



# SCHOOLS FOR A HEALTHY ENVIRONMENT

# EARTH

Module 2



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# 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



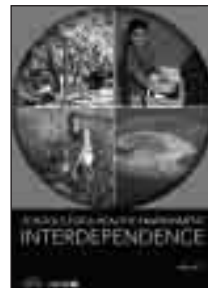
## Module 4: Resources from the Environment

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 2: Earth

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



## Module 5: Interdependence

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



## Module 3: Life Around Us

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



## 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 7x50, 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 <sub>2</sub> S	Bottle with hydrogen sulphide strip (H <sub>2</sub> S 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. ( <a href="http://www.australiangeographic.com.au">www.australiangeographic.com.au</a> )
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
<b>Identifications Guides:</b>		
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).
<b>Flip Charts:</b>		
1	Weather, Water, Waste and Energy	Weather, Water, Waste and Energy Flip Chart (2008).
2	Environment and Biodiversity	Environment and Biodiversity Flip Chart (2008).
<b>Reference Books:</b>		
	Subject	Author, year of publication, title, publisher and ISBN
1	Biodiversity	Krys Kazmierczak (2000) <i>A field guide to the Birds of India, Sri Lanka, Pakistan, Nepal, Bhutan, Bangladesh and Maldives</i> , Gopsons Papers Ltd, ISBN 81-87107-04-9
2	Biodiversity	Dr. R.C. Anderson, <i>Living Reefs of the Maldives</i> , Novelty Publishers, ISBN 99915-801-1-5
3	Biodiversity	Dr. R. Charles Anderson, (2005), <i>Reef fishes of the Maldives</i> Manta Marine Pvt. Ltd, ISBN 99915-5401-7
4	Biodiversity	National Centre for Linguistic and Historical Research, (2002), <i>Gasgahaagehi</i> , ISBN 99915-1-016-8
5	Biodiversity	National Centre for Linguistic and Historical Research, (2001), <i>Dhivehi raajjeygai hedhey baeh meyvaa</i> , ISBN 99915-1-009-5
6	Biodiversity	National Centre for Linguistic and Historical Research,(2002), <i>Maamelaameli</i> , ISBN 99915-1-025-7
7	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2004), <i>Dhivehi Raajjeyga Huri Aasaaree Thanthan</i> , 99915-1-063-X
8	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2002), <i>National Museum</i> , ISBN 99915-1-016-8
9	Traditional Knowledge	Naseema Mohamed and P.Ragupathy (2005) <i>Inscriptions of Maldives No 1</i> , National Centre for Linguistic and Historical Research, ISBN 99915-1-069-9
10	Traditional Knowledge	Naseema Mohamed, (2006), <i>Essays on early Maldives</i> , National Centre for Linguistic and Historical Research, ISBN 99915-1-083-4
11	Traditional Knowledge	Dr.Philos Egil Mikkelsen, (2000), <i>Archeological excavations of a Monastery at Kaashidhoo</i> , National Centre for Linguistic and Historical Research, ISBN 99915-1-013-3
12	Traditional Knowledge	National Linguistic and Historical Research, (2006), <i>Vihivana garunuge thereyga Dhivehi Raajje 1</i> , Novelty press, ISBN 99915-1-061-3
13	Traditional Knowledge	National Centre for Linguistic and Historical Research, (2006), <i>Vihivana garunuge thereyga Dhivehi Raajje 2</i> , Novelty press, ISBN 99915-1-084-2
14	Traditional Knowledge	National Centre for Linguistic and Historical Research,(2006), <i>Vihivana garunuge thereyga Dhivehi Raajje 3</i> , Novelty press, ISBN 99915-1-085-0
15	Traditional Knowledge	National Centre for Linguistic and Historical Research , (2006), <i>Vihivana garunuge thereyga Dhivehi Raajje 4</i> , Novelty press, ISBN 99915-1-069-6
<b>CD:</b>		
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 'Earth' in the Environmental Studies curriculum. The Module addresses the changing world, in particular its climate and places the earth in the solar system. It provides students basic facts and information on these areas. It then leads students to appreciate the pull of gravity and the influence the Moon and Sun have on tides. Students learn about the climate by first hand experience and become aware of these patterns and cycles that affect their lives. As the earth or the habitat of the living things is the key area of the physical environment, this Module teaches students about the threats to the earth and its components. The skills and values acquired through various activities in this Module would also contribute to the effective and sustainable use of natural resources available on Earth.

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

ITEM	DETAILS	SECTION
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	1
Globe of the Earth	Rubber ball - globe of the earth, fully numbered meridian ring, diameter of globe 30 cm.	2
Measuring cylinders (capacity 1000ml)	Clear plastic, capacity 1000ml, show divisions every 10ml	2
Water test kits (H <sub>2</sub> S paper strips in small bottles)	Bottle with hydrogen sulphide strip (H <sub>2</sub> S water test kit)	3
<b>Flip Charts</b>		
Water, Weather, Waste and Energy Flip Chart (2008)	Water, Weather, Waste and Energy	1, 2 and 3

# 1

# WEATHER

**Grades:** 1 to 3

**Number of lessons:** 4 to 6 lessons

## Purpose

To become aware of the impact the weather has on our lives and to learn why it is valuable to be able to predict the weather.

## Key questions

Key focus questions for this module are:

- What is weather?
- How do different weather conditions affect our lives?
- How can we predict the weather?
- Why is it useful to be able to predict the weather?

## Links with other modules

Resources from the Environment and Ourselves.

## Toolbox

### Physical materials

Weather kit

### Flip Charts

Weather pages in Weather, Water, Waste, Energy Flip Chart

## Preparation

Collect a range of newspaper weather reports for use in the deciding directions activity. Also read Teacher Information Sheets to familiarize yourself with the topic.

## 1.1 TUNING IN

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

### ACTIVITY 1: WHAT DO WE KNOW ABOUT WEATHER?

**Purpose:** Students learn and share information about the weather.

**Time:** Approx. 30 minutes

**Materials Required:** A3 paper, A4 paper, Rulers and Permanent markers

**Resource / Information Sheets:** N/A

#### Procedure

Introduce the idea that we are going to find out what we already know about weather.

Give students one minute of 'think time' (15 or 20 seconds if students are very young or unfamiliar with the concept of 'think time') to remember at least two kinds of weather they know about.

Ask students to fold an A4 sheet of paper to create eight boxes. In one box, each student will write or draw one kind of weather they thought of and write their name underneath it.

Students will then move around the classroom, asking each other to write or draw a type of weather in one of the boxes on the sheet.



*Example drawings of weather conditions.*

Sheets are exchanged for writing/drawing and then returned when one box is filled in and signed. Students then move on to find another person to share with. Each student may only fill in one box on another student's sheet.

This is repeated until all eight squares are completed (younger students may work with fewer boxes by folding the paper fewer times in the first instance).

If students' experiences are limited, the teacher might provide clues to remind them of weather types which are possibly outside their direct experience but which might have been encountered in stories, films/videos or songs.

Ask students if anyone knows about weather conditions people experience in different parts of the world? Answers might include (but are not limited to):

- Snow
- Sleet
- Hail
- Drought
- Dry heat

As age appropriate, talk about why different parts of the world experience different weather conditions.

Once everyone's sheet is full, sharing can occur in small groups or as a whole class. Ask students to share one of the types of weather on their sheet and thank the person who contributed it. The person thanked can then be the next to share one of the ideas they have.

