroom.
- I have more individual control over my energy use at home as it is often only me that is affected by my energy use decisions.

Energy use can be high or low depending on our lifestyles.

1.6 CONSIDERING, PLANNING AND TAKING ACTION

As a result of students being actively involved in decision –making throughout the inquiry process, it is hoped that they will be empowered to take action which has positive personal, community and global effects. Some suggestions are listed below:

ACTIVITY 8: HOW COULD WE USE LESS ENERGY?

Purpose: To plan and implement ideas on how to maintain energy use at home and at school
Time: Initially 1 hour, for follow up and monitoring 1 ½ hours
Materials Required: A4 or A3 papers, pens, pencils and markers.
Resource / Information Sheets: N/A

Procedure

As a class discuss ideas for reducing energy use in the classroom. Develop a list of possibilities and conduct a class vote on which changes students would like to make (e.g. voting about turning on lights rather than automatically turning them on).

To support these actions, create an energy reduction ideas chart for display in the classroom.

In pairs students can create signs, prompts and posters for school and home to help each other remember which energy saving actions they are trying to take. These prompts might be signs to be stuck on light switches to remind people to turn them off, prompts on fan controls to check the temperature before turning it on (have a temperature agreed to), prompts to remind people to turn off appliances, etc.

This can be followed up a week or so later with a discussion about how the process of change is going. Consider questions such as:

- Is it easy to use less energy?
- Do you often forget to ask others before you turn the lights on?
- Have the prompting signs helped?

You could consider appointing a rotating energy monitor to check that things are turned off if students feel they need more support in making the changes agreed to.

Encourage students to have similar conversations with their families about using less energy at home as appropriate.

Provide opportunities in class for students to share stories of energy savings at home as a way to celebrate changes (be careful not to 'penalize' those whose homes are not participating).

Additional celebration and ongoing reinforcement could be carried out by follow up monitoring of classroom energy use to see if reductions have been made or sustained one or two months later (this would also provide ongoing practice with and reinforce use of charts/graphs/tables as useful tools for comparative purposes when follow up monitoring is undertaken).

1.7 EVALUATION AND REFLECTION

At this stage it may become evident that there is a need to return to some stages of the inquiry process to clarify knowledge or refine skills. The following questions may be asked:

- Are you happy with the ways in which your information was gathered, analysed and presented?
- Is there anything you would change?
- Are there things you need to investigate further?

ACTIVITY 9: HOW HAS THE THINKING CHANGED?

Purpose: To make judgments on what has been learnt about energy an**d its use**
Time: 40 – 50 minutes
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets: N/A

Procedure

Return to the list made in the tuning in stage of this Module about what energy is. Revisit the ideas students had about energy and its use before undertaking audits and ask how their thinking has changed.

- What would students like to add to the ideas they had at the beginning?
- What things would they like to change?

1.1 STUDENT RESOURCE SHEET

CLASSROOM ENERGY AUDIT

Record how energy is used in the classroom

What uses energy in our classroom?	How many are there in the classroom?	When are they turned on?	How long are they left on for?
Lights	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
Fans	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day

1.1 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

CLASSROOM ENERGY AUDIT

Record how energy is used in the classroom

What uses energy in our classroom?	How many are there in the classroom?	When are they turned on?	How long are they left on for?
Lights	☐ none ☐ 1 ☐ 2 ☑ 3+	☑ morning ☐ lunchtime ☑ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☑ all day
Fans	☐ none ☐ 1 ☑ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day

1.2 STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

Fill in the table to show how lights are used at school

Rooms in my school	How many lights in each room?	What kind of lights are used?	When are they turned on?	How long are they left on for?
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other _______	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day

1.2 STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

Fill in the table to show the types of transportation used to come to school

Reason for travel	Mode of transport	Length of trip	Alternative
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice

1.2 STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

Tick the relevant boxes to show the electrical appliances used in school

What appliances are used in your school?	When are they turned on? (tick all that apply)	How long are they used for? Less than 1 hour, 1-4 hours, all the time	Are they turned off properly after use?
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode

1.2 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

1. Appliances

Rooms in my school	How many lights in each room?	What kind of lights are used?	When are they turned on?	How long are they left on for?
Classroom	☐ none ☐ 1 ☐ 2 ☑ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☑ afternoon ☐ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Music Room	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☑ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Computer Lab	☐ none ☐ 1 ☐ 2 ☐ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Hall	☐ none ☐ 1 ☐ 2 ☐ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Toilet	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☑ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Other rooms				

1.2 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

2. Transport

Reason for travel	Mode of transport	Length of trip	Alternative
Went to school	☑ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☑ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
Went home after school	☑ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☑ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
Went to school for Quran practice	☐ walked ☑ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☑ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
Went to school for extra classes	☐ walked ☐ rode bicycle ☐ rode scooter ☑ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☑ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice

1.2 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

SCHOOL ENERGY AUDIT

3. Appliances

What appliances are used in your school?	When are they turned on? (tick all that apply)	How long are they used for? Less than 1 hour, 1-4 hours, all the time	Are they turned off properly after use?
TV	☐ morning ☐ lunchtime ☑ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☑ no, they are left on stand by mode
Radio	☑ morning ☑ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☑ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Stereo	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☐ yes ☑ no,they are left on ☐ no, they are left on stand by mode
Fridge	☑ morning ☑ lunchtime ☑ afternoon ☑ evening	☐ up to 1 hour ☐ 2-4 hours ☑ all day	☐ yes ☑ no,they are left on ☐ no, they are left on stand by mode
Electric stove	☐ morning ☐ lunchtime ☑ afternoon ☐ evening	☑ up to 1 hour ☐ 2-4 hours ☐ all day	☑ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Fan	☐ morning ☐ lunchtime ☑ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Other _____	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode

1.3 STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

Fill in the table to show how lights are used at home

Rooms in my home	How many lights in each room?	What kind of lights are used?	When are they turned on?	How long are they left on for
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day
	☐ none ☐ 1 ☐ 2 ☐ 3+	☐ light bulb ☐ strip lamp ☐ other ________	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day

1.3 STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

Fill in the table to show the types of transportation used at home

Reason for travel	Mode of transport	Length of trip	Alternative
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice
	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☐ no choice

1.3 STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

Fill in the table to show how electrical appliances are used at home

What appliances are used in your house?	When are they turned on? (tick all that apply)	How long are they used for? Less than 1 hour, 1-4 hours, all the time	Are they turned off properly after use?
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode
	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode

1.3 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

1. Lighting

Rooms in my home	How many lights in each room?	What kind of lights are used?	When are they turned on?	How long are they left on for?
Living room	☐ none ☐ 1 ☐ 2 ☑ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Kitchen	☐ none ☑ 1 ☐ 2 ☐ 3+	☐ light bulb ☑ strip lamp ☐ other _____	☑ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Bedroom 1	☐ none ☑ 1 ☐ 2 ☐ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☑ up to 1 hour ☐ 2-4 hours ☐ all day
Bedroom 2	☐ none ☑ 1 ☐ 2 ☐ 3+	☑ light bulb ☐ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day
Bathroom	☐ none ☑ 1 ☐ 2 ☐ 3+	☐ light bulb ☑ strip lamp ☐ other _____	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☑ up to 1 hour ☐ 2-4 hours ☐ all day
Other rooms				

1.3 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

2. Transport

Reason for travel	Mode of transport	Length of trip	Alternative
Went to school	☑ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☑ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☑ could have ridden bicycle ☐ no choice
Went home for lunch	☑ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☐ went by boat	☐ under 5 minutes ☑ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☐ could have walked ☑ could have ridden bicycle ☐ no choice
Went shopping	☐ walked ☐ rode bicycle ☑ rode scooter ☐ went by car/taxi ☐ went by boat	☑ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☐ more than 15 minutes	☑ could have walked ☑ could have ridden bicycle ☐ no choice
Went fishing	☐ walked ☐ rode bicycle ☐ rode scooter ☐ went by car/taxi ☑ went by boat	☐ under 5 minutes ☐ 5-10 minutes ☐ 10-15 minutes ☑ more than 15 minutes	☐ could have walked ☐ could have ridden bicycle ☑ no choice

1.3 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

HOME ENERGY AUDIT

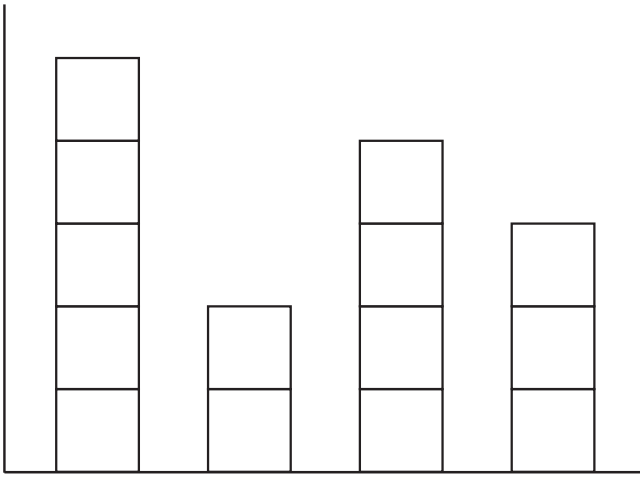
3. Appliances

What appliances are used in your house?	When are they turned on? (tick all that apply)	How long are they used for? Less than 1 hour, 1-4 hours, all the time	Are they turned off properly after use?
TV	☐ morning ☐ lunchtime ☑ afternoon ☑ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☑ no, they are left on stand by mode
Radio	☑ morning ☑ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☑ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Stereo	☐ morning ☐ lunchtime ☐ afternoon ☑ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☐ yes ☑ no,they are left on ☐ no, they are left on stand by mode
Fridge	☑ morning ☑ lunchtime ☑ afternoon ☑ evening	☐ up to 1 hour ☐ 2-4 hours ☑ all day	☐ yes ☑ no,they are left on ☐ no, they are left on stand by mode
Electric stove	☐ morning ☐ lunchtime ☑ afternoon ☐ evening	☑ up to 1 hour ☐ 2-4 hours ☐ all day	☑ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Fan	☐ morning ☑ lunchtime ☑ afternoon ☐ evening	☐ up to 1 hour ☑ 2-4 hours ☐ all day	☑ yes ☐ no,they are left on ☐ no, they are left on stand by mode
Other _____	☐ morning ☐ lunchtime ☐ afternoon ☐ evening	☐ up to 1 hour ☐ 2-4 hours ☐ all day	☐ yes ☐ no,they are left on ☐ no, they are left on stand by mode

1.1 TEACHER INFORMATION SHEET

PICTOGRAPH

A pictograph is a way of representing quantities by using pictures. In this context, a graph framework is used in which the vertical axis marks the number of times a theme is depicted and the horizontal axis marks the different themes that are represented. The bars on the graph are made up of the boxes students have written or drawn on for each other, which depict answers to the question 'how do we use energy in our homes?'.



The columns along the horizontal axis could be lighting, cooking, fans, TV.

The vertical axis should count each box as 1 unit.

Each box will have a different student's writing or drawing that relates to the theme of the column (e.g. column 1 is lighting so the boxes may have pictures of overhead lights, lamps, fluorescent tubes, or the word 'lights' written in English or Dhivehi).

Gallery Walk

A gallery walk is an opportunity for students to view each others work. When students have visually presented what they have learnt, posters, graphs, concept maps, etc. can be put up on the wall and students given time to walk around the room looking at each other's work.

1.2 TEACHER INFORMATION SHEET

INTRODUCTION TO ENERGY

WHERE DOES ENERGY COME FROM?

Energy comes from a variety of sources including:

- Food for people and animals.
- Electricity is made from burning petrol, oil, coal and natural gas. These are non-renewable sources.
- Electricity can also be made from the movement of water (hydro) and wind, from biomass or from the sun (solar) directly. These are all renewable sources.
- Nonrenewable sources of energy will run out. Renewable sources will not. Currently most of the world is reliant on non-renewable sources. We need to develop our ability to generate electricity from renewable sources.

In the Maldives there are no known reserves of oil, natural gas or coal, so all non-renewable energy producing resources must be imported. Diesel is the most commonly imported source, but petrol, kerosene and LPG are also imported.

Electricity in the Maldives is primarily produced by diesel generators.

Wind, solar and biogas sources are beginning to be used in pilot locations such as Baa Atoll Goidhoo and Raa Atoll Fainu.

Firewood is also burned for energy – cooking, for light etc.

How do we use energy?

The most common ways of using energy in the Maldives are shown in the table below. Almost 50% of energy is used to make electricity. 43% is used for transport and fishing combined.

Transport

Marine transport is the most significant form of transport in the Maldives and can be broken down into 4 categories – fishing, transfer of tourists, passenger ferries and cargo, and pleasure craft and others. These all use either diesel or petrol to power them.

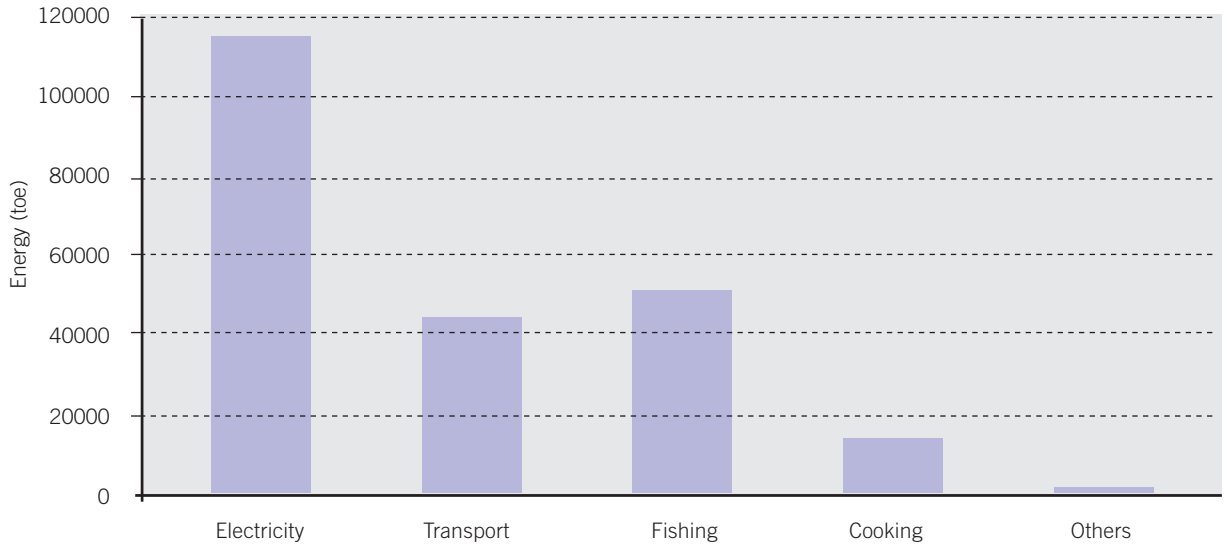
More than 95% of all registered vehicles are in Male'.

Vehicle ownership, especially motorcycles, has increased rapidly in recent years. The following table shows how many cars and motorcycles were owned in 2002 compared to 2004

(source: Ministry of Planning and National Development)

Type of vehicle	2002	2004
Motorcycle	8 889	14 448
Car	1 361	1 757

The community uses only 6% of all the energy generated in the Maldives, but everyone needs to be more careful about energy use, as it is expensive to produce. The diagram below shows how much energy different sectors use in the Maldives.



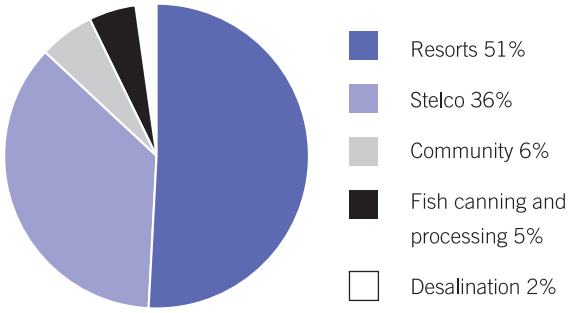
Primary energy usage for different sectors in the Maldives (2002). *Source from http://www.meew.gov.mv/energy/*

Why do we need to use energy more efficiently?

We need to use energy more efficiently as it is expensive to produce. All fossil fuels have to be imported into the Maldives and renewable energy sources are still being developed. If energy consumption continues to grow, as is predicted (see graph below), it will be more difficult to satisfy everyone's needs.

Using fossil fuels to generate energy creates greenhouse gases, which contribute to climate change.

Energy generation and corresponding diesel consumption by sector



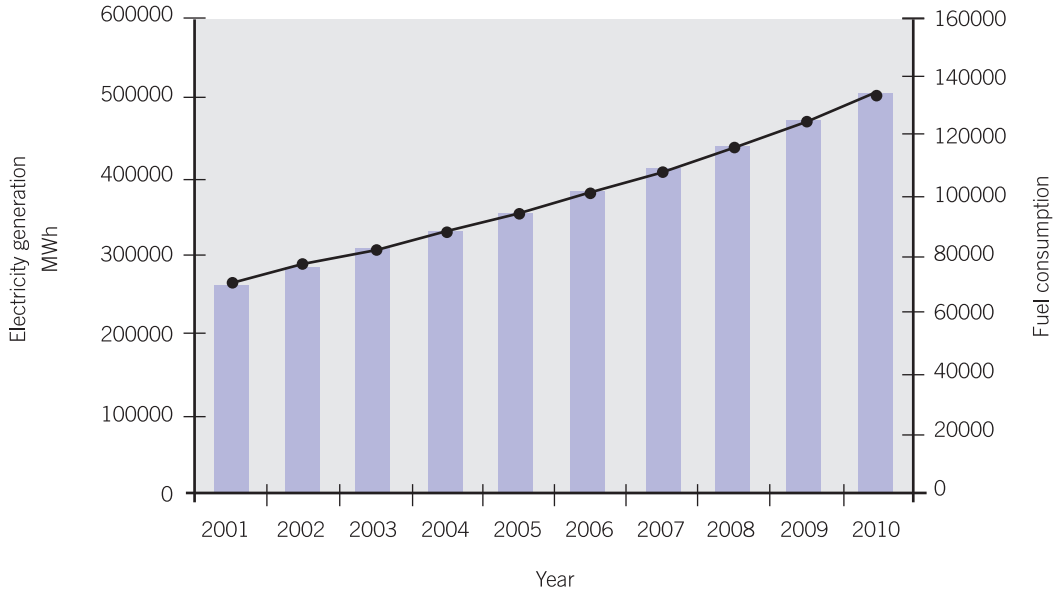
Unless otherwise specified, figures in tables are taken from Ministry of Environment, Energy and Water Report Development of a Technology Needs Assessment Resource Kit: Data for Estimation of GHG Emissions. August 2006.