Possible responses might include (but are not limited to):

- Rain
- Sunny

- Cloudy
- Hot
- Humid
- Misty/foggy
- Windy
- Cold
- Thunder storms
- Monsoon

Create a word bank of all the words that relate to weather that students use. Write them all in the alphabetical order, on an A3 sheet of paper and display it. These words can then be used in spelling activities, or for writing stories and poems.

Ask students to cut up their sheets and in small groups bundle all their individual squares together.

Students can then work with the squares to group together similar weather conditions (e.g. all the pictures of rain can go together).

Ask students questions about their categories, such as:

- Which kinds of weather were most commonly represented?
- Are there any kinds of weather you can think of that are not represented in your group?
- How can the categories you have made be interrelated? E.g. Can rainy and sunny weather be experienced at the same time?

Once students are happy with their categories, have them paste their pictures on large pieces of paper and ask them to indicate the relationships between weather conditions they have discussed on the paper with arrows, circles, etc.

Post these pictures of weather on the walls of the classroom.

## ACTIVITY 2: HOW DOES THE WEATHER AFFECT US?

**Purpose:** To discuss and share information about how the weather affects us.

**Time:** Approx. 30 minutes

**Materials Required:** A3 paper, Markers and Weather, Water, Waste and Energy Flip Chart

**Resource / Information Sheets:** 1.2 Teacher Information Sheet - Placemats

### Procedure

Show students the page on “Weather Theory” in the Weather, Water, Waste and Energy Flip Chart

In small groups ask students to discuss how the weather affects our lives.

Each group of four students sits around an A3 sheet of paper and takes part in a placemat activity. See the *Teacher Information Sheet 1.2 - Placemats* for advice on how to conduct this activity.

The central oval should be filled with a single question. This can either be quite a specific question about what we can do in one particular sort of weather, or a more general question about how the weather influences what we do. Specific questions could be:

- What activities do we do when it is raining?
- What activities do we do when it is sunny?
- What activities are best done when it is windy?
- What do you like to do when it is very hot?
- What do you like to do when it is cool?

More general questions provide scope for a wider variety of answers and are more appropriate for younger students.

Each student writes or draws answers in his/her space (leaving room for others to write later).

When all students in each group of four have finished writing, the A3 sheets are passed around to the next group so that all groups now have a new question to respond to.

Circulate sheets as time allows or until all students have answered all questions.

Next, arrange sheets on the wall and allow students to move around reading everyone's answers. If space makes this difficult, simply pass sheets around the groups again, but this time for reading entries rather than writing them.

## 1.2 DECIDING DIRECTIONS

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

### ACTIVITY 3: PREDICTING THE WEATHER

**Purpose:** Students predict activities for different weather conditions.

**Time:** Approx. 30 minutes

**Materials Required:** A3 paper

**Resource / Information Sheets:** 1.1 Teacher Information Sheet - Weather

#### Procedure

Introduce the idea that since we like to do certain activities in certain weather conditions it is very useful to have ways of knowing what the weather will be like at certain times.

In small groups have students talk about what they already know about weather prediction.

Groups should talk about what kinds of activities are carried out at different times of the year, or in different weather conditions.

Guide group discussion with questions such as (but not limited to):

- When is the best time of year to harvest rain water?
- When is the best time of year for planting crops?
- When is the best time of year for fishing?

Also encourage students to think about weather prediction in our daily lives.

Guide group work with questions such as (but not limited to):

- How can you tell if it's going to rain?
- Can local fishermen predict storms at sea?
- Do any local animals behave in certain ways before it rains?
- Can you tell when you get up if it is going to be a particularly hot day?

If seasonal weather changes do not come up in these discussions, guide students to consider looking at the seasons as a way of helping to understand the patterns of weather.



*Weather stations, such as this one at Male' International Airport, help us predict the weather.*

Some students will probably contribute scientific methods of weather prediction and others might have weather prediction stories. All information should be accepted and students should be encouraged to think of the science underpinning the stories (e.g. older person's arthritic joints becoming sore before rain comes may be linked to the increasing humidity before rain).

All ideas should be written onto A3 pieces of paper and posted where everyone can gather to see them.

Encourage students (as appropriate to their age) to ask their parents, grandparents, extended family, neighbours, family friends, etc if they know of any other ways in which community members predict weather.

Provide an opportunity for students to share this information with the class and to add it to the ideas posted on A5 pieces of paper. These ideas can be tested against the data we collect with the weather station.

## ACTIVITY 4: WEATHER REPORTS

**Purpose:** To identify symbols for weather conditions and to engage in a role play.

**Time:** Approx. 25-30 minutes

**Materials Required:** Samples of weather reports from the newspaper or website at <http://www.meteorology.gov.mv/>

**Resource/Information Sheets:** N/A

### Procedure

If the idea of using the weather report in the newspaper or on the radio has not come up in group discussions, introduce it now.

Provide small groups with the samples of weather reports from the newspaper or website that you have gathered in preparation.

Ask students to identify the symbols used in the weather reports to represent different kinds of weather.

- Are there any weather conditions that we came up with in the tuning in exercise that are not represented in symbol form in the newspaper report?
- What symbols could we create for these conditions?

Encourage students to take turns in their groups playing the role of weather reporter.

Ask them to use the different weather reports in each group and to explain what the data in the reports means for their classmates. They should explain the symbols and translate the conditions represented into terms relating to this activity. For example 'Tomorrow will be a warm and sunny day, as the picture of the sun over our island in this weather report suggests. This means it will be an excellent day for swimming and fishing.'



*A sample weather report from <http://www.meteorology.gov.mv/>*



## 1.3 FINDING OUT

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

### ACTIVITY 5: WEATHER MONITORING STATION

**Purpose:** To make and share ideas for recording different types of weather data.

**Time:** Approx. 2 hours

**Materials Required:** Weather Kit, Pens and paper, Weather, Water, Waste and Energy Flip Chart

**Resource / Information Sheets:** Student Resource Sheet 1.2 - Weather Monitoring

#### Procedure

Show students the page on “Weather Monitoring” in the Weather, Water, Waste and Energy Flip Chart and discuss how measuring and monitoring weather conditions can help us to understand and predict trends and patterns. Introduce the weather station as a way in which we can actually do this.

Ask students what kinds of weather information we could track at school. Direct this discussion from the starting points provided by students. Ensure that you ultimately cover the five types of information that will be collected by the weather kit.

The Weather Kit allows you to record:

- Total rainfall
- Recent rainfall
- Temperature
- Wind direction
- Wind speed

Discuss each of these in turn.

Ask students for their ideas on how to measure these weather features before telling them.

If it seems appropriate, give them time in small groups to discuss each measurement option before discussing it as a class.

Explain also how important it is to take the readings at the same time each day.

As appropriate, discuss units of measurement that different age groups will have covered in Mathematics classes (degrees for temperature, millilitres for rainfall, etc).