Different atolls use and generate energy differently, as the following table shows.

TYPE OF ENERGY USED FOR COOKING 2004

Atoll	Wood	Kerosene	Gas
Haa Alif	39	51	20
Haa Dhaal	50	42	28
Shaviyani	37	33	30
Noonu	40	40	33
Raa	42	43	34
Baa	43	58	38
Lhaviyani	47	70	24
Kaafu	29	24	61
Alif Alif	33	25	60
Alif Dhaal	43	32	79
Vaavu	14	65	38
Meemu	47	57	44
Faafu	33	32	35
Dhaalu	23	26	50
Thaa	16	53	41
Laamu	73	48	42
Gaafu Alif	10	42	43
Gaafu Dhaal	49	51	39
Gnaviyani	0	66	62
Seenu	0	59	59
Male'	0	25	77

Forecast Electricity Generation and Fuel Consumption (2003-2010)



2 CONSERVATION, MANAGEMENT AND REUSE OF WATER

Grade: 1 to 3
Number of lessons: 4 to 6

Purpose

The purpose of this section is to develop an understanding of individual and collective impact on water as a resource. The students will realise the importance of water for all life, the need to conserve and manage our water resources sustainably, and their roles and responsibilities in doing so. They are introduced to concepts of water cycle, human impact on the water cycle, uses of water, wastewater and pollution of water and environmental impact assessment.

Key questions

Key focus questions for this Module are:

- What is the relevance of water for all life?
- How does the water cycle work?
- What impact do we have on the water cycle?
- How do we use water on our island?
- How is water being polluted on our island?
- What are the risks of wastewater?
- How could you save water?
- How can we conserve, manage and reuse water?

Links with other Modules

Ourselves

Toolbox

Physical materials

Ropes to tie the plastic cover, Spring Balance

Flip Charts

Weather, Water, Waste and Energy Flip Chart

Preparation

Familiarise yourself with the topic, the materials and the activities suggested.

In this section a number of scientific, technical and health facts are discussed. At times, this may shift the view of water to a more instrumental and mechanical one. Water can thus be reduced to a cleaning fluid, or simply a fuel for the body. There is a risk that water is characterised as a disease-carrying agent. However, in the context of education for sustainable development, which includes looking after other species and habitats, we need to acknowledge our interconnectedness with the natural environment.

A means to achieve this in the educational context with children is to engage all senses, reflective practice and artistic experience. Guided journey allows us to open our senses and emotional and intellectual engagement. Practice the reading for the guided journey as per *Teacher Information Sheet 2.2*

You could liaise with the visual arts teacher who can provide support with a number of activities. Therefore, it is important to study all of them before making any decisions. You can decide on where you want to enlist their support, then give her or him an outline of the activities and discuss with them possible cooperation.

You could also liaise with any of the language teachers for any poetry or story writing activities. There may be more that you can think of or would like to do.

2.1 TUNING IN

The following activities help to engage and focus students' interest on the topic

ACTIVITY 1: THE CYCLE OF WATER

Purpose: To focus the student's interest on water by discussing the water cycle.
Time: Approx. 30 minutes
Materials Required: Weather, Water, Waste and Energy Flip Chart
Resource/Information Sheets: N/A

Procedure

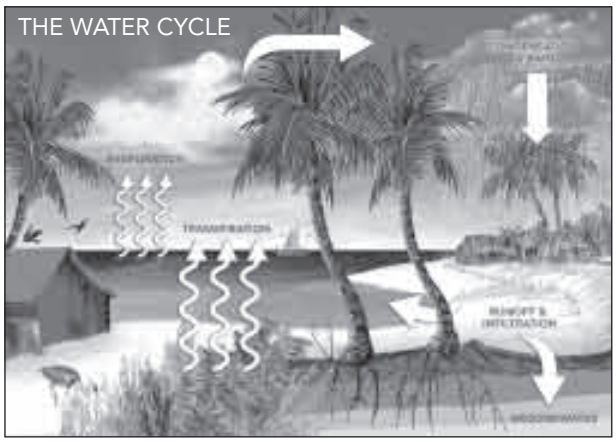
Begin with a class or group discussion, or have the students record on a piece of paper, the following points:

- Where have you seen water since you got up this morning?
- When and for what have you used water since you got up this morning?
- For what and where have you seen others (your family members, others in the community) use water?

Note the responses in a chart and display on the wall and have the students record in their exercise book.

In a second step: Discuss for each of the points gathered, what happens to the water that they have observed or used? The students will realise that the water does not disappear. It will continue to be part of the water cycle in some form or another.

Discuss with the students Weather, Water, Waste and Energy Flip Chart; 'Water cycle Theory'. Since the water cycle is truly a 'cycle,' there is no beginning or end. Water can change states among liquid, vapour, and ice at various places in the water cycle, with these processes happening in the blink of an eye and over millions of years. Although the balance of water on Earth remains fairly constant over time, individual water molecules can come and go in a hurry. The water in a fruit you ate yesterday may have fallen as rain half-way around the world last year or could have been used 100 million years ago by Mother Dinosaur to give her baby a bath.



ACTIVITY 2: CREATING A MINI-WATER CYCLE

Purpose: To create a mini water cycle and to record and discuss observations.
Time: 1 ½ hours
Materials Required: Weather, Water, Waste and Energy Flip Chart, big plastic container, small plastic container, small rocks and pebbles, soil, sand, small plants and clear plastic to use as cover.
Resource / Information Sheets: N/A

Procedure

Get students to follow the steps below:

- Students fill the container with small rocks and pebbles. These represent bed rocks.
- Add the soil and sand. These represent layers of soil covering the bed rocks.
- Place small plants in the soil. These represent vegetation cover.
- Fill the small container with water and place it on the soil. This represents a lake, stream or other surface water.
- Seal the container with the plastic. Your mini water cycle is complete.
- Place mini water cycle in a sunny place.
- Observe your mini-water cycle in action.
- Record and discuss students' observations.

Discuss the following concepts with your students:

- The role of sun light in the water cycle. What would happen if you placed your water cycle model in the dark?
- The importance of plants to the water cycle. What role do plants play in the water cycle? What would the effect be if there were no plants in your mini-water cycle?
- Did you notice any condensation on the plastic cover? What would this be in the real water cycle?
- What happens to the water that gets in to the ground? Is it lost?

Consider the following concepts:

- evaporation
- vapour
- transpiration
- condensation
- precipitation
- aquifer
- infiltration
- run-off
- cycle
- solar energy

ACTIVITY 3: WATER IN THE FOOD WE EAT

Purpose: To visualize and predict what happens to the water present in food, over a period of time.
Time: 15 – 20 minutes per day for two weeks
Materials Required: A suitable cut piece of fruit or vegetable and spring balance
Resource / Information Sheets: N/A

Procedure

This is a small activity that can be conducted in parallel to the above discussions and mini-water cycle activity in order to visualise that food, and by extension all living things, consist mostly of water. Water is in all the food we eat. For example, watermelons are almost all water, but nuts and seeds are less than 10% water.

Divide students into small groups. Each will have a suitable cut piece of fruit or vegetable.

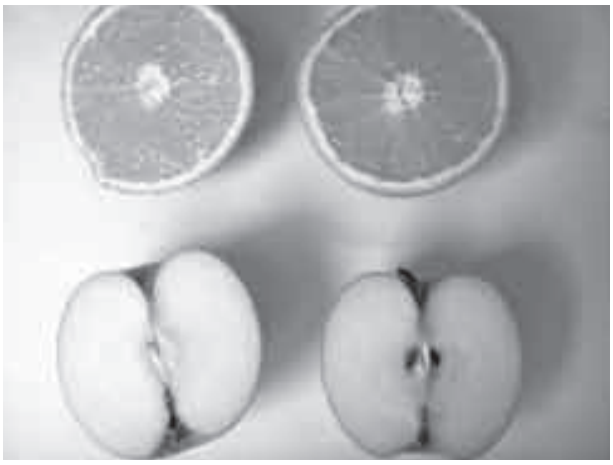
Have the group weigh their cut piece of fruit or vegetable on the spring balance.

Let the students predict what will happen to the weight of the piece, what it will look like, and how the weight will change over several days.

Let the piece dry for several days. Weigh and record the difference every day.

Discuss the results with the students.

Also discuss the appearance of the apple. "Would people weigh more or less if they had no water in their bodies?"



Water is an important part of the food we eat.

ACTIVITY 4: GUIDED JOURNEY

Purpose: To explore the element of water in relation to the self.
Time: 1 ½ hours
Materials Required: Pens or pencils, water colours and A4 or A3 papers.
Resource / Information Sheets: 2.6 Student Resource Sheet – Images of Water, 2.2 Teacher Information Sheet – Guided Journey

Procedure

The visualisation allows you to move the idea of water out of the instrumental, mechanical view to one of connectedness between the self and water as part of the natural environment.

Show aesthetically beautiful images of water that relate to the 'Guided Journey' *(Student Resource Sheet 2.6)*

Allow the students to describe what they see and think about those images.

Engage the students in the 'guided journey': Prepare the children, explain that you would like to introduce this exercise to allow them to have a new experience of "water", and have them relax before they start.

Listening to the sound of waves can be very calming.

They can sit down or lay down in a comfortable position, keeping their spine straight. Explain that you are going to read a story that involves water flowing. Explain that they have to focus on the story and imagine what is happening. Ask them to close their eyes, feel comfortable and remain straight.

Read the visualisation slowly and calmly as per *Teacher Information Sheet 2.2.* When you are finished with the guided journey have the students come back slowly and move on to discuss reflection questions. You can either enter a conversation with the students immediately, or ask the students to write down their thoughts. In the follow up conversation, ensure that the students' key thoughts are noted on the black board or in charts and displayed on the walls. Entries about the activity can be accompanied by watery paintings using water colours. Reflection questions are, for example:

- What did you think about during this exercise?
- Could you imagine the water flowing along your body?
- What was the strongest image or thought you had?
- How did you feel about it?

Extensions

Students could write a story describing the journey of a rain drop after it has fallen to earth. The story could begin like this (find some other ways of beginning a story and ask the students to continue with it):

> *"It's a long way down, but the landing is actually soft. It's not like I'm the first one ever to take this plunge. I think I landed in the ocean this time. Some of the locals seem kind of salty – but I don't mind the ocean at all. The dolphins are pleasant, and the waves keep us busy.*
>
> *The only downside to being here is that in the ocean you join up with so many other drops that you can lose your sense of individuality. The clouds that dropped us here are passing. The sun is warming us up. Looks like a short stay here this time. The ride skyward is slow – it's the quick flight plummeting back down that I like most."*

2.2 DECIDING DIRECTIONS

The following activities will assist students to decide on the directions they wish to take in their research.

ACTIVITY 5: HUMAN IMPACT AND THE WATER CYCLE

Purpose: To investigate discussion and share information about how human activities in the local area impact the water cycle.
Time: 2 ½ hours
Materials Required: A4 or A3 papers, markers, pens or pencils.
Resource / Information Sheets: 2.1 Student Resource Sheet –Water cycle

Procedure

Ask the students to investigate how human activities locally disrupt the water cycle. They find out what activities happen in their local area and lead a class discussion about how they may affect the water cycle. This will also facilitate the students' understanding of the human impact on the water cycle, and the interconnectedness between us and the natural environment.

This activity enables students to look at how various stakeholders use water and the amounts of water needed for each activity. Students will identify the different uses of water in their local community and explore how those uses impact theenvironment. Introduce the students to what constitutes use of water, as some will be more obvious than others. Virtually everything uses water, it is a matter of identifying who and how much. Students will recognise that water quality determines how it can be used.

Divide the students into small groups and organise them to explore their island. Provide them with *Student Resource Sheet 2.1*.

The students will identify water in their environment that is part of the water cycle, for example, surface water, areas of vegetation cover, places where runoff occurs, clouds, or even water in buckets or uncovered wells from where water evaporates.

Next, the students will discuss how human activities affect this part of the water cycle.

Ask students to create a map of their local area or school yard labelling sites that make up parts of a water cycle.

The results are shared in the classroom. Ensure note taking on the blackboard and in their exercise books.

Collecting water from a well.

Extension

Research water usage by a larger institution, for example, a hospital or an industrial or commercial organisation and develop a plan on how to raise awareness within that particular organisation.

Ask the students to find and cut images from newspapers and magazine that depict uses of water, pollution of water, and any other images showing water. Pin-up the images for the whole class to see. Ask the students to write down what they see, some things they like, some things they dislike about each poster, and how these comments to their life.

2.3 FINDING OUT

The following activities involve students in shared experiences that provide new information about the topic and stimulate curiosity.

ACTIVITY 6: HOW WE USE WATER ON OUR ISLAND

Purpose: To investigate, record and discuss how water is used at home, at school and in the community.
Time: 1 ½- 2 hours
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets:
2.2 Student Resource Sheet –Uses of water at home
2.3 Student Resource Sheet –Uses of water at school
2.4 Student Resource Sheet –Uses of water for livelihoods

Procedure

This activity enables students to look at how various stakeholders use water and the amounts of water needed for each activity. Students will identify the different uses of water in their local community and to explore how those uses impact the environment. Introduce the students to what constitutes use of water, as some will be more obvious than others. Virtually everything uses water, it is a matter of identifying who and how much. Students will recognise that water quality determines how it can be used.

Explore with the students how water is being used at home, school and for livelihoods. List and monitor how water is used in your home, at school and in your community.

Calculate the total amount used per activity used in a day. Decide on a unit of measure to use.

Introduce *Student Resource Sheets 2.2, 2.3 & 2.4*

IMPORTANT: Instruct the students not to fill in the columns yet: How can water consumption be reduced? Can the used water be reused? How?

The activity can be conducted individually or in groups. You may like to vary this approach with each student resource sheet.

Discuss in the classroom, and collect the main points. Discuss which activities use up a lot of water.

Students could also discuss how life would be different if they did not have water to do these things.

2.4 SORTING OUT

Students at this stage will be collating, processing, analyzing and presenting the information in a variety of ways. Students will have the opportunity to further explore any questions that may have arisen when they were investigating. This would also be a good time to revisit some of the initial activities from Tuning In or Deciding Directions sections, for the students to witness how their knowledge has increased.

Water is a precious resource on our islands which must be conserved.

ACTIVITY 6: CONSERVING AND REUSING WATER

Purpose: To explore ways of minimizing and reusing water at home, at school and for livelihoods.

Time: 1 ½ hours

Materials Required: Weather, Water, Waste and Energy Flip Chart, pens or pencils and student 's exercise books

Resource / Information Sheets:

2.2 Student Resource Sheet –Uses of water at home

2.3 Student Resource Sheet –Uses of water at school

2.4 Student Resource Sheet –Uses of water for livelihoods

Procedure

Students recognise that water is a limited resource that should be protected from contamination and used wisely. They develop ideas on how water use can be minimised and discuss whether water used in some of the activities can be recycled or used elsewhere.

Explore with the students how the uses of water at home, school and for livelihoods can be reduced.

- Can the used water be recycled? How?
- Complete the relevant column on the sheets.

Extension

Where applicable, monitor how much water is used at home or at school in relation to the water bills your family or school has to pay on a monthly basis and suggest ways you can help lower the water bills.

Where applicable, students could monitor the water usage for the school or at home and compare that against the monthly bills. Then they can come up with some simple ways of minimising the bills as a target to achieve a reduction in water consumption in their school or home.

2.5 DRAWING CONCLUSIONS

The following activities will help students to interpret information, establish connections and confirm/reject or modify predictions.

ACTIVITY 7: WASTEWATER AND WATER POLLUTION

Purpose: To draw conclusions on what has been learnt about waste water and water pollution.
Time: 50 - 60 minutes
Materials Required: Pens or pencils and student 's exercise books
Resource / Information Sheets: 2.5 Student Resource Sheet –Places of water pollution

Procedure

Use *Student Resource Sheet 2.5.* The students identify and discuss sources of potential water pollution, predict and list possible effects of pollution, and list the processes and activities that produce wastewater and sewage. They recognise that wastewater pollution causes waterborne diseases and health problems. They come to realise that protecting and preserving our water sources is the best way to ensure there is enough clean water for all life on their islands and in the ocean.

Well contamination from leaking septic system.

2.6 CONSIDERING, PLANNING AND TAKING ACTION

As a result of students being actively involved in decision –making throughout the inquiry process, it is hoped that they will be empowered to take action which has positive personal, community and global effects. Some suggestions are listed below:

ACTIVITY 8: PLANNING A WATER AWARENESS EVENT

Purpose: To plan and implement activities to create awareness of conservation, management and reuse of water.
Time: 1 ½ hours per day for three days
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets: N/A

Procedure

Undertake a visioning exercise with the students:

- Ask the students to read the notes they have taken in relation to the guided journey.
- Ask them: Take a moment, close your eyes and imagine your favourite water place, your favourite kind of water, your favourite activity with water.
- Ask them: What do you want your water resources to look like in the future?
- What words and pictures do you associate with this vision?
- Ask the students to draw their ideal water resource of the future. What are some of the things they can do to help this vision become a reality.

Next, discuss what they can do individually or at the community level to improve water conservation, management and reuse on their island. Their task is for each of them to formulate at least three actions that need to be done, and develop a plan of how to implement those. They can then communicate to and celebrate their ideas with the community in a number of ways:

- Devise an educational event (an information day for the parents conducted by the students), or
- Have students design an eye catching poster promoting different ways on how to conserve water. Have participants think up an original slogan or catch phrase for their poster. Advise them that the best posters are simple with a clear message.
- Develop an educational flyer to educate their family and/or community on certain issues that need urgent attention.
- Paint a mural.
- Design an awareness campaign as outlined in the Module Ourselves, a TV or radio advertisement and perform as role play for the school and the parents.

Ask students to record their experience of this activity in their exercise book.

2.7 EVALUATION AND REFLECTION

At this stage it may become evident that there is a need to return to some stages of the inquiry process to clarify knowledge or refine skills. The following questions may be asked:

- Are you happy with the ways in which your information was gathered, analysed and presented?
- Is there anything you would change?
- Are there things you need to investigate further?

ACTIVITY 9: FUTURE WATER CONSERVATION, MANAGEMENT AND REUSE

Purpose: To make judgments and to reflect on what has been learnt about conservation, management and reuse of water.
Time: 1 ½ hours
Materials Required: Pens or pencils and student 's exercise books
Resource / Information Sheets: N/A

Procedure

Include outlines of the awareness campaign or other community action, any drawings and any other notes in their exercise book. The following questions are a guide. Relate the reflections to the activities they have undertaken, the students' involvement in the community, their roles in relation to safeguarding drinking water, whether their ideas of their roles and responsibilities have changed.

- What did you like about this section?
- What did you not like about this section?
- What was the most important thing that you have learnt?
- What do you see as most important to improve water conservation, management and reuse on their island and in the Maldives?

Extension

Have students explore their personal impact on their local environments by writing an essay, short story (day in the life) or poem, preparing a presentation or somehow expressing how their own water use practices contribute to water resources, whether positively or negatively. How does their use of water impact global water resources?

Or

Analyse the concepts, uses, management issues and views of water described in the Quran. What perspective does Islam have on water management and conservation?

2.1 STUDENT RESOURCE SHEET

WATER CYCLE

Answer the following:

Identify water in your environment that is part of the water cycle, for example, surface water, areas of vegetation cover, places where runoff occurs, clouds...

Part of water cycle:.....

.....

How may human activities affect this part of the water cycle?

.....

.....

.....

Part of water cycle:.....

.....

.....

How may human activities affect this part of the water cycle?

.....

.....

.....

Part of water cycle: .....

How may human activities affect this part of the water cycle?

.....

.....

.....

2.1 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

WATER CYCLE

Answer the following:

Identify water in your environment that is part of the water cycle, for example, surface water, areas of vegetation cover, places where runoff occurs, clouds...

Part of water cycle: Surface water, such as wetlands

How may human activities affect this part of the water cycle?

Rubbish and water pollution can affect the quality of surface water. Pollution might even kill animals and plants that also use the surface water.

Part of water cycle: Groundwater

How may human activities affect this part of the water cycle?

Houses with leaking septic tanks can leak pollution into groundwater. This can make water smell bad and make anyone sick who drinks it.

Part of water cycle:

How may human activities affect this part of the water cycle?

2.2 STUDENT RESOURCE SHEET

USES OF WATER AT HOME

Measure and record the following:

Activity (use in litres)	Number of times a day	Total water used in litres	Water quality	How can water consumption be reduced? Can the used water be reused? How?
Cooking main meal (10 litres)				
Other meals				
Drinking (0.25 litres per glass)				
Washing dishes in a sink (9 litres)				
Washing clothes (how many?) by hand (60 litres)				
Washing with washing machine each cycle (155 litres)				
8 minute shower (120 litres)				
Cleaning teeth with tap running (5 litres)				
Cleaning teeth if tap is turned off (1 litres)				
Flushing of toilet (11 litres)				
Gardening				
Other, for example play or: _____				
TOTALS				

2.2 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

USES OF WATER AT HOME

Measure and record the following:

Activity (use in litres)	Number of times a day	Total water used in litres	Water quality	How can water consumption be reduced? Can the used water be reused? How?
Cooking main meal (10 litres)	2	20L	Good– rain water	Use less water. Take the used water and put on plants in the garden.
Other meals	1	5L	Good– rain water	
Drinking (0.25 litres per glass)	10	2.5L	Good–drinking water.	No – we need to drink water. No.
Washing dishes in a sink (9 litres)	2	18L	Good– tap water	Do 1 big wash per day. Take the used water and put on plants in the garden.
Washing clothes (how many?) by hand (60 litres)	1	60L	Well water	Do 1 big wash per week. Use water in the garden.
Washing with washing machine each cycle (155 litres)	–	–	–	–
8 minute shower (120 litres)	3	360L	Good– from tap water	Take shorter showers
Cleaning teeth with tap running (5 litres)	2	10L	Good– tap water	Turn off the tap.
Cleaning teeth if tap is turned off (1 litres)	–	–	–	–
Flushing of toilet (11 litres)	5	55L	Well water	Use less water in the toilet.
Gardening	1	20L	Well water	Water when it is cool, so to reduce evaporation.
Other, for example play or: _____				
TOTALS		550.5L		

2.3 STUDENT RESOURCE SHEET

USES OF WATER AT SCHOOL

Measure and record the following:

Activity/ Undertaken by whom?	Number of times a day	Total water used in litres	Water quality	How can water consumption be reduced? Can the used water be recycled? How?

2.3 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

USES OF WATER AT SCHOOL

Measure and record the following:

Activity/ Undertaken by whom?	Number of times a day	Total water used in litres	Water quality	How can water consumption be reduced? Can the used water be recycled? How?
Gardener waters plants	2	100L	good	Water one time per day when it is cool. Grow plants that need less water. Use water from well.
Janitor cleans the toilets	2	50L	Water from tap	Clean the toilets once a day. Use water from well. Water can not be recycled.
Students drink water	Many	100L	Good– water from tap	Can't reduce drinking water use. Turn off taps when finished.

2.4 STUDENT RESOURCE SHEET

USES OF WATER FOR LIVELIHOODS

Investigate and record the following:

For example in agricultural activities, garden, fishing, building boats, shops, other…

Activity	Number of times a day	Total water used in litres	How can water consumption be reduced? Can the used water be recycled? How?

2.4 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

USES OF WATER FOR LIVELIHOODS

Investigate and record the following:

For example in agricultural activities, garden, fishing, building boats, shops, other…

Activity	Number of times a day	Total water used in litres	How can water consumption be reduced? Can the used water be recycled? How?
Agriculture	2	200L	Use mulching around plants so that water does not evaporate in the sun. Grow plants that do not need much water.
Shops	1	10L	Water is used to clean the floor of the shop. Used water can be poured on plants in the garden.

2.5 STUDENT RESOURCE SHEET

PLACES OF WATER POLLUTION

Many activities at home, play, work or school reduce water quality. Identify places of potential water pollution on your island. Use one sheet per potential pollution. Identifying the possible effects and how water pollution can be reduced or prevented.

Places and sources of potential water pollution are, for example, septic tanks, places where wastewater is stored or disposed of, sources of wastewater that enter waterways untreated, human waste, runoff from roads, runoff from gardens, runoff from drains; drainage from industry, washing clothes, waste dumping, clearing, runoff from agricultural chemicals, animal and human faeces,…

1. Place: .....

2. Source/activity: .....

.....

Drawing of source/place:

3. Possible effects (on health, environment, livelihoods…):

.....

.....

.....

4. How can this (potential) water pollution be reduced or prevented?

.....

.....

2.5 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

PLACES OF WATER POLLUTION

Many activities at home, play, work or school reduce water quality. Identify places of potential water pollution on your island. Use one sheet per potential pollution. Identifying the possible effects and how water pollution can be reduced or prevented.

Places and sources of potential water pollution are, for example, septic tanks, places where wastewater is stored or disposed of, sources of wastewater that enter waterways untreated, human waste, runoff from roads, runoff from gardens, runoff from drains; drainage from industry, washing clothes, waste dumping, clearing, runoff from agricultural chemicals, animal and human faeces,…

1. Place: Waste Center (kuni koshi)

2. Source/activity: Waste is collected here. When it rains waste from around the area washes into the sea. These include plastic bags and tins.

Drawing of source/place:

3. Possible effects (on health, environment, livelihoods…):

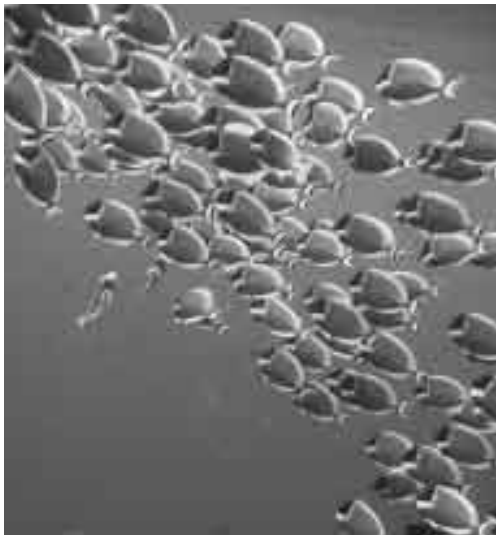
The waste that washes into the sea looks bad and sometimes smells bad. When tourists come to our island they comment that it looks bad. Also I see birds and other animals living near the waste, so maybe they will accidentally eat the waste.

4. How can this (potential) water pollution be reduced or prevented?

We can collect litter from the road and keep waste away from the beaches. This way waste can't be washed into the sea.

2.6 STUDENT RESOURCE SHEET

IMAGES OF WATER



2.1 TEACHER INFORMATION SHEET

WATER

Water covers most of the world. If you were an astronaut gazing down from outer space, you would notice that most of the earth's surface is blue. Almost three quarters of the earth (70%) is covered by water. Almost all of the world's water (97%) is found in oceans and seas and is salty. The oceans are full of life, teeming with many plants and animals – but we cannot easily use salt water for our daily needs. All animals and plants that live on land, including humans, need fresh water to drink. People can live for 3 or 4 weeks without food but we can only survive 3 days without water.

A very small amount (2.8%) of the world's water is fresh and most of it is not available for us to use. It is:

- locked up in polar ice caps and glaciers (82%),
- trapped under the ground as ground water (14%), or
- found in the atmosphere or soil as water vapour (a tiny amount around 1%),

Only 0.7% of this water is freshwater that we can drink:

- 97% is saltwater
- 2.3 % is water frozen in glaciers

A very small amount around 0.3% is found in rivers and lakes – this is water we can use!

Water in us

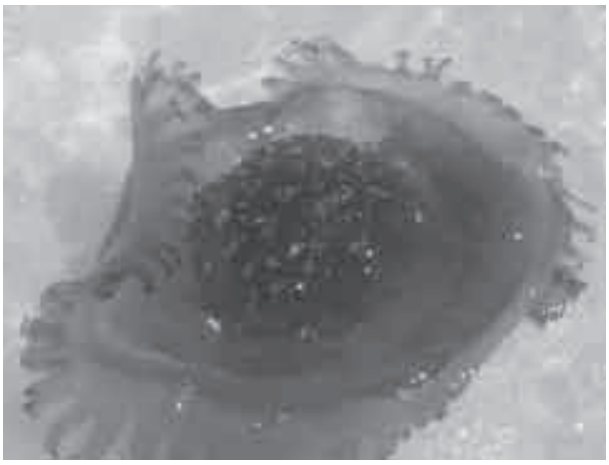
All active living organisms are at least half water. Chicken and cats are almost $^2/_3$ water. Jellyfish are almost all water! Water makes up almost $^3/_4$ of our bodies:

- almost $^2/_3$ (67%) is found in our cells,
- around $^1/_4$ (25%) is found between our cells, and
- the rest (about 8%) is found in our blood.

Our bodies need water to stay cool, to move blood (which carries food and oxygen) and to remove body wastes. We get water from drinking and from the food we eat. We lose water from our bodies through sweat, when we cry and when we go to the toilet.

Water in nature

Clean, fresh water is essential to support and maintain almost all plants and animals in the natural environment. All living things need water to survive. Freshwater is also an important habitat for organisms, including fish, birds, aquatic insect larvae and algae.



Jellyfish are almost completely made up of water.

The Maldives is surrounded by saltwater. We cannot drink this water, unless it undergoes a process of desalination.

Why do plants need water?

Plants need water to make food. The green parts of the plant, mainly the leaves, use nutrients and water from the soil (which they draw up through their roots) and the sun's energy to make sugar. This process is called photosynthesis.

Plants also need water to transport energy and nutrients through their tissues. Plants use oxygen to break down sugars which produces the energy they need for growth. This reaction, called respiration, produces carbon dioxide and water, just like when we breathe. This water is released as gas back into the atmosphere.

How does water move through plants?

As water evaporates from the pores on the leaves surface more water is pulled up from the plant's roots to replace that which has been lost to the atmosphere. This process is called transpiration.

Plants can absorb a lot of water making transpiration a very important part of the water cycle. A lot of trees in one place, can add a lot of water to the atmosphere. It is enough to affect local climates and influence weather patterns.

Trees and water in the soil

Trees can influence how water moves through the soil. Tree roots bind the soil, holding it together. Removing trees affects the soil in a number of ways.

Not as much water soaks into the soil. This is because trees help to slow the rate of runoff after rain.

There are not as many tree roots to hold the soil together. : In the Maldives, lack of trees in the shoreline causes beach erosion. Heavy rain can more easily wash away soil (called soil erosion). This soil often ends up in streams and rivers, changing water flows. This is a big problem if riverbanks are cleared for gardens and plantations.

The water table may rise because the trees roots no longer reach deep into the soil. Rising water tables can bring nutrients and salts to the surface.

Uses of water and water quality

Water is used in many different ways. People use water for watering animals, agriculture, domestic and industrial uses, including generating electricity. Domestic uses include drinking, cooking, bathing, laundry, gardening, in the toilets and for heating and cooling domestic places. Water is used for recreation, travel, and for livelihoods.

The use of water for different purposes depends on its quality. The quality of water depends on several factors, for example the source of water. Water quality in rivers and natural water holes are influenced by land use and management practices in the catchment. In the Maldives the catchment area is confined to the island. (Refer to WWWE Flip Chart page, Water Lens)

Worldwide, residential use accounts for a small amount overall. The main residential use comes from personal hygiene and home cleaning. Agriculture uses more than half of the fresh water available. Water feeds plants and irrigates lands allowing farmers to produce crops. Industry accounts for about 40% of all fresh water use. Industry uses

Agriculture uses a lot of water to grow food for us to eat.

water to transport goods, cool machinery, dispose of waste, as a power source, and refining of natural resources. An example, 15,000 litres of water is used to make steel for one washing machine.

Many factors influence the amount of water that we use, including:

- what we use it for,
- how easy it is to access,
- how much it costs,
- how much water is available
- how clean the water source is,
- who manages the water,
- how much we value clean water,
- the number of people living in the house.

These factors also shape our attitudes to water. We might value it more if it was harder for us to get, and if we had to pay more for it.

Pollution of water

Pollution occurs when pollutants such as waste, litter, leaves and plastic bags, or other substances entering the water have a negative effect on the water quality. To help us understand and monitor where pollutants are coming from, pollution can be broadly divided into two types:

- point source pollution which comes from a clearly identifiable source, such as a factory pipe or toilet; and
- non-point source (or diffuse) pollution which comes from a broad area, such as pesticides from agriculture, oil and grease from roads. Diffuse pollution is much harder to identify and treat.

When people throw their rubbish away they rarely consider that 'away' is actually somewhere else. There are consequences related to the volume and quality of waste and pollution that we put down the drain or in the water.

Water pollution comes in many forms. It can refer to any physical or chemical substance that has a negative impact on the quality of the water. Wastewater contains any unwanted materials from homes, factories, and industries. It can be a mixture of water and dissolved or suspended substances.

Supplies of water are prone to pollution. For instance, rainwater which is pure can pick up dirt or other forms of pollution from the atmosphere, roofs, roof guttering and storage tanks. Surface water can also be polluted easily by direct contamination from humans and animals, or indirectly when rain washes human waste and other pollutants from the banks into streams and rivers. Underground water can also be easily polluted, when surface water may leak into the wells.

What is in wastewater?

Water is an excellent dissolving and carrying substance and when it leaves residential and commercial properties it can contain a variety of substances. These substances can be categorised into:

- biodegradable pollutants which can be broken down (decomposed) by natural processes such as digestion by bacteria. This waste is often organic matter such as food scraps, paper, soaps and detergents. These biodegradable wastes are usually produced by living things, including humans;
- non-biodegradable pollutants (inorganic matter) are chemicals and waste that are very difficult to break down and often makes their way into the rivers and ground water system. Plastics, cans, tins, glass, chemicals such as oils and other human-made materials would take many years to break down. It has taken technology to create these materials and it will take technology or thousands of years to break them down into a reusable form;
- heavy metals and industrial wastes including lead, zinc, cadmium and mercury which may be a bi-product of industry or found in runoff from roads. Small amounts may be found in wastewater;
- nutrients, which are essential for life but may cause environmental problems if they are concentrated in wastewater. Human wastes contain high amounts of phosphate and nitrogen. Other domestic products such as dish washing liquid, laundry detergent, shampoo and soap contain phosphates which can be found in household wastewater.
- there are also pathogens in wastewater, which are disease-causing organisms such as bacteria, protozoas and viruses.

Sources of freshwater

Surface Water

Surface water is any water that is stored on the Earth's surface (including oceans). Fresh surface water includes lakes, rivers, streams, ponds, pools and wetlands. It also includes surface runoff, water that falls as precipitation and flows across the land rather than soaking in.

Ground Water

14% of all fresh water is stored underground! Groundwater is one of the world's most important sources of fresh water – one third of the people in the world rely on it. Ground water is stored in rock pores, cracks and openings, which act like a huge underground sponge. People extract this water by digging wells, bores or by putting in pumps. The water can be cold or hot. Ground water is replenished by rain fall, which soaks into the ground.