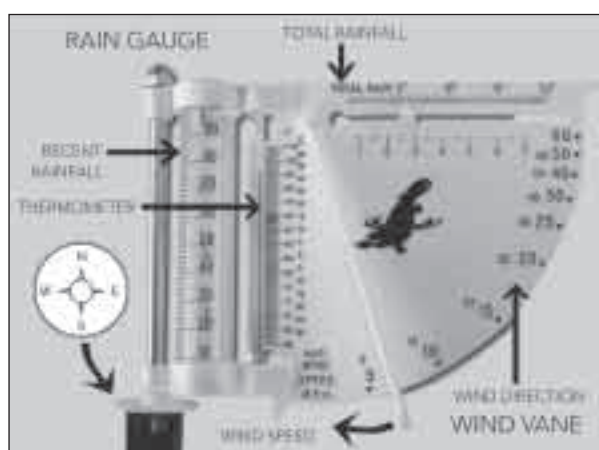
Having established what will be measured, focus the student’s attention on how the data will be recorded.

In groups of 4, have students focus on one of the weather conditions to be measured. Ask them to come up with a way for the class to record the data for that weather condition. This may be on a graph, in a check box format, with scale measures, through symbols, etc – different weather conditions will lend themselves to different tracking mechanisms.

If students have not covered these kinds of ideas in mathematics classes, they will require more teacher guidance in this activity.

For younger students you may wish to provide them with the recording frameworks as included in *Student Resource Sheet 1.2* etc.

If there are more than 5 groups, ensure that the smaller groups come together as a larger group to decide on the recording format before proceeding to create that framework on large sheets of paper.



*A weather station.*

Recording frameworks may be as follows:

- Temperature can be graphed with degrees on the vertical axis and days on the horizontal axis
- Daily rainfall can be graphed with millilitres on the vertical axis and days on the horizontal axis
- Total (monthly) rainfall can be graphed on a cumulative bar chart with each day represented in a different color. Millilitres can be represented on the vertical axis and months on the horizontal axis to show monthly variation more clearly than the daily rainfall graph will show
- Wind speed can be graphed with kilometres per hour on the vertical axis and days on the horizontal axis

If students have completed the Science and Technology Module, they can use the scale for measuring wind strength they developed themselves.

Wind direction can be indicated on a chart with the initials of the direction of the wind.

For younger students, less specific readings of temperature, rainfall and wind may be appropriate. Work with students to create scales that can be pictorially represented on a chart. For example, days between 25-28 °C may have a picture of the sun and days of 29 °C and higher may be given a picture of a sweating face.

As a class, share each group's ideas for recording the different sorts of weather data.

Discuss the benefits of creating graphs with the same variables on the same axis so that comparisons can be made (e.g. if both the temperature and daily rainfall graphs have the days along the horizontal axis then looking for relations between the two will be easier – it will be clear if higher temperature days are more or less likely to have high rainfall).

Discuss whether it is better to record all information on separate charts or if it is useful to group some readings (e.g. wind speed and direction) on one chart. If students would like to chart more than one sort of data on one framework, discuss how they could be clearly integrated (e.g. allocating different colours to different wind directions and then using those colours as appropriate to chart wind speed).

When the class is happy with the recording frameworks for each weather condition, have groups create the frameworks.

Make sure students think about the necessary range for each measurement (e.g. what is the highest and lowest temperature we should make provision to record on the degrees axis, how long will information be recorded for) before starting.

Decide as a class how long you want to track weather data for – every day for 1-2 weeks? Weekly for 10 weeks or a term? Be mindful of choosing a timeframe that will retain the interest of the students.

Create a schedule for each student to have a turn recording the weather conditions. Keep this on the wall for the duration of the schedule. Decide as a class where to locate the weather station (unless this decision is to be made at a school level, or between teachers of several classes).

## ACTIVITY 6: OBSERVING THE MONSOON

**Purpose:** To observe changes in the environment that indicates the coming of a monsoon.

**Time:** Approx. 25-30 minutes

**Materials Required:** N/A

**Resource/ Information Sheets:** 1.1 Teacher Information Sheet - Monsoons in the Maldives

### Procedure

At a suitable time of year, ask students to observe the changes in the environment that indicate a monsoon is coming. See *Teacher Information Sheet 1.1* for an outline of the Monsoons in the Maldives.

Guide their observations with questions such as (but not limited to):

- Can you see changes in the colour of the sea?
- Can you see changes in the swell, the current or in wave size?

- Can you see changes in cloud type, cloud cover and cloud movement?
- Can you feel a difference in temperature or humidity?
- Is it raining more or less?
- What time of day is it raining?
- What direction is the wind coming from?

Ask students to use their records of observation to either draw pictures of the changing conditions related to the monsoon, or to write stories.

Display and share these stories and pictures.

Help students relate their observations of the monsoon to the monsoon calendar that Maldivian fishermen and others use (see *Teacher Information Sheet 1.1*).



*Dark clouds like these are a sign that rain is coming.*

## ACTIVITY 7: THE WEATHER AND MY ACTIVITIES

**Purpose:** To increase awareness of the connections between student's activities and the weather conditions.

**Time:** Approx. 5 minutes/day

**Materials Required:** N/A

**Resource / Information Sheets:** 1.1 Student Resource Sheet  
-The weather and my activities

### Procedure

Ask students to fill in *Student Resource Sheet 1.1*, over a week.

This will help students become more aware of the connection between their activities and the weather conditions.

This completed sheet will be used again in activity 8.



*The rain in Male'.*

## 1.4 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 8: RELATIONSHIPS BETWEEN WEATHER CONDITIONS

**Purpose:** To make comparisons between the data gathered on weather conditions.

**Time:** Approx. 15-20 minutes

**Materials Required:** N/A

**Resource / Information Sheets:** Completed data sets from activities 5, 6 and 7.

### Procedure

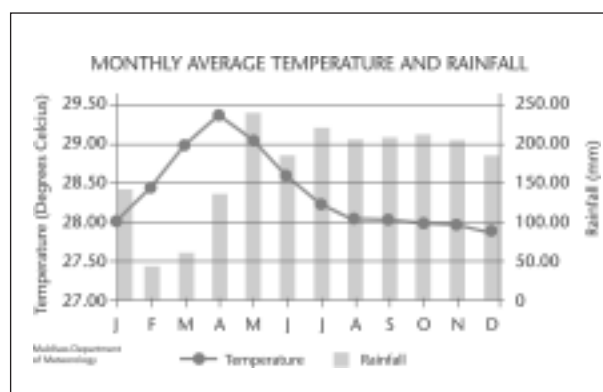
Now that the frameworks for weather monitoring have been filled in, encourage students to compare the data sets.

In small groups ask students to talk about changes within each set of gathered information.

Also ask groups to make comparisons between the data sets. For example: is there a correlation between changes in temperature and levels of rainfall? How does wind direction relate to this relationship?

Guiding questions for small group discussion might include:

- Do wind or rain patterns/events occur in a particular relation to temperature changes such as before, after or during?
- Do certain weather conditions always occur together? Separately?



This can be dealt with in more detail over time, as more data is collected. Keep class data for other classes to use in subsequent years.

## ACTIVITY 9: TESTING PREDICTIONS

**Purpose:** To revisit and revise ways of predicting the weather.

**Time:** Approx. 10-15 minutes

**Materials Required:** Notes from activity 3.

**Resource/Information Sheets:** N/A

### Procedure

Ask students to revisit the ways of predicting the weather they came up with in the deciding directions activity 3.

Does the data collected help to verify or disprove these ways of predicting the weather?

If we cannot answer this question with the data collected, what kinds of recordings would need to be made in order to verify or disprove the predictions?

## 1.5 DRAWING CONCLUSIONS

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

### ACTIVITY 10: WEATHER PREDICTION AND ME

**Purpose:** To interpret data collected on weather conditions in relation to favorite activities.

**Time:** Approx. 15-20 minutes

**Materials Required:** N/A

**Resource/Information Sheets:** N/A

### Procedure

Encourage students to interpret the data collected in terms of their own favourite activities and the weather conditions that are suitable to those activities.

Ask students to refer back to their completed Student Resource Sheet and relate what they have learnt about weather prediction.

Assist students to make the link between, for example, the fact that it rains every day at noon and the fact that they like to play skipping games. If we play skipping games at lunch time the rope will get wet and the puddles will splash up on us as the rope hits the water, so it would be better to play skipping games first thing in the morning or later in the afternoon when the ground is dry.

Older students can explore more complex situations such as the necessity of the wind to fly kites (but windy conditions of just the right strength, i.e., strong enough to lift the kite but not strong enough to break the string).

## ACTIVITY 11: WEATHER POEMS

**Purpose:** To create poems about favourite weather conditions.

**Time:** Approx. 25-30 minutes

**Materials required:** Pen and paper

**Resource/Information Sheets:** N/A

### Procedure

Ask students to write poems about their favourite weather conditions.

You can provide them with a structure for these poems that encourages students to use different aspects of weather. For example:

First line: identify the weather condition you are writing about

Second line: give 3 adjectives to describe that weather condition

Third line: use numbers or scale terms to describe the weather condition

Fourth line: give a time when that weather condition occurs

Fifth line: describe what the weather condition does or creates

Sixth line: describe your feeling about that weather condition

Seventh line: identify the weather condition you are writing about

For example:

*Rain*  
*Gentle, torrential, refreshing*  
*3 millilitres a day*  
*Early in the morning*  
*It cleans our island and fills our wells*  
*It makes me feel happy*  
*Rain*



A later activity could have them continuing to work with verse/s but now expressing sentiments that linked weather conditions and activities such as wind and kite flying or walking and dry weather.

## ACTIVITY 12: WEATHER RIDDLES

**Purpose:** To describe the weather by creating weather riddles.

**Time:** Approx. 20 minutes

**Materials Required:** A piece of paper/card for each student.

**Resource/Information Sheets:** N/A

### Procedure

On one side of a card, ask students to write the name of a weather condition.

On the other side, ask students to write 2 features of that weather condition.

Provide time in which students can share their riddles with each other. In sharing, one student should choose a card and read the two features of a weather condition written on that card, without showing the card to his/her partner.

The second student then guesses the weather condition being described.

Students take turns reading out the features and guessing.

## 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.

### ACTIVITY 13: HANDMADE WEATHER STATIONS

**Purpose:** To create weather monitoring devices to compare and record weather conditions over a period of time.

**Time:** Approx. 1 hour

**Materials Required:** N/A

**Resource / Information Sheets:** 1.1 Student Resource Sheet - The weather and my activities

1.3 Teacher Information Sheet - Making a rain gauge

1.4 Teacher Information Sheet- Making a Wind Vane

#### Procedure

Make weather stations that students can use at home.

This will allow the class to compare weather conditions at different points within a small geographical area.

Start by making rain gauges. See *Teacher Information Sheet 1.3*, for instructions.

You can also ask students to think about how they could make other weather monitoring devices to use at home, such as pin wheels, wind vanes or wind socks.

Ask students to record rainfall at their home every day for a predetermined period of time (e.g.1-2 weeks).

Encourage them to think and write about how the weather impacted on their activities. This can either take the form of a diary, or could be a more focused log using the form provided in *Student Resource sheet 1.1* (this activity is best conducted when there is likely to be a number of rain events in the course of a week.)



*Students making a pinwheel.*

### ACTIVITY 14: WEATHER STORIES

**Purpose:** To create an illustrated story using ideas about weather prediction.

**Time:** Approx. 1 hour

**Materials required:** pen, paper, coloured pencils and markers

**Resource / Information Sheets:** N/A

#### Procedure

Encourage students to use the ideas they have written about in their exercise books to help them create an illustrated story. This story should be about how being able to predict the weather helped someone. Share the stories with others in the class and with students in younger grades.

### ACTIVITY 15: HUMAN EFFECTS ON THE WEATHER

**Purpose:** To consider how our activities may have an effect on the weather.

**Time:** Approx. 20 minutes

**Materials Required:** Pen and paper, Weather, Water, Waste and Energy Flip Chart

**Resource/Information Sheet:** 1.1 Teacher Information Sheet- Weather

## Procedure

Show the students the 'Weather Theory' page of the Weather, Water, Waste and Energy Flip Chart and explain that just as the weather can affect our activities, human activities can also affect the weather. Explain that when fossil fuels are burned, they add large amounts of greenhouse gases, especially carbon dioxide, to the atmosphere. These gases trap too much heat and the Earth is now heating up. This is known as global warming. One of the effects of global warming is sea level rise.

Questions for reflection:

- Did they realize that human activities can affect the weather?
- What types of activities can change the weather?
- What human activities use fossil fuels such as petrol or diesel?
- What are greenhouse gases?
- Where do most greenhouse gases come from?
- How can we reduce our emission of greenhouse gases?
- How will the weather change?

Encourage students to consider and take action on this subject. Possibilities might include:

- Make posters and display them in the school.
- Prepare and distribute leaflets to parents.
- Perform role plays or devise an educational event (an information day for the parents conducted by the students).

## 1.7 EVALUATION AND REFLECTION

Conduct ongoing discussions with students about adapting to and taking advantage of weather conditions and our ability to predict them.

Incorporate such understandings and skills into future planning of activities (e.g. shall we do this activity indoors or outdoors? How might the weather assist or hinder us?).

### ACTIVITY 16: LESSONS LEARNT

**Purpose:** To reflect upon what students have learnt.

**Time:** Approx. 20 minutes

**Materials Required:** Pen and paper

**Resource / Information Sheets:** N/A

## Procedure

Ask students to write down:

- Four important ideas/concepts/information/values I have learnt in this section are .....
- Two things I now want to do for myself and for others are.....

Ask students to decide what they would like to do with the results of their research and discussion. One of the possibilities might be to write a story or play about the weather and its importance to us.



# STUDENT RESOURCE SHEET

## THE WEATHER AND MY ACTIVITIES

Answer the following questions in the table provided.

Day	What was the weather like?	How did the weather impact on what we did at home?	Did you use the weather forecast to help you decide on your activities?
Day 1			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 2			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 3			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 4			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 5			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 6			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 7			<input type="checkbox"/> yes <input type="checkbox"/> no



# 1.1

## EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

### THE WEATHER AND MY ACTIVITIES

Example of completed Student Resource Sheet 1.1 – The weather and my activities

Day	What was the weather like?	How did the weather impact on what we did at home?	Did you use the weather forecast to help you decide on your activities?
Day 1 Wednesday	Warm and sunny all day	After school I helped my mum hang out the washed clothes. Then I played on the beach with my friend. I couldn't have done either thing if it was raining.	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no
Day 2 Thursday	Rained in the night, cleared up in the morning.  Warm in the afternoon.	I was asleep when it rained, but had to be careful of puddles on my way to school. By afternoon all the puddles were gone and I played with my friend.	<input type="checkbox"/> yes <input checked="" type="checkbox"/> no
Day 3 Friday	Sunny all day.  Windy in the afternoon.	I went fishing with my dad in the morning as we knew it would be too windy to go in the afternoon.	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no
Day 4			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 5			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 6			<input type="checkbox"/> yes <input type="checkbox"/> no
Day 7			<input type="checkbox"/> yes <input type="checkbox"/> no



# STUDENT RESOURCE SHEET

## WEATHER MONITORING

### Setting up the weather monitoring station

When setting up your weather monitoring station it is very important to consider the following:

1. Place in an open location, so wind and rain can be accurately measured,
2. Align the directions North, South, East and West using a compass,
3. Place it in a secure place so it would not be stolen.