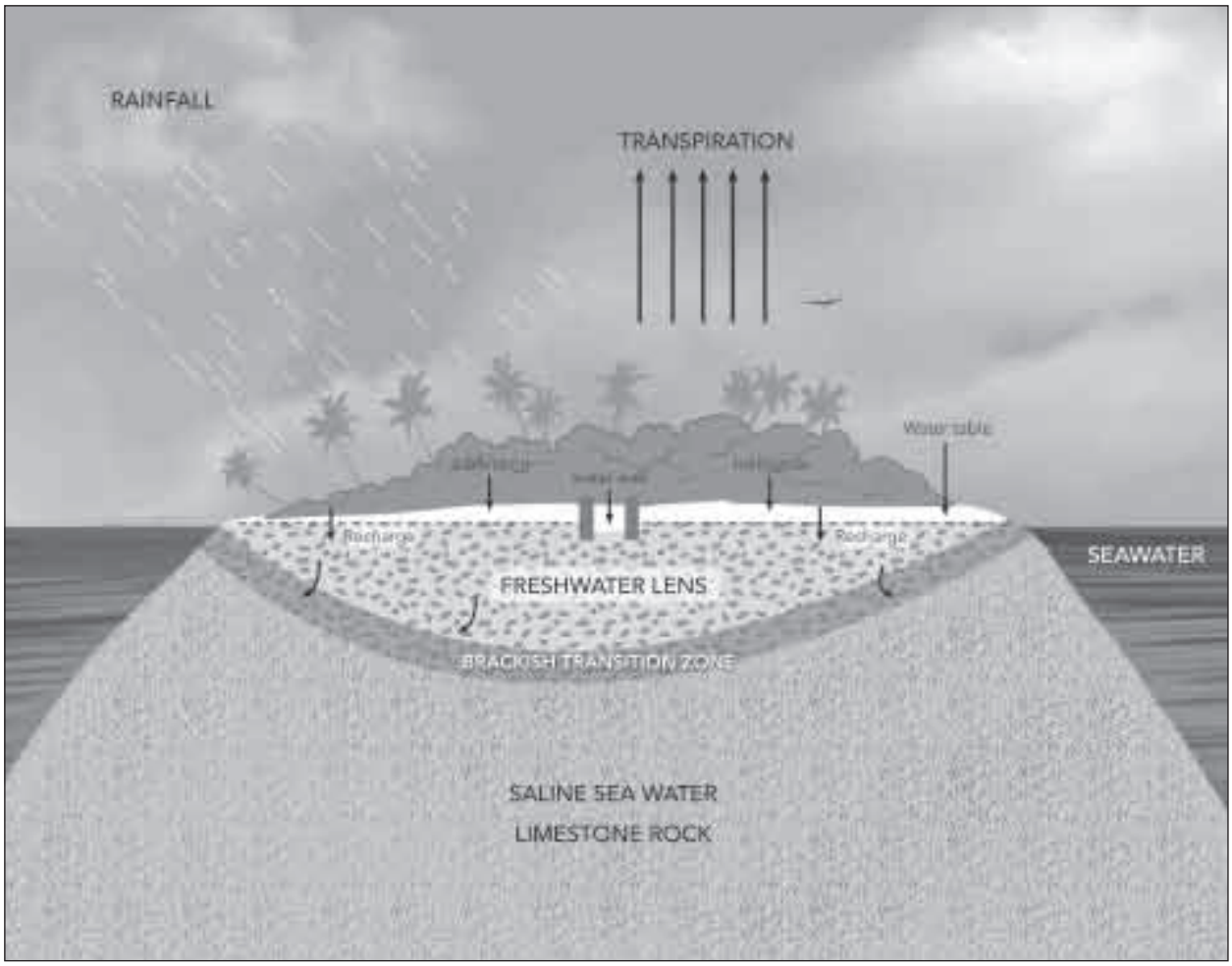
Compared to surface water, ground water moves very slowly, sometimes only centimetres every year. The speed at which ground water moves depends on the rock type and gravity – some of the water deep in the ground may have been there for thousands of years!

Water Table

When all the spaces between soil particles and rock fractures fill up with water, the soil is said to be saturated. The top of this zone is called the water table. The water table can be centimetres or meters below the surface, depending on rainfall and how much water is being used. This water may be only days, weeks or months old.

Freshwater Lens

A freshwater lens is a natural feature that makes it possible for life on many small Maldivian Islands. The fresh water collects below the ground and on top of the sea water, and is good enough quality for plants, animals and communities to use. This supply is replenished by rainfall which percolates down through the coral and sand.



The freshwater lens is an important source of water in the Maldives.

Freshwater lenses are a particularly important source of water on atoll islands, which often have no surface water.

Will we always have enough freshwater?

It is easy to think that we have plenty of water in the oceans – it rains often, sometimes for days on end – so why do we need to worry about the quality and quantity of fresh water?

How much fresh water is available for our use depends on lots of factors, including:

- the fresh water source and how it is replenished
- how well we look after our water sources
- the country's level of development
- who owns the water supply and how much they charge
- who makes the decisions about managing water quality
- how much water we use

The fresh water supplies are particularly vulnerable to climate change. Rising sea levels will probably affect the quality and quantity of water available. Low-lying atoll islands that rely almost completely on rainwater or freshwater lenses, for their water supply will be most affected. Rainfall is likely to increase in some areas, leading to more storms. This may lead to more flooding and less water soaking into the soil. However, some areas will get less rain and experience more droughts.

2.2 TEACHER INFORMATION SHEET

GUIDED JOURNEY

Reading a story and reading a Guided Journey serve different functions. When reading stories, children do understand and become involved in what you are reading and the purpose is to create a link to the external events that are occurring in the storyline. But in a Guided Journey, they become more actively involved with their own body and self. Instead of engaging in more thoughts in relation to the story, Guided Journey enables the mind to become free and to explore without the burden of thought clutter that is usually constantly moving around in our head.

Through the practice of Guided Journey, it becomes possible to diminish the clutter of thoughts that are constantly moving through the mind. Most importantly, our attachment to these thoughts, and our identification with them, progressively become less. Meditation is the process of withdrawing attention from externals, including physical and mental processes, and consciously focusing one's attention.

Each Guided Journey has its own distinctive theme and gives children the opportunity to experience it. There are many types of Guided Journey, various techniques and practices. Meditation normally involves concentrating on an object, which could be a candle, a sound or word, your breath or a beautiful harmonious pattern.

In the case of this exercise here, the water mediation at the same time facilitates the process of focusing on water, sensing it, connecting with it emotionally, mentally, visually and kinaesthetically (that is through visualised movement of the water in connection with one's own body).

Gentle Wave

Imagine your body getting lighter. Imagine that a gentle wave of fresh and cool water is washing over your body, beginning with the top of your head. Let the coolness and the freshness wash all around your head.

Feel the coolness bringing peacefulness and calmness to your head as it washes away all tensions and worries and the clutter of thoughts. Feel the movement of the water. Feel the ripples, a slight gurgling.

Now, allow the freshness and coolness of the water to wash down your neck and shoulders. Feel the light ripples and the gently flowing waves of coolness, a gentle gurgling of water down your neck and shoulders. Cool and fresh. Sensual water. Peacefulness is washing over you and you feel yourself growing more and more relaxed.

Let the coolness of water wash down your arms to your fingertips. Let any tension flow out through your fingertips, disappearing forever. Let the clutter of thoughts flow out with the tensions. It floats away with the water.

Now let the cool water wash down your chest and back. Feel the coolness and relaxation wash over your stomach and down your thighs. The ripples of water are engaging all your senses through the skin. Waving coolness on your skin. Your body and mind are feeling lighter and lighter. You begin to float.

Let the coolness wash down your knees and calves and then your feet and toes. The water is flowing along your legs and feet and toes. Let any remaining tension flow out through your toes, disappearing forever. All tensions and the clutter of thoughts disappear. Now, you are completely relaxed. Worries, stress, and tension have all been washed away by the purifying and cool water. Enjoy the feeling of the cleansing, fresh and cool water. Enjoy the waving, enjoy the lightness and peacefulness.

Now, begin slowly to move your toes, move your legs, your arms, your body, your head. Open your eyes, maintain the feeling of relaxation, look around you and be awake.

3 MANAGING WASTE

Grades: 1 to 3
Number of lessons: 3 to 4

Purpose

The generation and management of waste is a concern for countries around the world. Solid waste disposal is now one of the most critical environmental issues in the Maldives. Developing waste minimisation strategies to reduce the amount of waste going to landfill or transfer stations is the way forward. Modelling preferred sustainable lifestyle options as part of daily school life has the potential for positive and long-term impacts on student attitudes towards sustainability.

In this unit students have the opportunity to develop deep understandings and skills in relation to the principles of sustainability by analysing and questioning current waste management at home and school. Students will actively plan waste management strategies, participate in actions and reflect on the impacts of the actions.

Key questions

Key focus questions for this section are:

- How do our decisions affect the environment?
- What choices do we have when disposing of waste/rubbish?
- How do you decide on actions to reduce waste/rubbish?
- How can managing our waste help the environment?

Links with other Modules

Ourselves

Toolbox

Physical materials

Thick gloves, Safety spectacles, long handled tongs, Washing facilities with soap and towels, large plastic bags or bins.

Flip Charts

Weather, Water, Waste and Energy Flip Chart

Preparation

Become familiar with:

- Using the *Student Resource Sheet 3.1*. See example procedure and equipment required for the Waste audit, use *Teacher Information Sheet 3.3*
- Teaching strategies outlined in *Teacher Information Sheet 3.1*
- Information about waste management in the Maldives, *Teacher Information Sheet 3.2*.
- Weather, Water, Waste & Energy Flip Chart: Pages on waste

3.1 TUNING IN

The following activities help to engage and focus students' interest on the topic.

ACTIVITY 1: WHAT'S THE STATE OF WASTE MANAGEMENT AT HOME AND AT SCHOOL?

Purpose: To develop ideas on the state of waste management at home and at school.

Time: 2 hours

Materials Required: Environment and Biodiversity Flip Chart

Resource / Information Sheets: 3.1 Student Resource Sheet –Ideas wheel on waste management and Example of how to fill Student Resource Sheet

Procedure

Ask students to visualise what happens to waste/rubbish at home and at school.

Encourage students to expand their visual images by asking questions such as:

- What types of things do you dispose of regularly in your rubbish?
- How do you dispose of waste?
- Are there similarities between home and school (refer to Flip Chart pages on waste)
- Where does our waste end up?

Invite students to share some of what they visualised.

Show students the Environment and Biodiversity Flip Chart page on 'Bad Environment Practices'. Discuss what they see in the Flip Chart that indicate bad environment management and suggest impacts on the environment and community. Ask students to suggest ideas for improvement.

Show students the Environment and Biodiversity Flip Chart page on 'Good Environment Practices'. Compare and contrast the features of the two illustrations. Discuss the advantages for the community and environment when good waste management practices are in place.

Organise students into pairs and provide them with *Student Resource Sheet 3.1*. Explain to students that the first level of circles is for ideas relating to Waste Management. The next level of circles is for anything that relates to that specific idea, which could include impacts, issues, actions, systems, people involved etc. You may refer to the *Example of how to fill Student Resource Sheet 3.1.* Encourage students to develop the diagram further if they have more ideas.

Allow time for students to discuss and enter responses on to the Ideas Wheel.

On a chart or on the board replicate the centre circle of the ideas circle and list student ideas from the second level. If an idea has been noted already tick it to acknowledge any additional response. Using this approach helps in prioritising the most important for the class.

As a class develop a priority list of ideas which may focus on categories such as community waste management, school waste management or home waste management.

Ask any students monitoring their waste at home to share their approaches with the class.

Waste often ends up on our beaches.

3.2, 3.3 DECIDING DIRECTIONS AND FINDING OUT

The following activities will assist students to decide on the directions they wish to take in their research.

The following activities will also involve students in shared experiences that provide new information about the topic and stimulate curiosity.

ACTIVITY 2: FIND OUT ABOUT OUR WASTE

Purpose: To decide on the waste process and to investigate the waste situation at school
Time: Initial sessions approx. 1 ½ hours, follow up sessions 20 minutes per day for a week
Materials Required: Weather, Water, Waste and Energy Flip Chart and Environment and Biodiversity Flip Chart
Resource / Information Sheets:
3.2 Student Resource Sheet –School Waste Audit Form
3.3 Teacher Information Sheet – How to conduct a waste audit

Procedure

Ask students to draw and describe the steps involved in the waste process from people first disposing of the waste to where they think the waste ends up? Share the ideas and decide on the most accurate.

Show students the Flip Chart pages on 'Waste Theory', from the Weather, Water, Waste and Energy Flip Chart and 'Bad Environmental Practices' page from Environment and Biodiversity Flip Chart. Discuss with students what they notice, what they feel about how the waste is being managed, how it is impacting on the environment. Ask students to think about their island's Waste management Centre. Explain that these are rapidly filling and this should be a real concern for the community.

Students conducting a waste audit.

Pose the challenge of reducing the amount of waste produced by the school through a waste management project. Ask students what they think they would need to do first in a project such as this?

Discuss with the class ways for finding out about the waste situation at school. What makes up our waste? How do we currently collect and dispose of waste?

Explain that the most accurate way to establish the current waste situation is to conduct a School Waste Audit. Write on the board or a chart the key characteristics of a School Waste Audit.

What is a School Waste Audit?

- It collects facts about the types of waste
- It is a way to look at the make-up of your systems waste disposal and reuse.
- It requires you to separate and weigh the different materials in these systems.
- It helps you to develop a more accurate waste management plan specific to your needs.
- It assists in making informed decisions when buying equipment such as recycling bins so you do not under/over estimate your needs.
- It helps you to estimate the costs/ benefits that will result from your waste management plan.

Organise students in to groups of four. Groups can take responsibility for conducting the audit on different days so that they all have a turn.

Provide students with a copy of *Student Resource Sheet 3.2*. As a class, practice filling in the form so that students are very familiar with what is required. You may use the example to practice with or you can make up some figures. If you feel that this is too complex for younger students to complete develop a simpler version.

This activity provides an excellent opportunity to investigate the volume of waste.

Students use the *Student Resource Sheet 3.2* to conduct a school waste audit over the time decided on by the class for example a week, a month. Teachers refer to *Teacher Information Sheet 3.3*

3.4 SORTING OUT

Students at this stage will be collating, processing, analyzing and presenting the information in a variety of ways. Students will have the opportunity to further explore any questions that may have arisen when they were investigating. This would also be a good time to revisit some of the initial activities from Tuning In or Deciding Directions sections, for the students to witness how their knowledge has increased.

ACTIVITY 3: INTERPRETING THE DATA

Purpose: To collate data gathered from the waste audit conducted at school
Time: 1 ½ hours
Materials Required: Weather, Water, Waste and Energy Flip Chart, pens or pencils and student' s exercise books
Resource / Information Sheets: 3.3 Student Resource Sheet –Waste Audit PMI (Plus, Minus, Interesting)

Procedure

At the end of the auditing period organise a method for collating all data collected by the students. The class may discuss and decide which is going to be the best way to do this, which could include tally sheets, tables or graphs.

Using a *Student Resource Sheet 3.3* students interpret the data. Discuss student responses as a class. Focus on common themes or ideas asking students to justify their ideas.

Invite students to make suggestions on the best way to represent the data to others, for instance drawing a map of the school with symbols, or annotated information, or a chart.

3.5 DRAWING CONCLUSIONS

The following activities will help students to interpret information, establish connections and confirm/reject or modify predictions.

ACTIVITY 4: COMING UP WITH WASTE FACTS AND IDEAS

Purpose: To make decisions about waste facts and ideas for improving waste management at school.
Time: Approx. 1 ½ hours
Materials Required: A4 or A3 papers, markers and pens or pencils.
Resource / Information Sheets: 3.4 Student Resource Sheet –Waste audit brainstorm.

Procedure

Students will use *Student Resource Sheet 3.4* to consider the information from the waste audit including facts they have learnt and ideas for managing waste.

Create a class facts and ideas bank by asking students to contribute their top 3 facts and ideas.

As a class, discuss the ideas and tick those, which are considered a possibility for taking action.

Students design a waste information poster for the school using the facts from the audit and ideas for improving waste management at school.

3.6 CONSIDERING, PLANNING AND TAKING ACTION

As a result of students being actively involved in decision making throughout the inquiry process, it is hoped that they will be empowered to take action which has positive personal, community and global effects. Some suggestions are listed below:

ACTIVITY 5: DEVELOPING A WASTE MANAGEMENT ACTION PLAN OR INITIATIVE

Purpose: To develop a waste management action plan or initiative

Time: 1 ½ hours

Materials Required: Pens or pencils, student 's exercise books, sponge, window screening (mould), wood frame/old picture frame, plastic basin/tub, blender/food processor, white felt/flannel fabric and staples/ blue tack

Resource / Information Sheets: 3.4 Teacher Information Sheet – Making Paper

Procedure

Challenge the students to take an idea and develop it into a Waste Management Plan for the school. This may be done individually, in pairs or small groups.

Ensure that students include in their plan:

- Details of how it will work
- Who will be involved?
- When will it happen?
- Resources needed
- How it will be monitored?
- Reporting mechanism

Some suggestions are:

- Bins in the school are labelled – plastics, reuse, metals, and organics and children are encouraged to use the correct bins
- Weekly litter-free food days
- Paper 'reuse' with a focus on 'reduction'
- Worm farming and composting for food scraps

In addition or as alternatives you could include waste minimising initiatives such as:

- Recycled art/craft activities
- Developing a storyboard for a TV advertisement telling about the importance of waste management at home drawing on their understandings from the school audit
- Paper making as 'reusing'. The paper made by the students could be gifts or sold as a fund raiser.
- Develop a waste management plan for home.

Waste can be separated at schools in bins like this one.

3.7 EVALUATION AND REFLECTION

At this stage it may become evident that there is a need to return to some stages of the inquiry process to clarify knowledge or refine skills. The following questions may be asked:

- Are you happy with the ways in which your information was gathered, analysed and presented?
- Is there anything you would change?
- Are there things you need to investigate further?

ACTIVITY 6: WASTE MANAGEMENT ACTION PLAN

Purpose: To develop an information brochure based on the Waste Management Action Plan
Time: 1 ½ hours
Materials Required: Pens or pencils and student 's exercise books
Resource / Information Sheets: N/A

Procedure

Students write an information brochure for the community telling about the successful outcomes of the waste management action plan or waste managing initiative.

The information brochure should:

- describe what actions were taken
- describe what changes have occurred including data
- include illustrations
- indicate how the actions help the people of the Maldives to live more sustainably
- include why it is important to manage waste carefully for their community, the Maldives and the global community.

An ultimate goal of any waste management action plan should be its implementation. Students could present their plans to the principal with a view to one or more suggestions being implemented in the school.

Students may also present their ideas to the Women's Development Committee and the Island Development Committee. Discussions could take place about the possibility of some of the ideas being adopted by the community.