**Note:** For weather activities it is best to try to record the data on a daily basis but if this is not possible then as often as possible. It is also important to collect the information at the same time each day – if you collect temperature readings at 7.30am one day and then 11am the next you will definitely see a difference but it will not help you monitor the local weather over a period of time. It may be useful to have at least two volunteers for each daily reading. The data obtained from the following activities should be recorded daily. This data should be recorded on individual charts for temperature, wind, rainfall and cloud formations. A summary of all this data should then be transferred to the 'Weather Monitoring Chart' on the wall of the classroom, so the whole class can see the daily results and become involved. This will help to keep the class interested. Teachers should prepare a large chart using the format of a 'Weather monitoring Chart' as shown below.

The activities in these Student Resource Sheets encourage the students to:

1. Observe weather,
2. Measure weather,
3. Record weather,
4. Analyze data,
5. Make graphs to show longer term trends,
6. Display in class.

Weather Monitoring Chart									Month _____			
									School _____			
Date	temperature ° celsius	rainfall mm	weather conditions				wind direction (°)	wind strength	cloud types			
									cirrus	cumulus	stratus	nimbus



# STUDENT RESOURCE SHEET

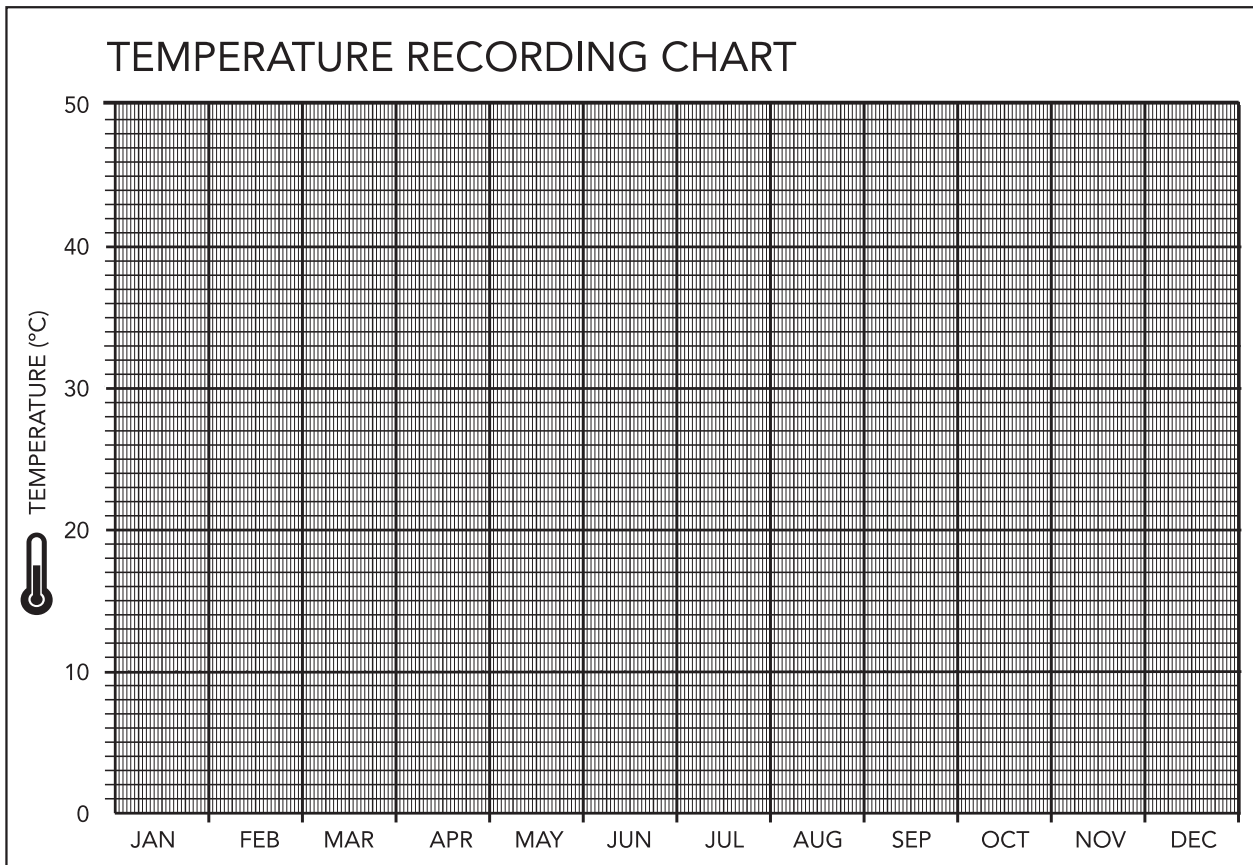
## WEATHER MONITORING

### Temperature

**Materials:** Thermometer, temperature recording chart (*see sample below*) to pin up on wall

**Action:** As a group get students to check the thermometer and write down the temperature at the same time each day/week. (The teacher should nominate 2 students to do this for about a week or more). Record the daily temperature on a graph (see sample below) and display this graph on the classroom wall. Are the days getting hotter or colder? On the weather monitoring chart (see sample on previous page) also mark the appropriate weather box (e.g.: sunny, cloudy etc).

**Theory:** When the sun is closer it can heat up the Earth more. Factors such as cloud cover or forest cover can influence the temperature. Large areas of water tend to moderate changes in temperature as water is slower to change temperature than air.