Extension

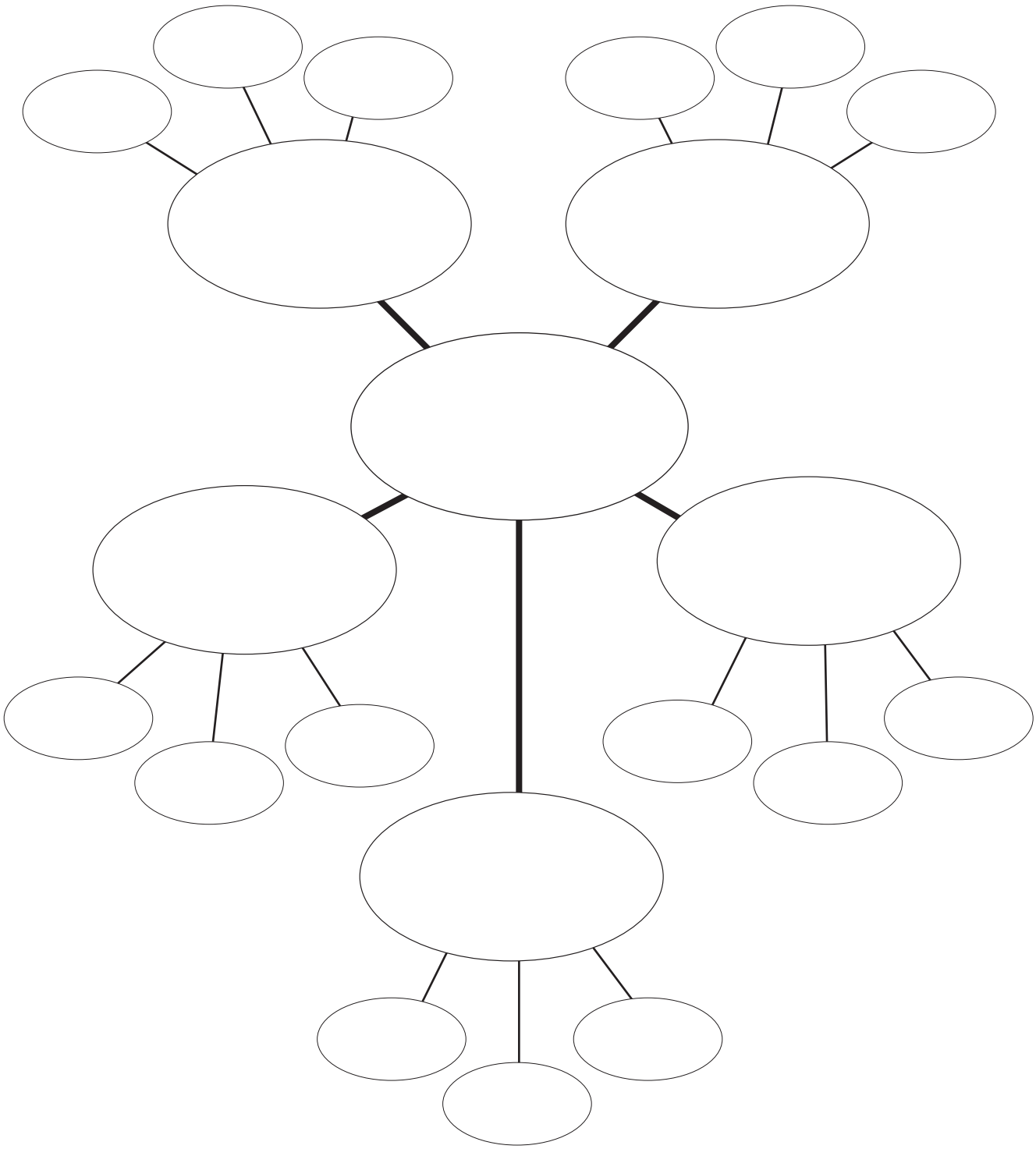
Students may conduct a similar audit at home at the same time. They should record information about the different types of waste produced at home, how it is disposed of, and the quantities of each type of waste. Following the model used at school, they can develop a waste management plan that may be implemented at home.

To encourage students to think beyond their own school and community, students could design a series of television commercials to promote the importance of waste management with a focus on actions to achieve this goal. Students could role play their advertisement or video record it. Parents and the broader community could be invited to view the productions at a special time at the school.

3.1 STUDENT RESOURCE SHEET

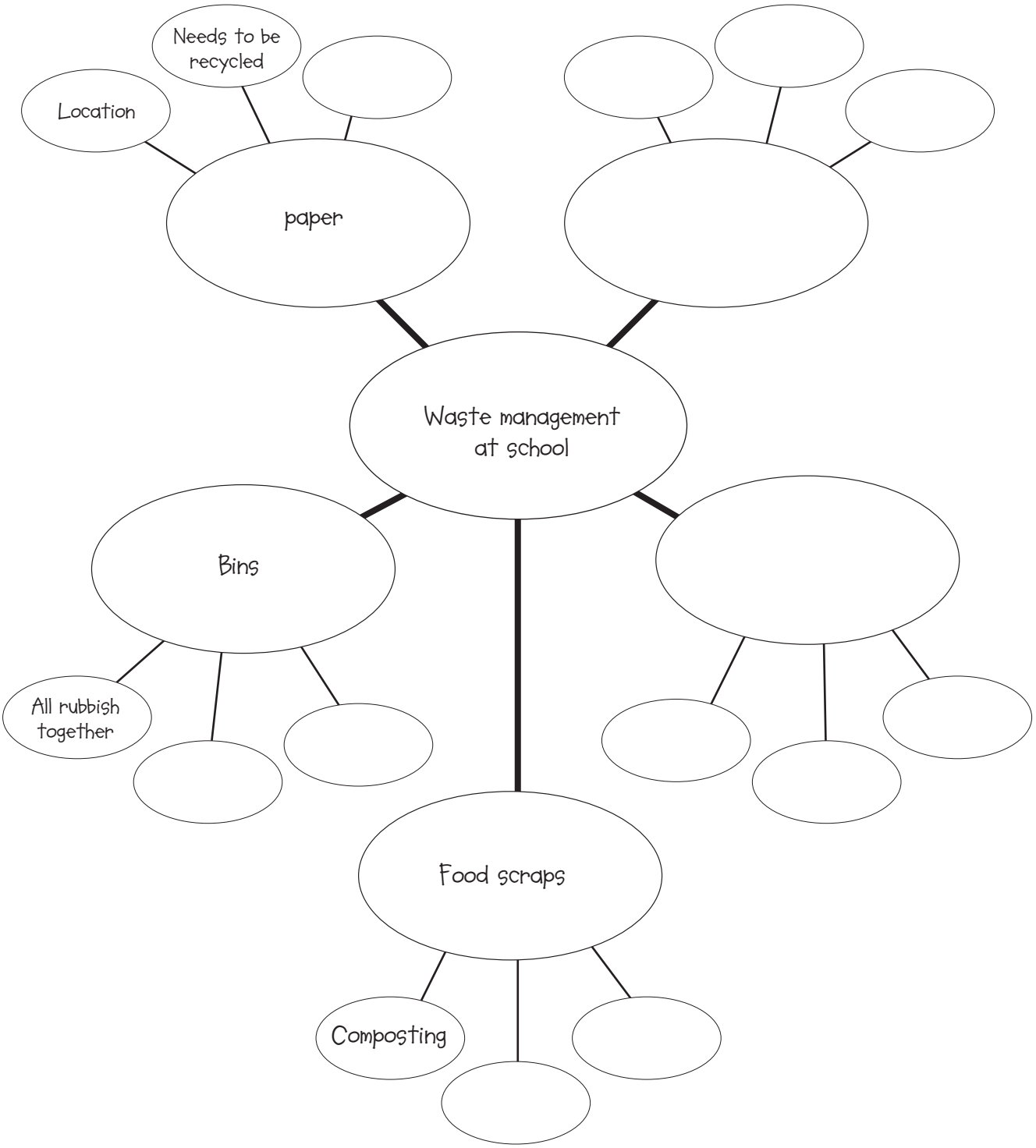
IDEAS WHEEL FOR WASTE MANAGEMENT

Fill in the concept map by writing ideas relating to waste and things which relate to the ideas.



3.1 EXAMPLE OF HOW TO FILL STUDENT RESOURCE SHEET

IDEAS WHEEL FOR WASTE MANAGEMENT



3.2 STUDENT RESOURCE SHEET

SCHOOL WASTE AUDIT FORM

Fill in the table over a period of time. A separate form will need to be completed for each area.

School name:	
Season & Weather:	
Date: Time:	
Auditors:	
Bin location (circle)	School compound classroom office other
No. and type of bins at location Size of bins	
Period of accumulation (e.g. I day)	

Waste Type	Approx. Volume/no.	% Waste Stream approx.	Responsible actions	Comments/Type
Paper				
Soiled paper				
Cardboard				
Aluminium cans				
Tetra packs (milk/juice cartons)				
Glass				
Plastics				
Polystyrene (ie. Coffee cups, packaging)				
Food (organic waste)				
Other- please specify				

3.2 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

SCHOOL WASTE AUDIT FORM

Fill in the table over a period of time.

The aim of the audit is to determine the approximate percentage each stream of waste represents in the total waste produced and determine key areas for reduction/recycling. You may need to adapt this form, depending on the age of the students. Example:

School name:	Atoll Education Centre
Season & Weather:	Hulhagu Moosun– wet
Date: Time:	21 June 2006 3:00pm
Auditors:	Mohamed, Ali, Aminath, Mariyam
Bin location (circle)	School compound (classroom) office other
No. of bins in office Size of bins in office:	3 small waste bins, 2 litre kitchen bin 25 litres (most small bins are roughly this size)
Period of Accumulation:	Full day (cleaners empty bins first thing in the morning)

Waste Type	Approx. Volume/no.	% of Waste approx.	Responsible actions	Comments/Type
Paper	1. 60% of total vol of office bins 2. classroom bin 25% full	60%		15 litres x 15 bins = 225 litres of waste
Soiled paper	5 pieces of paper	2%	Compost	White paper soiled with food scraps
Cardboard	3 x packaging boxes	10%	Flatten	
Aluminium cans	1200mls	5%	Crush before disposing	4 x 400ml cans
Tetra pack (milk/juice cartons)	4 litres	10%	Crush before disposing	4 x 1 litre milk cartons
Glass	1 litre	5%		4 x 250ml bottle
Plastics	1800mls	6%	Crush before disposing	3 x 600ml
Polystyrene (ie. Coffee cups, packaging)	0	0		
Food (organic waste)	3 x apple cores ½ sandwich	2%	compost	Use in school compost bin/heap. Keen gardener could take home for compost
Other	15 sweets wrappers			

3.3 STUDENT RESOURCE SHEET

WASTE AUDIT PMI

Use this PMI chart to record your thoughts about the waste audit data.

Plus What were the positive things?	**Minus** What were the negative things?	**Interesting** What things were interesting?

3.3 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

WASTE AUDIT PMI

Use this PMI chart to record your thoughts about the waste audit data.

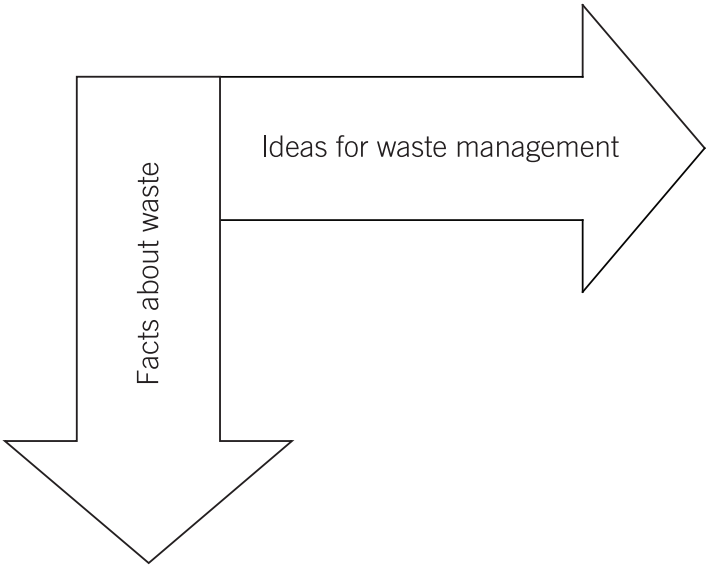
Plus What were the positive things?	**Minus** What were the negative things?	**Interesting** What things were interesting?
Before the audit I did not know how much waste we made. Now I see it is a lot. Also we went outside the classroom to do this activity. This was good.	The waste smelled bad. It was not very nice to be so close to the waste.	It was interesting to see the number of food packets and plastic bottles.

3.4 STUDENT RESOURCE SHEET

WASTE AUDIT BRAINSTORM - RIGHT ANGLED THINKING

Record facts you have learnt about waste from your waste audit in the left hand column.

List your ideas for managing waste in the right hand column.

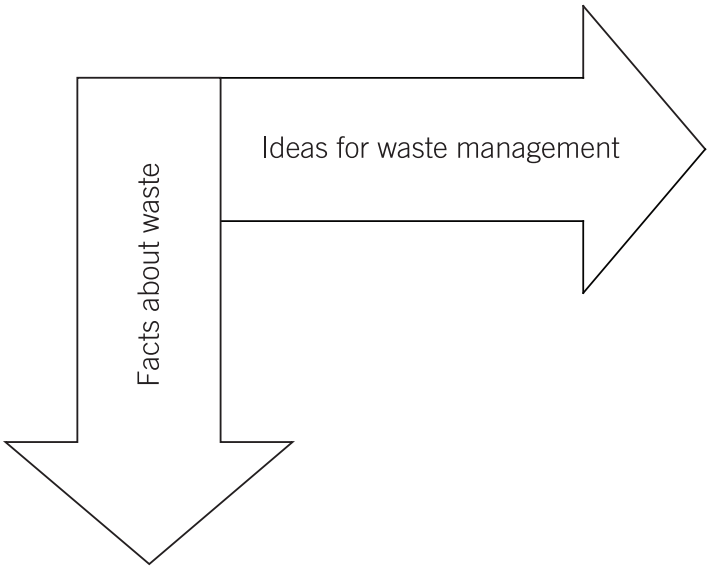


3.4 EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

WASTE AUDIT BRAINSTORM - RIGHT ANGLED THINKING

Record facts you have learnt about waste from your waste audit in the left hand column.

List your ideas for managing waste in the right hand column.



Our school produces a lot of waste.

A lot of the waste was cardboard and plastic bags.

Some types of waste can smell bad.

Some types of waste do not smell– like metals and plastic.

We could stop using plastic bags at the shop.

We could reuse paper in our classroom and recycle plastic bottles and cardboard by making things.

We should think about waste when we buy things.

3.1 TEACHER INFORMATION SHEET

TEACHING STRATEGIES

PMI

The plus, minus and interesting (PMI) tool can be used to assist students in evaluating and unpacking the details of a product, piece of writing, text or issue. This tool encourages students to look at all sides of the topic and recognise the strengths and weaknesses rather than focusing on their immediate emotional reaction. This organiser also assists students to evaluate their own work, the work of others and reflect on their progress and learning.

Students sort data into logical categories based on their relationship. Teachers may choose to collect the data on sticky notes as a brainstorming exercise. The teacher acts as facilitator and groups the data to show the relationship between the issue and the category.

Right Angled Thinking

This strategy is a structured thinking process which scaffolds thinking in a linear structured manner as well as making connections to associated ideas and creative thoughts.

This strategy also provides students with a whole brained approach to note taking and gathering and organising information.

Storyboarding

Storyboards show pictorially the sequence of ideas, procedures or events. These are similar to flow diagrams but are pictorial rather than text-based and provide students who are visual learners with ways to demonstrate their ideas visually rather than in print.

3.2 TEACHER INFORMATION SHEET

WASTE MANAGEMENT IN THE MALDIVES

Solid waste management is now one of the most critical environmental issues in the Maldives. The amount and the rate of solid waste generated vary throughout the country and there is a significant difference between the amount of waste generated in Male' and that of the atolls.

According to the State of the Environment Report 2004, on average 1.1 kg of waste are generated per capita per day in Male' while in the atolls this value is between 0.70 - 0.79kg of waste per capita per day. Average waste generation in the resorts stands at 3.5 kg per guest per day. The amount of waste being generated is increasing at an alarming rate.

Presently, solid waste generated in Male' is collected and taken to a transfer station. From the transfer station, the waste is transported by barge to Thilafushi, a municipal landfill, located 5 km away from Male'. The Thilafushi landfill site has now become a landfill for the central region of the country. In addition to waste from Male', it now receives waste from islands in Male' atoll, the resorts and the Male' International Airport.

Solid wastes generated in the atolls are disposed using various methods. Organic wastes are composted at home backyards in most of the islands. Non-biodegradable waste such as plastics is dumped near the beach in many islands and buried in a few islands. Burning of combustible waste at designated areas in the islands is also widely practised in many islands.

Current waste disposal practices adversely affect the environment through habitat destruction and pollution. Often, wetland areas such as swamps and mangroves are considered as disposal areas and reclamation of such areas to increase land space often takes place. Dumping of solid waste near beaches also has adverse effects on the reefs and lagoons of the islands.

In 2008 the Ministry of Environment, Energy and Water has released a National Solid Waste Management Policy (refer to www.erc.gov.mv). Some of the options of managing waste provided by the Environment Research Centre are as follows:

1. The biodegradable waste to be composted or burned.
2. Burning to be done safely.
3. Not to burn plastics and hazardous waste.
4. When burning biodegradable waste to leave it in the sun for a while for the moisture to evaporate before burning.
5. When burning waste to mount the waste on a platform so that it does not touch the ground and air can circulate in-between.
6. When the air circulates the burning pit would not emit black fuel instead it would emit gases which are not harmful to the health of living things.

Barge with waste trucks leaving for Thilafushi

Burning waste

Waste on lagoon edge at Thilafushi.

3.3 TEACHER INFORMATION SHEET

HOW TO CONDUCT A SCHOOL WASTE AUDIT

Your audit is intended to examine a representative sample of your waste collection system over an average school week. It will involve examining, identifying, sorting and recording the contents of the bins.

You will need to do separate audits for the waste bins in each of the following areas (because the composition usually varies):

- Classrooms
- Playground
- Office/Library

It is not necessary to sort and weigh the material from all bins in each area - but make sure that your sample is typical of the area as a whole.

Note on the audit form, the number of the bins sampled and the total bins in the area. Also note how many days it is since the bins were last emptied.

Preparation

There are a few things you must do before beginning your waste audit to ensure that it will be safely and effectively carried out:

- Obtain parent/guardian permission for any student involved in the waste audit.
- Make sure that you have the correct equipment for the job:
  - Thick gloves must be worn by anyone handling waste.
  - Safety glasses must be worn to ensure no foreign objects (i.e. glass) get into the eyes.
  - Suitable shoes and clothing must be worn to ensure participants don't get cut by broken glass, etc.
  - Long handled tongs to collect and handle the waste.
  - Washing facilities with soap and towels for washing and drying hands during and at the end of the collection, sorting and disposal of waste.
  - Tarpaulins or large sheets of plastic for tipping and sorting the waste.
  - A rake to spread out the waste.
  - Scales for weighing the waste.
  - Clearly labelled bins or collection bags to separate materials in the audit.

Conducting the Audit

Using the School Waste Audit Form, make sure you have sufficient forms to cover each bin or area you will be collecting from.

Collect and sort the waste, allocating roles to each student (collecting, sorting and weighing of material and recording data). When sorting the waste students can also identify biodegradable and non-biodegradable waste.

Use the results obtained to develop a waste management program for your school.

3.4 TEACHER INFORMATION SHEET

MAKING PAPER

Simple Recipe for making paper:

Many types of paper that can be used include:

- Computer Paper (unprinted)
- Newspaper (If you want a greyish colour paper)
- Magazines
- Egg Cartons
- Old Cards (For heavier paper)
- Toilet Paper
- Paper Bags
- Non Waxed Boxes (Pre-soak in warm water)
- Office Paper
- Tissue Paper (For finer paper)
- Typing Paper
- Napkins
- Construction Paper

Supplies you'll need:

- Sponge
- Window Screening (mould)
- Wood Frame (old picture frame can be used too)
- Plastic Basin/Tub (Large enough to totally immerse frame)
- Blender/Food Processor (For making paper pulp)
- White Felt or Flannel Fabric
- Staples and Blue Tack® (For tacking screen on frame)
- Liquid starch (optional)

Instructions:

1. Select the pieces of paper to be recycled. You can even mix different types to create your own unique paper.
2. Rip the paper into small bits, and place into the blender. (About half full). Fill the blender with warm water. Run the blender slowly at first then increase the speed until the pulp looks smooth and well blended. (30 -40 seconds) Check that no flakes of paper remain. If there are, blend longer.
3. The next step is to make a mould. The mould, in this case, is made simply by stretching fibreglass screen (plain old door and window screen) over a wooden frame and stapling it. It should be as tight as possible.
4. Fill the basin about half way with water. Add 3 blender loads of pulp. (the more pulp you add the thicker the finished paper will be) Stir the mixture.
5. Now is the time to add the liquid starch for sizing. (This is not necessary but if the paper is going to be used for writing on, you should add some, the starch helps to prevent inks from soaking into the paper fibres.) Stir 2 teaspoons of liquid starch into the pulp.

   Place the mould into the pulp and then level it out while it is submerged. Gently wiggle it side-to-side until the pulp on top of the screen looks even.
6. Slowly lift the mould up until it is above the level of the water. Wait until most of the water has drained from the new paper sheet. If the paper is very thick, remove some pulp from the tub. If it is too thin, add more pulp and stir the mixture again.
7. When the mould stops dripping, gently place one edge on the side of a fabric square (felt or flannel square). Gently ease the mould down flat, with the paper directly on the fabric. Use a sponge to press out as much water as possible. Wring the excess water from the sponge back into the large plastic tub.
8. Now comes the tricky part. Hold the fabric square flat and slowly lifts the edge of the mould. The wet sheet of paper should remain on the fabric. If it sticks to the mould, you may have pulled too fast or not pressed out enough water. It takes a little practice. You can gently press out any bubbles and loose edges at this point.
9. Repeat the steps above, and stack the fabric squares on a cookie sheet. Save one fabric square to place on the top of the stack to cover the last piece of paper. Use another cookie sheet to press the remaining water out of the stack. (Do this outside or in the bathroom, it can make a mess)
10. After you press the stack, gently separate the sheets. They can be dried by hanging on a clothesline or laying them out on sheets of newspaper. When they have dried peel them off the fabric and voila! you have paper!

4 REDUCE, REUSE, RECYCLE

Grades: 1 to 3
Number of lessons: 4 to 6

Purpose

Do you know how much waste you make? Every Maldivian contributes a mixture of household waste created by things we buy or use. Waste management is a major issue for the government and the community. Minimising waste creation by reducing the amount of waste we generate, re-using, recycling and composting are the key components of waste management.

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 or 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 beaches, coral reefs, bushland, mangroves and streets.

In this unit students focus 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.

Key questions

Key focus questions for this Module are:

- How do our decisions affect the environment?
- What choices do we make when purchasing goods?
- How do you decide on actions to reduce waste?
- How does packaging or using packaged products impact on our environment?

Links with other Modules

Ourselves

Toolbox

Physical materials
Cubic meter Set & Corner Inserts, Two plastic sports hoops or ropes

Flip Charts
Weather, Water, Waste and Energy Flip Chart

Preparation

Organise equipment

Organise a range of packaging types from everyday products (enough for each student or pairs) – teacher provides or ask students to bring these

Make copies of *Student Resource Sheets 4.1*

Contact a local business if you decide to do *5. Considering, Planning and Taking Action: Into the community* – Possibility 2

4.1, 4.2 TUNING IN AND DECIDING DIRECTIONS

The following activities help to engage and focus students' interest on the topic. The following activities will also assist students to decide on the directions they wish to take in their research.

ACTIVITY 1: WHAT CAN WE DO WITH PACKAGING?

Purpose: To develop ideas about packaging and how this relates to the creation and disposal of waste
Time: 50-60 minutes
Materials Required: Two plastic hoops or ropes
Resource / Information Sheets: N/A

Procedure

Organise two plastic hoops or ropes to form circles. Explain to the class that you are going to sort a range of shopping items and that they have to guess how they are being sorted. (The groups are items with minimal packaging and items with multiple packaging).

Hold an item for viewing and place it in an appropriate hoop without telling the students why you have put it in that circle. Repeat for several items then hold up an item and ask students to tell you in which group they think it belongs. Ask several students to describe the sorting criteria.

Ask students to identify the material that different types of packaging are made from for instances plastic, paper or cardboard.

Packaged food.

Ask students to select an item of packaging. Students examine the packaging noting how the product has been packaged, the material it is made from and why they think it has been packaged in that way.

Create a class list of packaging types, the materials they are made from and any recycling information. As a class discuss the advantages and disadvantages of the different types of packaging and how these can contribute to the amount of waste created when being disposed.

4.3 FINDING OUT

The following activities will involve students in shared experiences that provide new information about the topic and stimulate curiosity.

ACTIVITY 2: PACKAGING FOOD FOR SCHOOL

Purpose: To explore ways of reducing waste and reusing waste at school
Time: 1 hour
Materials Required: Pencils or pens and student 's exercise books
Resource / Information Sheets: 4.1 Student Resource Sheet –Reduce, Reuse, Recycle

Procedure

Ask students what they think waste is and what happens to waste.

Ask students to look at how the food they have brought to school has been packaged. Make a class list of the types of food and the way it has been packaged for example food in plastic wrap, drink in plastic bottle, snack in cardboard box, banana – skin (natural).

As a class discuss how food waste is currently disposed of at school. Pose questions:

- Why do we need to package our food we bring to school?
- Could there be other ways to dispose of our food waste?

Introduce the idea of the waste hierarchy (in the Flip Chart). *Student Resource Sheet 4.1* provides information about this if students are unfamiliar with the ideas. It should read before answering these questions.

Ask students to name any of the packaging used for bringing lunches that could be used again. Discuss the idea of re-using waste such as a plastic drink bottle that may be washed and used daily.

What is biodegradable and what is non-biodegradable? What can be done with the different types of waste?

Discuss what it means to compost and why it is good for the environment.

4.4 SORTING OUT

Students at this stage will be collating, processing, analyzing and presenting the information in a variety of ways. Students will have the opportunity to further explore any questions that may have arisen when they were investigating. This would also be a good time to revisit some of the initial activities from Tuning In or Deciding Directions sections, for the students to witness how their knowledge has increased.

ACTIVITY 3: CREATING A POSTER

Purpose: To create a poster about reduce, reuse and recycle and composting.
Time: 1 ½ hours
Materials Required: Weather, Water, Waste and Energy Flip Chart, pens or pencils and student' s exercise books
Resource / Information Sheets: 4.1 Student Resource Sheet –Reduce, Reuse, Recycle

Procedure

Show students in the Weather, Water, Waste and Energy Flip Chart page on 'Waste Activity'. Ask them what they think the signs are for and the value of having signs such as these.

Using their understanding of the information they create a poster with a slogan for reuse, reduce, recycle and compost. The posters can be used in the school and at home to remind everyone to reduce, reuse, recycle and compost. Students may design symbols to represent reuse, reduce, recycle and compost as part of the activity.

4.5 DRAWING CONCLUSIONS

The following activities will help students to interpret information, establish connections and confirm/reject or modify predictions.

ACTIVITY 4: PLASTIC SHOPPING BAG NUMBERS

Purpose: To estimate the amount of plastic bags used within a period of time
Time: 55-60 minutes
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets: 4.2 Student Resource Sheet – Plastic shopping bags an environmental menace.

Procedure

Provide students with a copy of *Student Resource Sheet 4.2*.

After students have read the *Resource Sheet* ask them to estimate how many plastic bags:

- Their family uses in a week, month, a year?
- The class uses in a month, a year?

Plastic bags in supermarkets.

- The school community uses in a month, a year?
- The local community uses in a, month, a year?

Students keep an individual record of their estimates or a class record may be kept.

Challenge students to think of ways to find this out? List ideas on the board.

As a class decide on one of the ways and work through the mathematical procedure to calculate this out using some hypothetical numbers for a family.

Ask students to record over a week how many plastic shopping bags their family actually uses and what they did with them.

Students may also record where they have noticed plastic bags in their local community. For example on the beach, in the sea, caught in the coral reef, in the streets.

ACTIVITY 5: THE FACTS OF THE MATTER

Purpose: To read and analyse data gathered on plastic shopping bags.
Time: 50-60 minutes
Materials Required: A4 or A3 papers, pens or pencils and student' s exercise books
Resource / Information Sheets: N/A

Procedure

Draw a large table on a chart or on the board so that students can record their data from their shopping bag tally. Invite students to record their data.

Revisit the questions listed in Activity 4: *Plastic shopping bags numbers.* Ask students to recalculate their answers to the questions.

Discuss the results. Are there some aspects that are still difficult to find the answer to? What would be needed to help find out? For example for the local community you may need access to population numbers.

Ask for any information students may have gathered about where they noticed plastic bags in their community. Discuss as a class the impact of plastic bags on the local environment.

4.6 CONSIDERING, PLANNING AND TAKING ACTION

As a result of students being actively involved in decision making throughout the inquiry process, it is hoped that they will be empowered to take action which has positive personal, community and global effects. Some suggestions are listed below:

ACTIVITY 6: INTO THE COMMUNITY

Purpose: To develop a waste awareness implementation plan to reduce the use of plastic bags.
Time: 2 ½ hours
Materials Required: Pens or pencils and student's exercise books
Resource / Information Sheets: 4.3 Student Resource Sheet – My plastic bag reduction plan

Procedure

Possibility 1

Students develop a plan for reducing plastic bag use in their family. Using the *Student Resource Sheet 4.3* students develop their plan.

Data collection is an important aspect of this task as it will demonstrate any changes that occur as a result of the actions.

Possibility 2

Target the local business community to educate and promote 'Say no to plastic bags' for interested businesses.

Discuss the use of different types of data such as:

- which of the local businesses supply customers with plastic bags and which businesses provide environmentally friendly alternatives
- how many plastic bags on average are supplied by each business in a week
- questionnaires to ask shoppers about how they feel about plastic bags

Implement an agreed strategy to collect the data. Use this as baseline data.

Plastic bags often end up in the ocean.

Involve a suitable representative from the Women's Development Committee and/or Island Development Committee to provide support and advice. Discuss a suitable strategy to promote the reasons to say no to plastic bags with relevant information gained from a range of sources.

Develop an implementation plan that includes communication, monitoring, support, promotion, data collection and evaluation. Identify roles and responsibilities and timelines for students involved. Students keep a record of their progress and learning.

4.7 EVALUATION AND REFLECTION

At this stage it may become evident that there is a need to return to some stages of the inquiry process to clarify knowledge or refine skills. The following questions may be asked:

- Are you happy with the ways in which your information was gathered, analysed and presented?
- Is there anything you would change?
- Are there things you need to investigate further?

ACTIVITY 7: VISUAL PRESENTATION

Purpose: To make judgments and to reflect on plans implemented for reducing waste in the community
Time: 1 ½- 2 hours
Materials Required: Pens or pencils and student 's exercise books
Resource / Information Sheets: N/A

Procedure

After the student's plan has been implemented they develop:

- a presentation to the local Women's Development Committee, Island Development Committee or local community
- a visual representation such as flowchart which highlights the steps undertaken and annotated supporting evidence included such as the number of plastic bags, drawings of what the environment looked like before and after the strategy was implemented
- a slogan about saying no to plastic bags.

Each of these should include justification why this is worthwhile doing for the environment.

Possibility 2

A case study of the school's achievements in reducing waste by engaging the local community in an environmental issue can be written up and posted on the local noticeboard.

Alternatively, students write and perform a news item for television highlighting their achievements as part of a special feature on protecting the Maldives environment by using the reduce, reuse and recycle strategy.

Each of these should include justification why this is worthwhile doing for the environment.

Extension

Developing an understanding of the volume associated with waste especially packaging is an important aspect of this Module.

An extension could be the calculation of how many bags fill a cubic metre and the associated implications for disposal and land fill. This activity could also include an analysis of the difference between how many folded Vs squashed bottles fit into the same area. What implication does this have for landfill or Waste Centres?

4.1 STUDENT RESOURCE SHEET

REDUCE, REUSE, AND RECYCLE

Waste management 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 waste.

The 3Rs is a simple guide to help each of us to help us 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

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 eg; cloth or woven bag
- Consider how the goods are packaged

Re-use

Re-use containers, packaging or waste products. Reusing also means that the product does not go in the bin and end up in the sea, transfer station or landfill. Some ideas are:

- 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. 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
- Aluminium cans and foil
- PET plastic soft drink bottles and fruit juice bottles.

4.2 STUDENT RESOURCE SHEET

PLASTIC SHOPPING BAGS AN ENVIRONMENTAL MENACE

A plastic shopping bag is well suited to its task – it is cheap, lightweight, resource efficient, functional, moisture resistant, allows for quick packing at the supermarket and is remarkably strong for its weight. However, the environmental impacts of plastic shopping bags have raised community concern worldwide.

As well as being an eyesore (next time you are outside, have a look around - you'll be amazed at the number of plastic bags littering streets and the sea), plastic shopping bags kill large numbers of wildlife each year. In the sea, plastic bags can be mistaken for jellyfish by wildlife. This makes plastic bag pollution in marine environments particularly dangerous, as birds, whales, seals and turtles ingest the bags then die from intestinal blockages.

Disturbingly, it is claimed that plastic bags are the most common waste item seen by sailors at sea.

The biggest problem with plastic bags is that they do not readily break down in the environment, with estimates for the time it takes them to decompose ranging from 20 to 1000 years.

Plastic bags also clog drains, threatening not only natural environments but also urban ones. In fact, plastic bags in drains were identified as major factors in the severe flooding in Bangladesh in 1988 and 1998.

On top of the significant environmental costs, widespread use of plastic bags is also costly in terms of money. Apart from the price of the bags themselves, a great deal of money goes into collecting the bags and cleaning up once they've been discarded. In the Maldives the import of plastic bags has 200% import duty so plastic bags are very expensive here.

The best action we take for the environment is simply reuse, take a purpose designed shopping bag or refuse a plastic bag when we go shopping. It's easy to make a difference!

Plastic bag floating in the sea.

4.3 STUDENT RESOURCE SHEET

MY PLASTIC BAG REDUCTION PLAN

Plan how you will reduce the use of plastic bags using this planning sheet

What do I want to improve?

What ideas do I have to improve this?

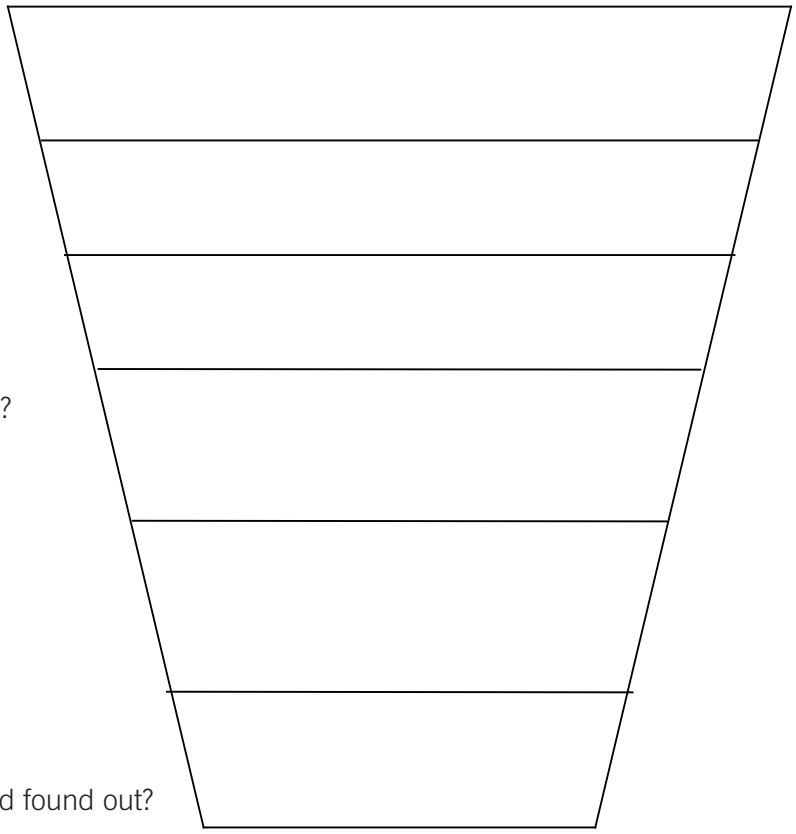
What will I do to improve this?