## 1.2

STUDENT RESOURCE SHEET  
WEATHER MONITORING

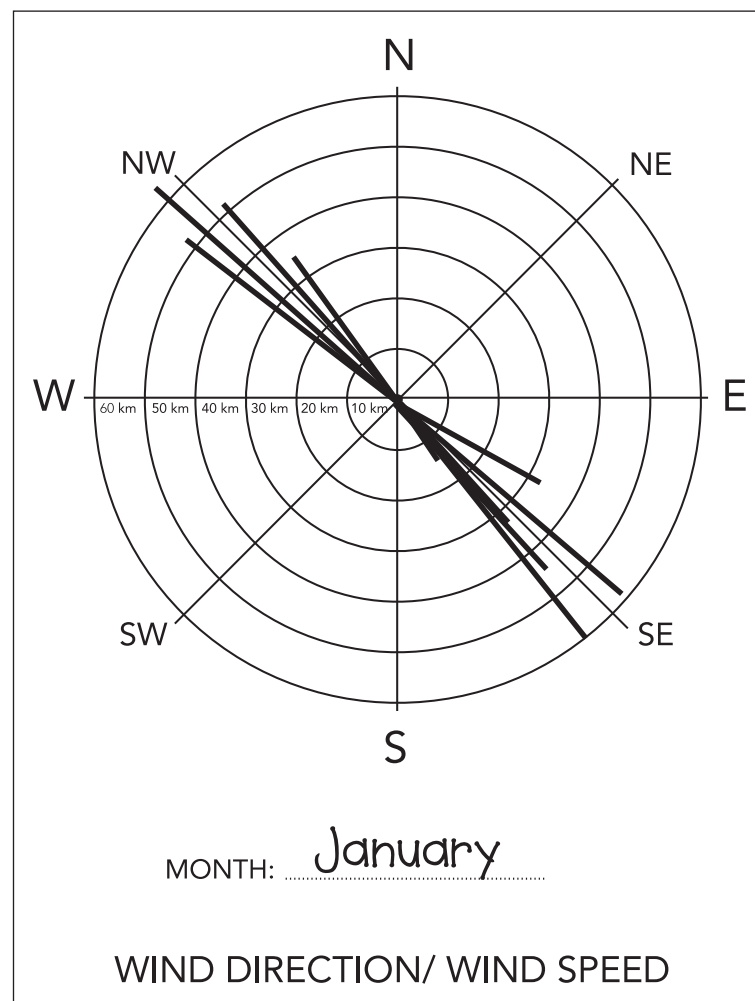
## WIND

**Materials:** Wind vane, compass and weather monitoring chart.

**Action:** Write down the direction and strength of the wind at the same time each day (nominate 2 students to do this for a week or more) and record it on the weather monitoring chart on the classroom wall. When the wind vane is pointing South it means that the wind is coming from the North. Graph the results each month as shown below. Is the wind coming from the same direction? Is it getting windy more or less often?

**Theory:** Heat from the sun warms the air, which rises and creates areas of low pressure. Wind is the movement of air from high-pressure areas to low-pressure areas in the atmosphere.

**Note:** It may be helpful to mark out the major compass bearings on the ground, below the weather station, to give the students an easily recognizable sense of direction.  
e.g. N, S, E, W, SE, SW, NE, NW



# 1.2

## STUDENT RESOURCE SHEET

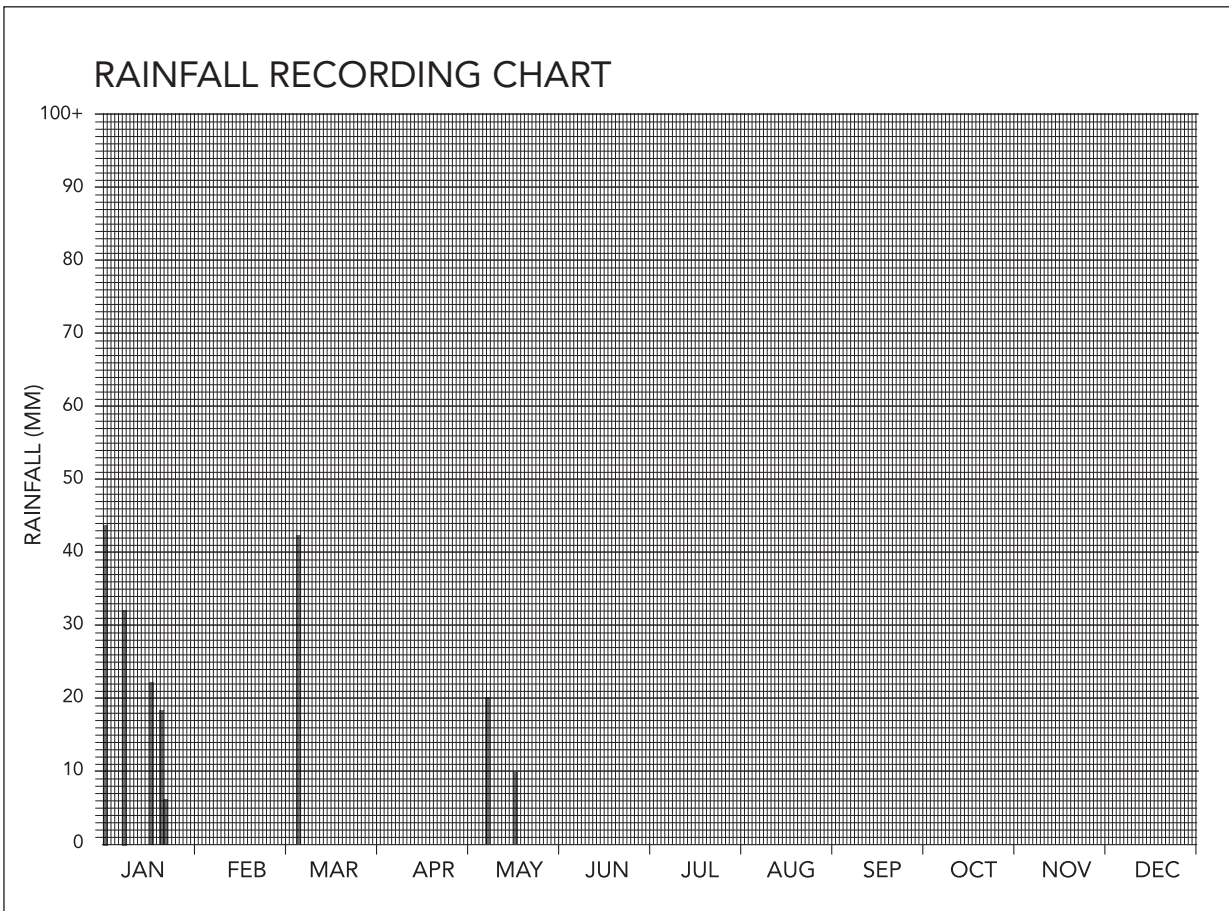
### WEATHER MONITORING

#### RAINFALL

**Materials:** Rain gauge and rainfall recording chart (see sample below).

**Action:** Use the rain gauge to measure the amount of rain each day. (The teacher should nominate a student to do this for a week or more). After measuring, empty the vessel. When the water is less than 10mm then you need to estimate. If the container is already full then note the amount and add a + sign. Record the information on a graph. Are you getting more or less rain?

**Theory:** Heat from the sun causes water to evaporate. Transpiration is the movement of water from the ground through the plant roots up into the leaves and out to the air. The moisture in the air, from evaporation and transpiration, accumulates in the atmosphere and can produce rain.