What information and data will I collect?

How will I do this?

What skills and resources will I need?

How will I present what I have done and found out?



5 COMPOSTING WASTE

Grades: 4 to 5
Number of lessons: 3 – 4

Purpose

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. Currently, yard and food waste for inhabited islands of the Maldives accounts for approximately 73% of all waste. The purpose of this section is to encourage students to think about the benefits of composting and explore ways that they may take actions.

Key questions

Key focus questions for this section are:

- Why is reducing our waste important?
- What waste can be turned into a valuable resource?
- How can a compost heap help our environment?

Links with other Modules

Ourselves

Toolbox

Physical materials
Spring Balance

Flip Charts
Weather, Water, Waste and Energy Flip Chart

Preparation

- Become familiar with teaching strategies outlined in the Teacher Information section
- Make copies of *Student Resource Sheet 5.1*
- Consider student grouping into groups of 4 and pairs
- Organise necessary materials
- Organise organic materials such as twigs, grass, banana leaves

5.1 TUNING IN

The following activities help to engage and focus students' interest on the topic

ACTIVITY 1: WHAT HAPPENS TO OUR WASTE?

Purpose: To develop ideas about how waste is generated and what happens to the waste at home and at school
Time: 1 ½ hours
Materials Required: Large pieces of paper e.g. poster or A3 paper, pens or pencils
Resource / Information Sheets: N/A

Procedure

Organise students into groups of four. Provide each group with a large sheet of paper. Using a Placemat strategy, ask students to list responses to the following questions:

- What happens to our food and yard waste at home and at school?
- What could be done with the waste?

As a class share group responses and create a class response list.

Invite students to contribute to a class list of the different types of food and yard waste that are thrown away. Challenge them to estimate the weight of the food and yard waste thrown away each day.

Discuss why this waste is an issue for the Maldives. Create a Waste Concerns chart and list student ideas on it.

Challenge students to identify possible solutions or strategies for dealing with the concerns listed on the Waste Concerns chart.

More than 75% of waste produced on islands in the Maldives is organic.

5.2 DECIDING DIRECTIONS

The following activities will assist students to decide on the directions they wish to take in their research.

ACTIVITY 2: AUDITING WASTE AT HOME

Purpose: To develop methods of auditing waste at home
Time: 1 ½ hours
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets: N/A

Procedure

Ask students to consider and propose methods of finding out the different types of food and yard waste. Ask them to suggest how this could be measured (for instance, numbers of buckets full).

Introduce the idea of conducting a waste audit at home. Ask students which of their proposed methods would be possibilities. As a class develop a home waste audit tool such as a table or tally sheet. The tool should allow space for students to record details about the different types of waste and the quantity of waste produced at home. An important aspect of the audit tool is deciding on the time frame for the audit e.g. a day, a week.

Students also could develop questions to ask older members of their family and community how they dealt with organic waste in years gone by. The responses to these questions could be compared with the audit results.

The development of the auditing tool could be linked to mathematics lessons with a focus on methods of collecting and organising data using tables and graphs.

5.3, 5.4 FINDING OUT AND SORTING OUT

The following activities will involve students in shared experiences that provide new information about the topic and stimulate curiosity.

Also, students at this stage will be collating, processing, analyzing and presenting the information in a variety of ways. Students will have the opportunity to further explore any questions that may have arisen when they were investigating. This would also be a good time to revisit some of the initial activities from Tuning In or Deciding Directions sections, for the students to witness how their knowledge has increased.

ACTIVITY 3: HOW MUCH FOOD AND YARD WASTE DO WE CREATE?

Purpose: To collate data gathered from the waste audit and to interpret the findings
Time: 1 ½ minutes
Materials Required: Pens or pencils and student's exercise books
Resource / Information Sheets: N/A

Procedure

Students conduct a waste audit at home using the tool developed by the class. On the completion of the waste audit students should bring their results to class.

Create a large class version of the audit tool on a chart, blackboard or whiteboard. This is used to collate all students' contributions from their waste audit results.

Invite students to contribute their results and create a final tally of the different types of waste and quantities.

In pairs, students interpret the data collected from the audit using prompt questions such as:

- Which is the most common type of waste?
- Which type of waste is created the most?
- Is their anything interesting in the data?
- Does the class data differ from what happens in my home?

While students are considering the data they could be encouraged to think about possible ideas for reducing food and yard waste.

Discuss as a class the data interpretation findings, using questions such as:

- What are the key findings?
- What do you think is the reason for the results?
- Why are these of concern?
- What suggestions do you have for reducing the waste?

Focus on the measurement method used for a waste audit, for instance a bucket full of waste. Introduce students to the idea of waste being measured by kilograms, and on a community scale, tonnes.

Ask students how they could calculate the identified waste from the audit in terms of kilograms? Create a mock bucket full and weigh it using the scales.

Have students calculate how many kilograms of food and garden waste is thrown away by the whole class over the designated time e.g. day, month, year.

Revisit the estimated weight of food and yard waste 1. Tuning In: What happens to our waste? How accurate was their initial estimate before conducting the audit? Were there any surprises?

Ask students if anyone already uses food and yard waste for something else? What are they using for? How are they using it?

Consider and discuss any suggestions made by students during the data interpretation stage for reducing food and yard waste including using it for another purpose.

5.5, 5.6 DRAWING CONCLUSIONS & CONSIDERING, PLANNING AND TAKING ACTION

The following activities will help students to interpret information, establish connections and confirm/reject or modify predictions.

Also as a result of students being actively involved in decision making throughout the inquiry process, it is hoped that they will be empowered to take action which has positive personal, community and global effects. Some suggestions are listed below:

ACTIVITY 4: MAKING A COMPOST HEAP

Purpose: To develop a model of a compost heap.
Time: 1 ½ - 2 hours
Materials Required: Weather, Water, Waste and Energy Flip Chart, pens or pencils, student 's exercise books, plastic bottle, materials such as twigs, palm leaves, grass clippings and food scraps.
Resource / Information Sheets: 5.1 Student Resource Sheet –Compost heap information

Making a compost heap.

Procedure

Introduce students to the idea of a compost heap or draw on the idea if suggested by students in Sorting Out.

Organise students into groups of four.

Show students the Weather, Water, Waste and Energy Flip Chart – page on 'Composting Activity'. Using an ideas wheel ask students to brainstorm what they know about composting, including any feelings and issues.

Provide groups with *Student Resource Sheet 5.1* and ask them to read it. Ask students to tick any information they correctly identified in their ideas wheel. When they have completed this, ask them to bundle other like ideas under appropriate headings such as concerns, pests.

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 students that they will be making a model of a compost heap using information in *Student Resource 5.1.* Groups or individuals may make the model compost heaps.

Provide students with 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. You may like to ask students to bring their own 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. Alternatively the compost heap model could be constructed as a free-standing model with an accompanying drawn cross section to illustrate the layers.

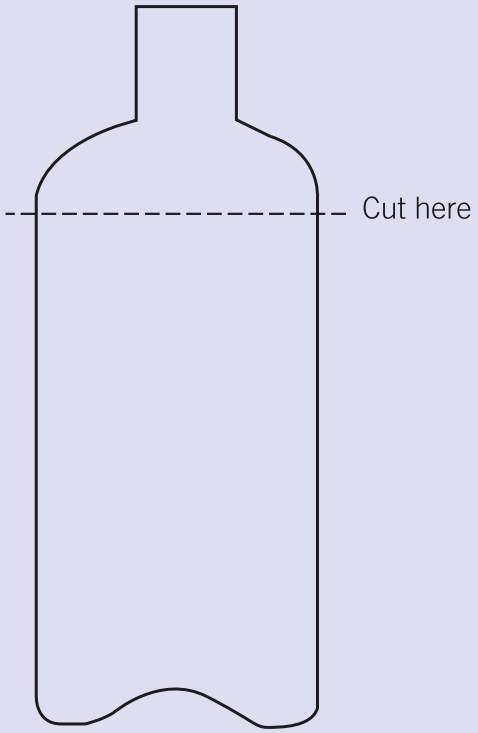
Have available a variety of materials suitable for creating a compost heap such as twigs, palm leaves, grass clippings etc.

For the layers of the model compost heap which involve food scraps and other organic materials ask students to draw, colour and cut out the examples for instances banana peel, pumpkin 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.

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



***Please note the container should not have previously been used for hazardous materials. One or two litre drink containers would be ideal.*

5.7 EVALUATION AND REFLECTION

At this stage it may become evident that there is a need to return to some stages of the inquiry process to clarify knowledge or refine skills. The following questions may be asked:

- Are you happy with the ways in which your information was gathered, analysed and presented?
- Is there anything you would change?
- Are there things you need to investigate further?

ACTIVITY 5: MY FOOD AND YARD WASTE GOALS

Purpose: To develop ideas and personal goals with waste issues relating to food and yard waste and carry out extension work in relation to the ideas and goals.
Time: 1 ½- 2 hours
Materials Required: Pens or pencils and student' s exercise books
Resource / Information Sheets: N/A

Procedure

Revisit the Waste Concerns chart developed in *1. Tuning In: What happens to our waste?* Ask students to offer ideas on how to deal with waste issues relating to food and yard waste based on their audit and compost heap knowledge.

Students develop a personal goal for improving how they discard food scraps and decide on how they will achieve this goal. An important aspect of the goal setting is justifying why this goal is important for the environment.

Students could be encouraged to have a similar conversation with their family and develop family goals and actions related to how they discard food and yard waste.

Extension

During this unit or as an extension, the food and yard audit may be conducted at school to identify issues that could address using student ideas.

Compost extension work could involve:

- students drawing a plan of their property indicating an appropriate location for the compost heap
- creating a poster to remind family members to compost food and yard waste
- make a school compost heap and begin a system for collecting food scraps. This may involve using commercially produced composed bins if space is limited.

If the Clean communities program has been conducted by Live and Learn Environmental Education in your community this would be an ideal opportunity to implement this activity. This would ensure that school students and community members are involved in the same environmental focus.

5.1 STUDENT RESOURCE SHEET

COMPOST HEAP INFORMATION

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 brakes down by naturally occurring bacteria and 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 high-Carbon (woody, brown, dry) and 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.

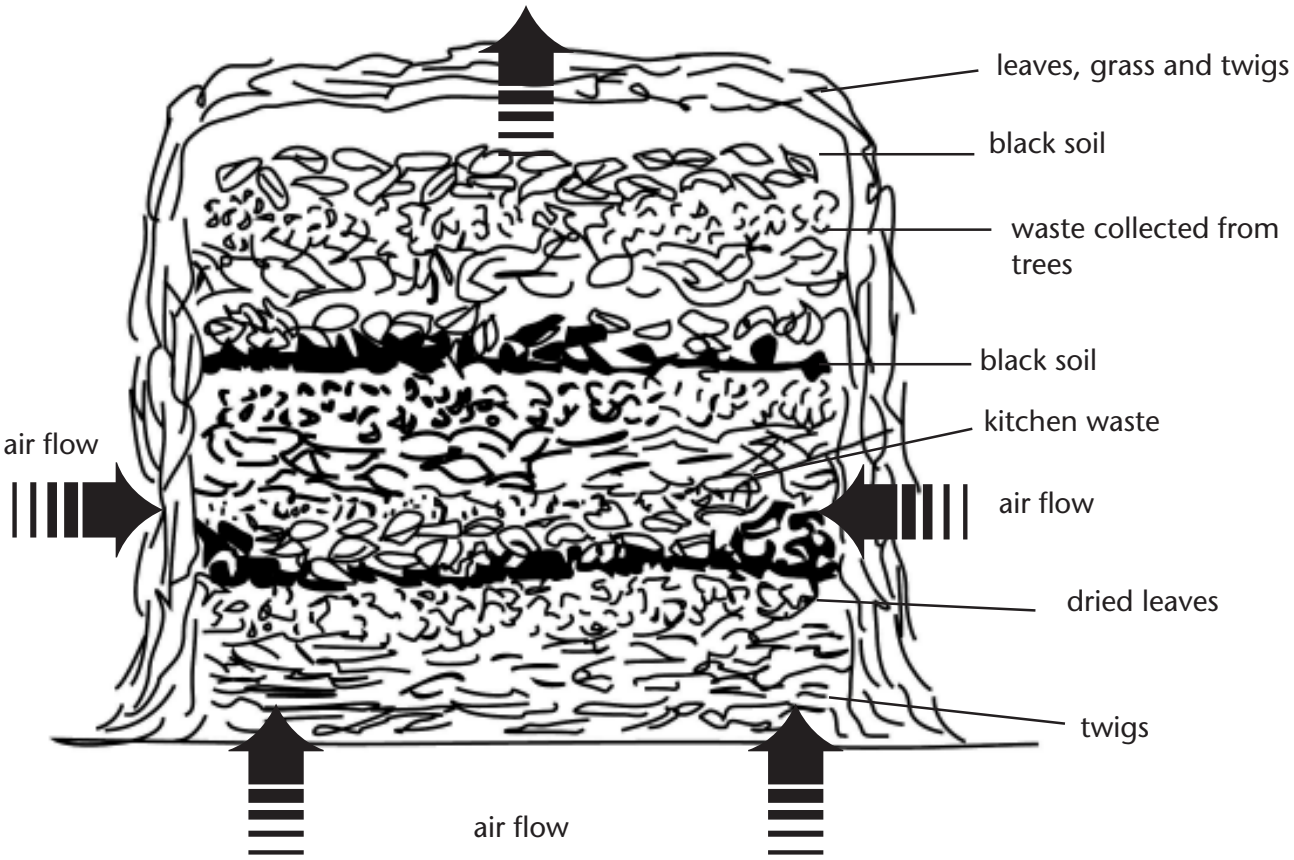
Diversity - Lots of different ingredients.

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.

5.1 STUDENT RESOURCE SHEET

COMPOST HEAP INFORMATION



Compost "must do's"

- 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

5.1 STUDENT RESOURCE SHEET

COMPOST HEAP INFORMATION

Compost recipe for beginners:

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:

- green leaves
- soil or compost from a previous heap
- coarse material, eg, tree pruning, 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 banana 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 – turning will help it dry out. If it's too dry turn it and then water.

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 wet dry compost to allow dust-free handling.
- Avoid direct inhalation of dry compost.

5.1 TEACHER INFORMATION SHEET

COMPOSTING IN THE TROPICS

WHAT IS COMPOST AND HOW IS IT USEFUL?

Compost is organic matter (plant and animal residues) which has been rotted down by the action of bacteria and other organisms, over a period of time. Many types of organic matter, such as leaves, fruit and vegetable peelings and manures can be used to make compost. The end product is very different from the original materials. It is dark brown, crumbly and has a pleasant smell.

Compost is cheap, easy to make and is a very effective material that can be added to the soil, to improve soil and crop quality.

- Compost improves the structure of the soil. It allows more air into the soil, improves drainage and reduces erosion.
- Compost helps to stop the soil from drying out in times of drought by holding more water.
- By improving soil structure, compost makes it easier for plants to take up the nutrients already in the soil. Compost may also improve soil quality by adding nutrients. This can help to produce better yields.
- Compost can reduce pest and disease problems in the soil and on the crop. The crop will be stronger and healthier and therefore resist pest and disease attack.

Compost is a better way of feeding plants than using chemical fertilisers.

These fertilisers provide nutrients for plants but do not improve soil structure or quality. They usually only improve yields in the season in which they are applied. Compost is not washed away through the soil like chemical fertilisers, so the beneficial effects are longer lasting.

Plants that are grown with chemical fertilisers are more attractive to pests because they have greener, sappy growth.

Making compost

Households and farms produce many materials which can be used to make compost. Making compost makes use of materials that may otherwise be wasted. Some of these wastes could also be used for other purposes. For example palm fronds may be needed for construction or kitchen wastes may be needed to feed livestock. A choice will need to be made as to whether to use such materials for the compost heap or not.

Garden Organics is the working name of the Henry Doubleday Research Association (HDRA). www.gardenorganic.org.uk/pdfs/international_programme/Compost102.pdf Page updated: July 11th, 2006 (accessed 24/11/06)

You may already be making compost. This booklet could help you to improve your methods. Organic matter is often piled up in the compound but left unmanaged. This will produce compost but the materials will take a long time to decompose and nutrients will be lost. If it is possible to invest some time and effort to manage the heap, the results will be very rewarding.

In a managed heap nutrient loss will be reduced, so more of the nutrients will be available to feed plants when the compost is used. This type of compost heap will often heat up enough to kill weed seeds and plant diseases.

What to put in a compost heap

Nearly all organic matter can be used to make compost but different items will take varying amounts of time to decompose and form different end products. For example, fruit on its own will go slimy and coconut leaves will go dry and dusty.