## 1.2

# STUDENT RESOURCE SHEET

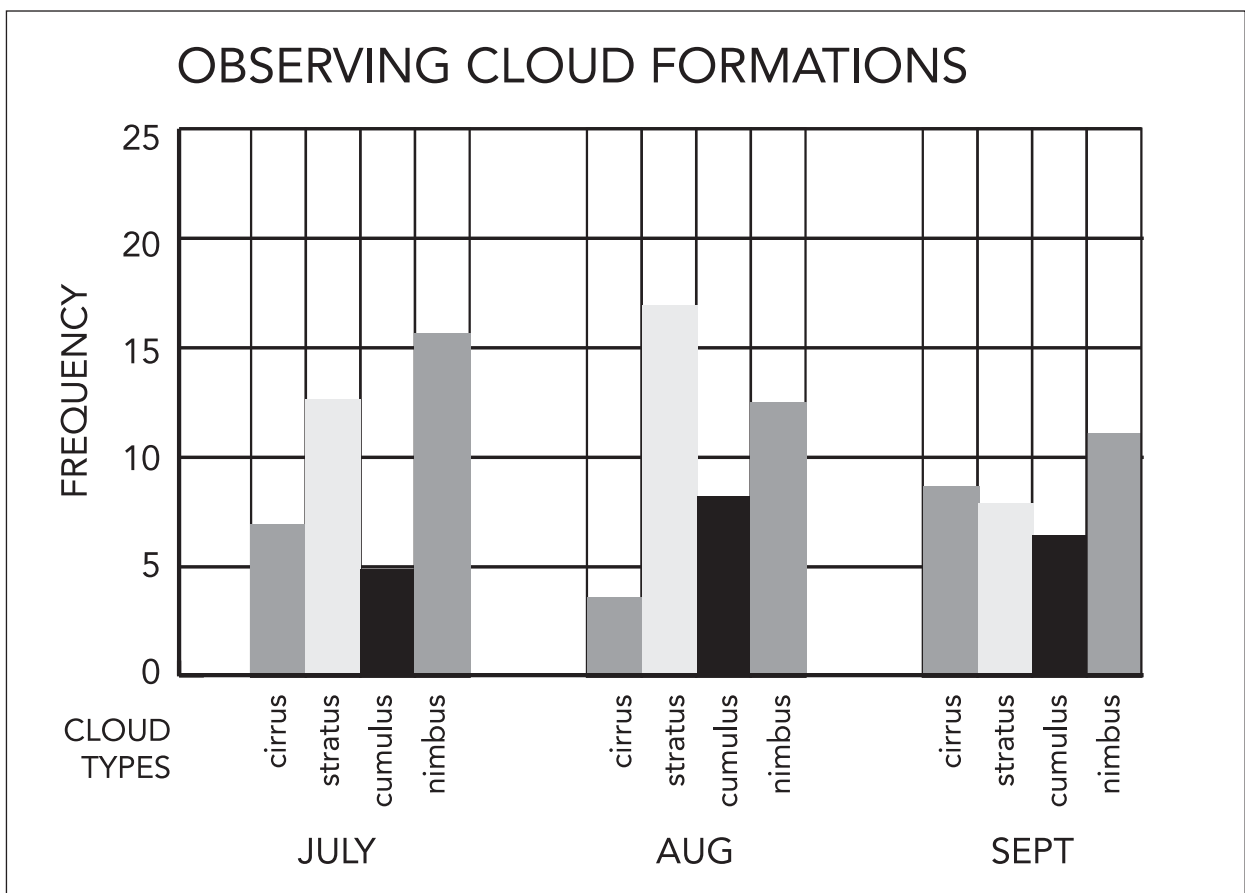
## WEATHER MONITORING

### OBSERVING CLOUD FORMATIONS

**Materials:** Weather monitoring chart.

**Action:** Observe the sky. What kinds of clouds are present – what do they look like? How high are they in the sky? What shape are they? Record the type of clouds on the weather monitoring chart. Do some clouds link to different weather such as rain or wind? At the end of the month, the data on cloud types can be graphed (see sample below).

**Theory:** Clouds are produced when moist air is cooled. They are a visual indicator of moisture cooling in the air: literally clouds are made up of very small liquid droplets. There is a large variety of cloud groups, which are broken into three primary groups depending on where they are in the sky: high clouds, middle clouds and low clouds. The clouds are further defined by their appearances – cumulus clouds have a bubbly appearance, cirrus clouds have a wispy appearance, stratus is sheet-like and nimbus clouds are rain bearing.



# 1.2

## STUDENT RESOURCE SHEET WEATHER MONITORING

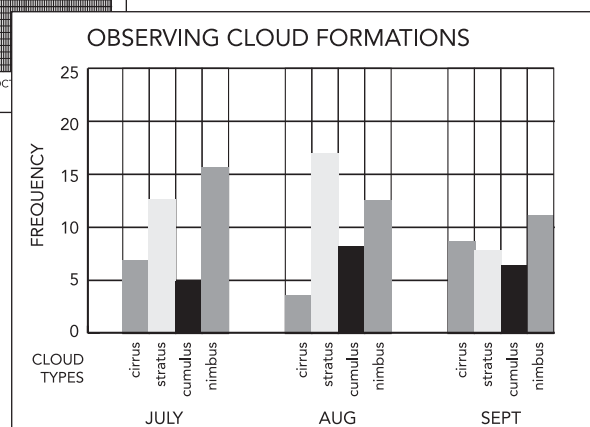
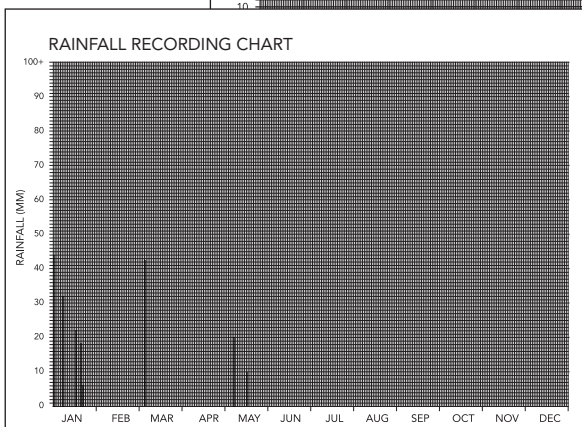
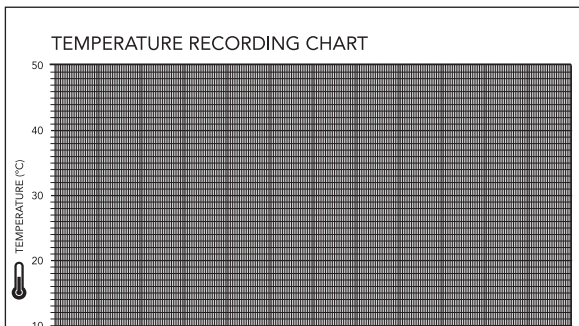
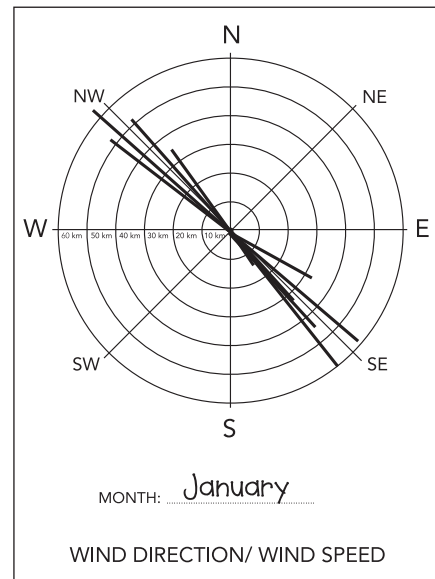
### SEASONS

**Materials:** Weather monitoring chart and graphs

**Action:** Compare the graphs from rainfall, temperature, wind, and cloud cover over a few months. Observe patterns between the graphs. Observe seasonal patterns over time.

**Theory:** Clouds, temperature, wind and rainfall all relate to each other, each one affecting the other. By observing the patterns, weather can be predicted and climate defined. Seasons are defined by the weather patterns. Seasons vary based upon the location on the Earth. All areas have seasons but areas that are further from the equator have greater changes in seasons.