It is essential to include a mixture of old and tough with young and sappy materials for a good result. This is because different types of organic matter contain different proportions of carbon and nitrogen. In general, young, living material that decomposes fast contains low levels of carbon but high levels

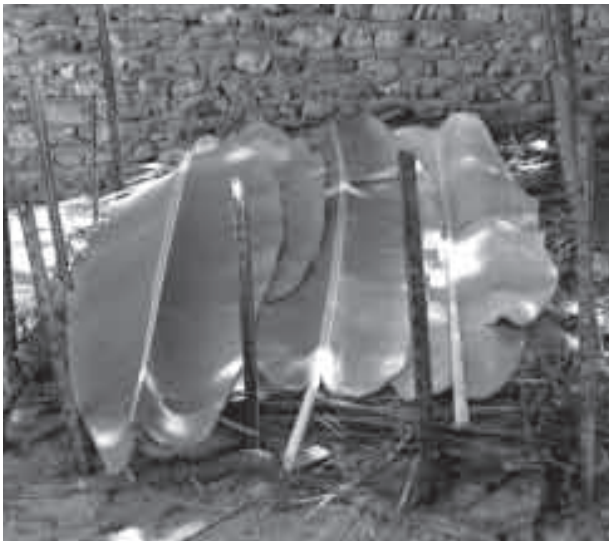
Material	Preparation	Notes	Precautions
HOME			
Fruit and vegetable peelings		Decomposes quickly	
Wood fire ash		High in potassium and lime	Use in very small quantities
Paper and cardboard	Tear up or shred	Decomposes slowly. Mix with wet/moist ingredients.	
House and compound sweepings		Variable quantity and quality	
GARDEN			
Crop residues (the remainder of a crop after it has been harvested).	Chop up tough material. If dry moisten well before use.	If the material is tough, it will decompose slowly.	Do not use if recently sprayed with herbicide
Dead leaves	If dry, use as above		
Crops grown specifically for the compost heap	Chop up if large	Legumes commonly recommended	
Crops grown specifically for the compost heap	Chop up if large		Avoid roots of perennial weeds and mature seeds of annuals.
OTHER SOURCES			
Manure		Not essential but an excellent source of nutrients.	
Urine (animal and human)	Difficult to collect. Maybe collected in the bedding of animals.	Sprinkle on heap. Will greatly accelerate decomposition.	Use in small quantities.
Soil	Use soil from the top 10cm of cropped land.	Not essential but a sprinkle may reduce nitrogen loss from hot heaps. May be used to cover a heap.	
Seaweed	If used in large quantities should be wilted first. Always apply with dry material.	Has an abundance of trace elements.	

of nitrogen. Tough, dead material, for example palm fronds and stalks, decomposes slowly and contains large amounts of carbon but low amounts of nitrogen. Too little nitrogen-rich material and the decomposition will be slow; too much and the heap will become acid and smelly.

If different compost ingredients are not available, households in the local community might have useful by-products such as coconut husks and groundnut shells. It may also be possible to obtain suitable material from the roadside. The table on the opposite page gives an indication of the type of items which can be put on a compost heap.

Availability of materials

Some of the materials mentioned in the table, such as soil or crop residues, may be collected on the day of building the heap. Some ingredients, such as kitchen wastes, are collected on a regular basis. If the heap is to be built in one single process these materials should be gathered and stored. They should be kept dry and cool and covered so that too much air does not reach it. Banana leaves or grass thatch provide a good cover. This treatment should prevent water loss before the heap is constructed.



It is also possible to build the heap in stages and add the material as it becomes available. However, the process of decomposition will be slower and it will therefore take longer to make compost.

Materials that should not be put in the compost heap:

- Material such as plants which have been recently sprayed with pesticides or herbicides
- Meat scraps, as these may attract rats and other pests
- Large amounts of material that is diseased
- Material with hard prickles or thorns
- Persistent perennial weeds. These should be killed by laying out in the sun to dry, or even burning, to avoid them spreading. The dried material or ashed could then be added to the heap.
- Non-organic materials such as metal or plastic

Where should a heap be placed?

There are three factors to consider when deciding where to put a compost heap:

Transport

A compost heap should be placed in an area to where it is easy to carry the materials collected. Distance and access to the fields or garden where the compost will be applied are also important considerations.

Water

A compost heap should be placed in a shady, sheltered area to avoid too much evaporation, for example under a tree. If you want to provide more shelter you could construct a fence around the heap, although this is not essential if labour is limited.

Water usually needs to be added to the heap so ideally, a source of water should be nearby. If you do not have a well close by you should keep a container, such as a jerrycan filled with water, near to the heap.

Vermin

It is important to consider pests and vermin such as rats, termites, flies and mosquitoes. It is possible that they may be attracted to the compost heap so it should not be placed too close to the home.

A compost heap should be placed away from the home, in a shaded position, with water available nearby

Other considerations before building a compost heap

Size

A good size for a heap is about 2 metres wide by 1.5 metres high. If it is much larger air circulation will be poor. The heap should not be smaller than 1 metre by 1 metre. The length can vary, as required. If there is not enough material available to make a compost heap of this size, a number of people could collect ingredients together to make a common one.

Water

If water is scarce, it may seem preferable to use available water directly for irrigation rather than for producing compost. However compost added to the soil can improve its water holding capacity and, in the long term, will reduce the amount of the water required to irrigate the crops.

If water is scarce, you may want to consider building the heap in a pit. This method is preferred in dry areas because the heap needs less water. Trenches are dug and are filled in the same way as a compost heap. However, heavy rainfall or a high water table could make the pit too wet.

Labour

Building a heap should be timed to fit in with the slack periods of labour. Some composting procedures, such as regular turning, are more labour intensive than others.

How to build the compost heap

A compost heap should be built on bare soil and not on a hard surface such as concrete. This is the recommended way to build a compost heap:

1. Firstly make a base 30 centimetres (cm) high and 2 metres (m) wide with coarse plant material such as twigs. This will ensure good air circulation and drainage.
2. Add a 10cm layer of material that is difficult to decompose such as palm fronds or coconut husks.
3. Add a 10cm layer of material that is easily decomposed such as fruit and vegetable scraps.
4. Add 2cm of animal manure, old compost or slurry, if available.
5. Add a sprinkling of earth from the top 10cm of cropped land.
6. Ash and urine can then be lightly sprinkled onto these layers, to accelerate the process of decomposition.
7. Then water the whole pile well.
8. Repeat all these layers except the first layer of coarse material, until the heap reaches 1 to 1.5m high.

The heap should be covered to protect it against evaporation and heavy rain as this will wash away all the nutrients. Sacking, grass thatch or banana leaves are suitable for this.

Each layer should be laid down by starting at the edge of the pile so that the heap does not collapse. Another way to ensure this is to use a wire mesh (not useful in dry areas because it will allow drying out) or wooden planks around the heap. Air vents, made out of bamboo canes with holes cut in them and placed both vertically and horizontally throughout the heap, will improve the air circulation.

Organisms involved in the composting process

Most of the organisms involved in the composting process are so small that you cannot see them. In order to survive they need water, air and organic material which is their food. The organisms feed on the organic matter and produce carbon dioxide, water and heat.

There are three important phases during the decomposition of a compost heap; the hot phase, the cooling down phase and the maturation phase.

During the 'hot phase' the highest temperatures are reached at the centre of the heap. This has a hygienic effect, killing diseases, if present, in the organic materials and sometimes weed seeds also.

Next, the heap goes through a 'cooling down phase' and the fungi become important. They break down the tough fibrous material such as crop stems.

During the final, 'maturation phase' larger organisms such as termites and worms also have an important role in breaking down and mixing material.

In a hot climate the organisms are more active and the organic materials are broken down more quickly than in a cold climate. The types of organic matter used and the acidity of the soil will also affect the rate of decomposition.

Conditions required in the heap

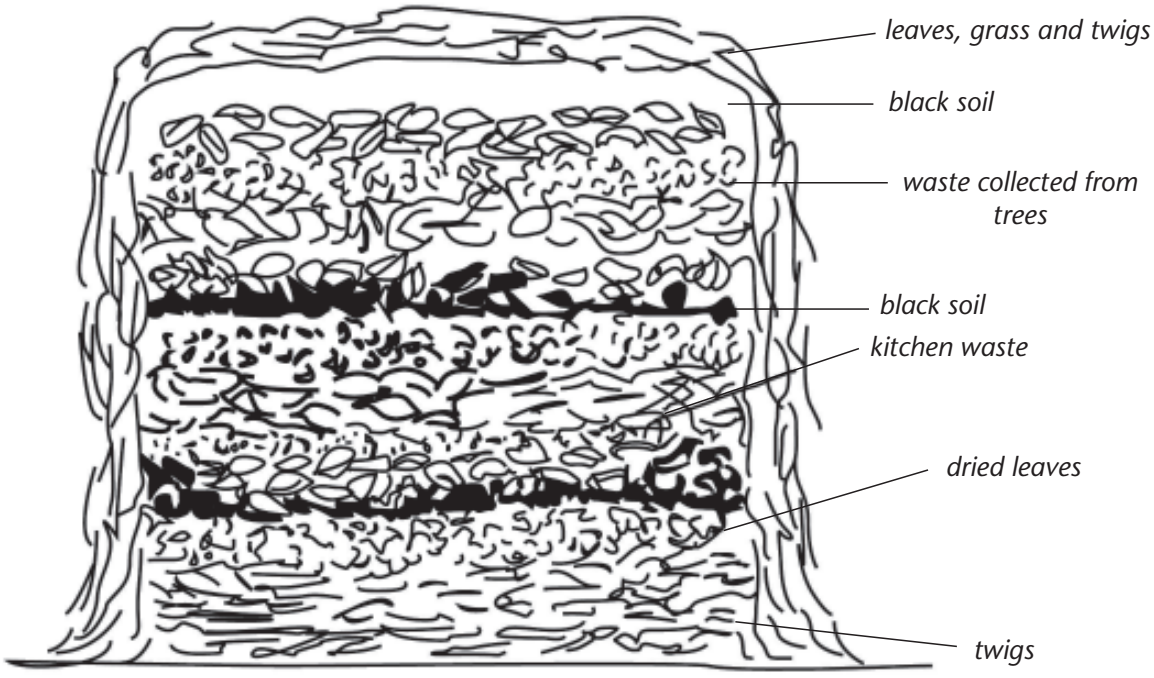
The compost heap requires three conditions: air, water and heat.

Air

The micro-organisms in the heap require oxygen to survive. The carbon dioxide produced by the activity of the organisms also needs to be blown out by a flow of air. If there is not enough air, other unwanted organisms will thrive which produce a bad smell and slow the decomposition of the heap.

Water

The activity of the organisms in the compost heap will slow down if the heap is too dry. But if the heap becomes too wet then there will not be enough air and the composting organisms will die. This will cause the heap to ferment rather than compost. Judging the right amount of water requires a little experience.



Layers of a compost heap

Heat

The heap will create its own heat as the decomposition process occurs. If the heap becomes too hot the micro-organisms may leave the heap, causing decomposition to slow down. When the heap cools down the organisms will return.

Managing a compost heap

To ensure successful compost production it is important that the heap is well managed after it is built. It requires water, turning, heat and a maturation phase.

Water

In dry conditions the heap will need to be watered twice a week. A way of testing the moisture is by placing a small bundle of hay in the middle of the compost heap. When removed, after five minutes, it should feel damp. If it does not, water needs to be added to the heap.

There are a number of ways to reduce evaporation from the heap and therefore the amount of water that needs to be added to it:

- Cover the heap with banana leaves or grass cuttings
- Cover the heap with a layer of mud
- Do not turn the heap

If the heap becomes too wet it should be opened up and mixed with dry organic matter or allowed to dry in the sun before rebuilding.

Water should be sprinkled onto the heap if it is too dry

TURNING

Within three weeks of building the heap, its size will have decreased considerably. Turning the heap will replace the oxygen supply and will ensure that the material on the outside decomposes as well. To turn a heap take it apart, mix the ingredients and rebuild it. The material on the outside of the heap is put in the middle of the heap. If the heap is dry, add water, and if it is wet, add dry matter. The first turning should be done after 2 or 3 weeks and the next after another 3 weeks.

Taking the thatch off the outside of the heap before turning the heap

Placing a stick in the heap to test the temperature

The temperature and moisture of the heap should be tested a few days after each turning. A third turning may be necessary before all the material, other than twigs and thick stems, has decomposed.

Compost can be made without turning, but material left at the edge of the heap may not compost properly. Weed seeds and any diseased plant material present in this may not be killed. These materials should be separated from the finished compost and used in the next compost heap. Although turning is not essential it is recommended to produce better compost.

HEAT

To test the heat of the heap put a large pointed stick into the heap, as shown, about 10 days after it has been built. The stick should feel slightly too hot to touch when removed after a few days. If it does not this may be because decomposition has not started. In this case, more air or water may be needed, or the heap may just need to be left for a while longer. If the heap is very hot, decomposition is happening but the excessive heat may kill the micro organisms.

In this case, the supply of air will need to be reduced and more water added to cool it down. You should test the temperature of the heap from time to time using the stick method.

MATURATION

Once the compost heap has cooled down it should be left to mature. The compost can be used as soon as most of the original material is no longer recognisable and has turned into a blackish brown colour, with a pleasant smell.

Even at this stage the heap should be kept covered to protect it from the rain and sun. The compost needs to remain moist, but not wet, while it is waiting to be used. If the compost is stored for too long before use it will lose some nutrients and may also become a breeding place for unwanted insects.

USING COMPOST

The main use of compost is to increase and maintain crop yields by improving the ability of the soil to hold water and nutrients and keeping the soil healthy.

It can also be used to prevent soil erosion by incorporating it into the soil.

Compost is commonly used close to home in the kitchen garden. When preparing a soil bed for sowing seed, compost can be mixed with the top 10cm of soil. It should not be dug in any deeper as crop roots will not be able to take up the nutrients released by the compost. An effective way of using limited supplies of compost is to place small amounts of compost directly into the planting holes. In dry areas these holes can be extended into pits or furrows which can be used for trapping water.

Compost can be used for mulching between crops or around trees. Compost that has not fully decomposed can be used for this; it will continue to mature on the ground and animals in the soil will draw it into the soil where it will decompose further.

When using compost as mulch it should be covered with a thin layer of leaves. This will avoid loss of nutrients due to direct exposure to sunlight and heat. Compost can also be mixed with soil and used for raising tree seedlings and can be used as fish feed.

Reference list

Other useful booklets about composting include the following:

'The Preparation and Use of Compost; Agrodok 8' (1990) by Inckel, M. et al AGROMISA, PMB 41, 6700 AA, Wageningen, The Netherlands

'Soil Management: Compost Production and Use in Tropical and Subtropical Environments' (1987) Food and Agriculture Organization of the United Nations (FAO) Soils bulletin 56. FAO, Via delle Terme di Caracalla, 00100 Rome, Italy

'Field Notes on Organic Farming' (1992) Njoroge, J. Kenya Institute of Organic Farming, PO Box 34972 Nairobi, Kenya

Adapted from Composting in the Tropics by HDRA the organic organisation, UK, 1998.

5.2 TEACHER INFORMATION SHEET

TEACHING AND LEARNING TOOLS

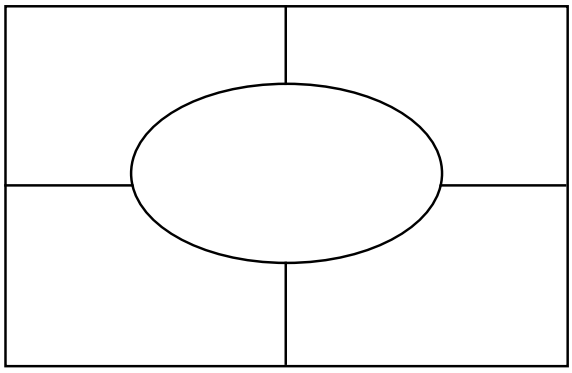
Placemat

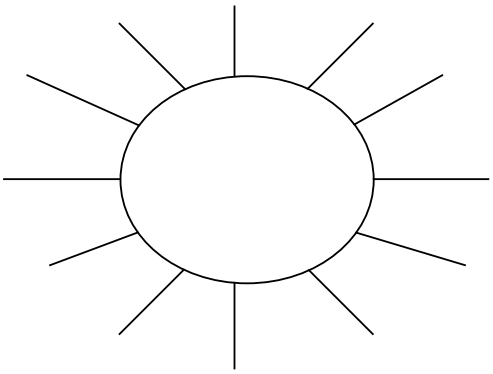
The placemat is drawn on a large sheet of paper. Divide the page so that each group member has a section to write in with a square or circle in the middle to record the group response. Students are given an issue, topic or question to consider and they begin the process by considering their responses and ideas. Responses are recorded in their section of the placemat. Students share their perspectives and a team response is recorded in the middle of the sheet. Possible follow up activities could include all class members walking around the classroom, considering the responses given by different groups and how they varied from their own.

Ideas wheel

An ideas wheel is used by groups to brainstorm ideas. Groups record the brainstorm focus topic in the middle and then the arms on the outside are used to record student responses. Responses could be emotions associated with a word, components that make up an object or thing, adjectives to describe an object, ideas relating to the focus topic.

Depending on the developmental level of students, teachers can easily adapt this tool to make it more challenging and extend thinking in a particular direction. This tool can also be used to introduce the initial step to the process of mind mapping.





GLOSSARY

Aquifer
An underground layer of water-bearing permeable rock or unconsolidated materials (gravel, sand, silt, or clay) from which groundwater can be usefully extracted using a water well.

Bedrock
The solid rock that underlies loose material, such as soil, sand, clay, or gravel.

Biodiversity
The variety of life on earth.

Bio Degradable
Easily broken down.

Catchment area
A structure in which water is collected (especially a natural drainage area).

Combustible
Waste that can burn

Condensation
The change of a gas or vapor to a liquid, either by cooling or by being subjected to increased pressure.

Decay
To rot or become rotten; decompose.

Ecosystem
A community of plants, animals and micro-organisms that are linked and that interact with each other and with the physical environment.

Endangered
Threatened with extinction, as a species of plant or animal; to have put in a dangerous situation.

Environment
Everything that surrounds a living thing and affects its growth and health.

Erosion
Wearing away of the earth's surface by wind or water.

Evaporation
The process by which a liquid is converted into a vapour.

Glacier
A large body of ice and compacted snow, formed in mountain valleys or in the Arctic or Antarctica.

Infiltration
The slow passage of a liquid through a filtering medium (e.g. the percolation of rainwater through soil).

Non Bio Degradable
Cannot be easily broken down.

Precipitation
The falling to earth of any form of water (e.g. rain, snow, hail, sleet, mist etc.)

Reclamation
To fill an area with soil or debris to gain space.

Runoff
The water from rain, snowmelt or irrigation that flows over the land surface and is not absorbed into the ground, instead flowing into streams or other surface waters or land depressions.

Sediment
Material which settles out of a liquid to form a layer.

Sewage
Fluid containing water borne, domestic and human waste.

Sustainability
Meeting the needs of the present without diminishing the ability of people, other species or future generations to survive.

Transpiration
The process of giving off vapor containing water and waste products, especially through the stoma on leaves or the pores of the skin.

Vapour
The gaseous form assumed by a solid or a liquid when sufficiently heated.

Wastewater
Water that has been used, as for washing, flushing, or in a manufacturing process, and so contains waste products; sewage.

All kids are gifted,
some just open their packages earlier

Educational Development Centre
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