Date		temperature °C	rainfall mm	weather conditions	wind direction °	wind strength	cloud types				
								cirrus	cumulus	stratus	nimbus



# TEACHER INFORMATION SHEET

## WEATHER



Weather is the general term given to the changing conditions of the Earth's atmosphere. It is affected by many factors including temperature, rain, air pressure, humidity, hours of sunshine, types of clouds, and amount of cloud cover. The main factor that allows the earth to have various weather conditions is the sun. The heat of the sun affects the atmosphere to create weather; for instance, heat from the sun causes water to evaporate, which can produce rain. The following activities will help you to better understand the weather by monitoring some of the key factors that affect the weather.

It is important that the measurements are taken at about the same time each day so that they can be compared. As such, timing is one of the first things to decide.

### Season

Maldives is an equatorial country and does not experience major seasonal differences. However, the early Maldivians carefully studied the patterns of weather and climate which is unique to this equatorial nation. Through their observations and recordings they related these patterns to the movements of the sun during a year. Based on this knowledge, the

Nakaiy (constellations of stars) calendar was developed by our forefathers to cater to the Maldivian lifestyle. Hence, the Maldives experiences a tropical, monsoon climate with warm temperatures year round and a great deal of sunshine.

There are two distinct seasons – the wet (Hulhan'gu or south-west monsoon) and the dry (Iruvai or north-east monsoon). The wet season runs from May to November. There are 18 'Nakaiy' in this season. It is the wettest period when moderate to rough seas and cloudy days are more common. Frequent gale force winds from the south-west with an average speed of 11-15 knots per hour occur, and wind gusts of 35-45 knots and above are occasionally recorded. September and October can be calmer and November is again a transitional period with variable winds swinging towards the north-east. The effects of cyclones from the Arabian Sea can be experienced during the south-west monsoon.

The north-east monsoon gradually travels down the Maldives from the north and is ushered in by a fortnight of very strong winds from the north-east with heavy rain squalls. The dry season runs from December to mid-April due to the Northeast monsoon. There are 9 'Nakaiy' in this season. This is the driest period, when hot days, cooler nights and calm seas are more common. There is generally little cloud cover





except in the south. Frequent light winds from the north-east and variable sea breezes with an average of 9 knots are experienced. The transitional period between monsoons begins in April and calm, windless days are more likely to be experienced than any other time of the year. A fortnight of strong winds and rain from the south-west usually ushers in the change of the new season and occasionally the tail end of cyclones from the Bay of Bengal can be felt. By the end of May the winds are predominantly west-south-west.

### Storms – Thunder and Lightning

These two always go hand in hand. Lightning is a massive electrical discharge between one cloud and another, from a cloud into the air, or between a cloud and the ground. Only about one in five lightning strikes are from cloud to ground. The delay between when you see lightning and when you hear thunder occurs because sound travels much more slowly than light. Sound travels through air at about 330-350 metres per second (one kilometre per three seconds). This forms the basis for a rule that we can use to estimate our distance from the lightning (ground stroke). Next time there is a storm, count the seconds between a flash of lightning and the thunder - every second indicates a distance of about 330 metres. Therefore, a pause of three seconds means that the lightning hit about 1 km away. Seek shelter immediately if a storm is approaching. But do not rest under large trees, as trees are sometimes hit by lightning as they are the highest point on the landscape.

### Human Effects on Weather

Our modern life and growth in global population are causing a huge increase in the world's use of energy. Much of the energy we use to power our cars and boats, produce electricity and manufacture products comes from fossil fuels. When burned, these fossil fuels add large amounts of greenhouse gases, especially carbon dioxide, to the atmosphere. Many scientists believe that the addition of greenhouse gases from human sources is throwing our atmosphere and the natural greenhouse effect out of balance. It would appear that the atmosphere is trapping too much heat and causing the Earth to heat up. This is known as global warming. Plants help in the absorption of carbon dioxide and they produce oxygen. Some countries are planting extra trees to compensate for the increase in carbon emissions (e.g. recently, the 'two million plants' campaign was carried out in the Maldives).

Scientists have identified that our health, agriculture, water resources, plants, wildlife and coastal areas are vulnerable to the changes that global warming may bring. But projecting what the exact impacts will be over the next century remains



very difficult. There is the possibility that a warmer world could lead to more frequent and intense storms, including cyclones. Preliminary evidence suggests that, once cyclones form, they will be stronger if the oceans are warmer due to global warming.

### Impact of Seasons on Fishing

Different activities related to fishing would be carried out at certain times of the year depending on the Nakaiy. For instance Fura-badhuruva and Fas-badhuruva of Iruvai season are considered to be two good Nakais' for fishing. The main reason behind this is that as mentioned above, the wet (southwest) monsoon has high rainfall and rough seas which could be dangerous for sail dhoanis to venture out. However, mechanized dhoanis can withdraw if the winds are not too strong. The number of reef fish, including bait fish, depends on the productivity of the reef. If the environmental conditions are favourable the fish stocks will increase and the productivity is said to be higher. Productivity depends largely upon the timing of the monsoons. Rough weather associated with the start of the southwest monsoon also affects the distribution of tuna stocks. This is important because it may be difficult for fishermen to find tuna.

*Reference: A Riyaz Jauhary, A I Chamberlain (1998)  
'Understanding Fisheries Science 1' Educational*

*Development Center, Ministry of Education, Republic of Maldives*

## MONSOONS IN THE MALDIVES

### SOUTH-WEST MONSOON – HULHAN'GU MOOSUN

DATE	NAKAIY	FISHING	WEATHER
08 April 21 April	Assidha	Poor. Usually sharks are caught.	Dry and hot. Very little rain. South-west monsoon starts.
22 April 05 May	Burunu	Poor.	Rather dry and stormy with rough seas.
06 May 19 May	Kethi	Poor.	Dry with very little rain. Seven storms occur.
20 May 02 June	Roanu	Mainly Kawakawa.	Stormy with heavy rain, strong winds and rough seas.
03 June 16 June	Miahelia	Poor.	Stormy with rough seas. Not suitable for travelling.
17 June 30 June	Adha	Good. Large schools of fish are found.	Calm seas with little rain. Wind blowing from south-west.
01 July 14 July	Funoas	Average.	Little rain with strong winds and rough seas. Not suitable for travelling.
15 July 28 July	Fus	Good. Schools are very close to coast.	Cloudy with a lot of rain.
29 July 10 Aug.	Ahuliha	Good. Schools move away from coast.	Calm and dry with a lot of sunshine.
11 Aug. 23 Aug.	Maa	Possible, if no rain.	Generally calm with a lot of rain.
24 Aug. 06 Sept.	Fura	Average. Schools are far from coast.	Rainy season ends. Wind starts to blow from north-west.
07 Sept. 20 Sept.	Uthura	Average.	Seas are generally calm with very little rain.
21 Sept. 03 Oct.	Atha	Good. Schools move closer to coast.	Calm seas accompanied with small storms and a westerly wind.
04 Oct. 17 Oct.	Hitha	Average. Schools are seen closer to the coast.	Isolated showers with weak westerly winds.
18 Oct. 31 Oct.	Hei	Good. Fish caught are usually large.	Lots of rain with winds generally blowing from west.
01 Nov. 13 Nov.	Vihaa	Good.	Calm seas with some rain.
14 Nov. 26 Nov.	Nora	Good. Season begins in the north.	Wind blowing from north-west. Currents change to north-east.
27 Nov. 09 Dec.	Dhoshha	Good. Season begins in the south.	Calm with rain and sunshine.

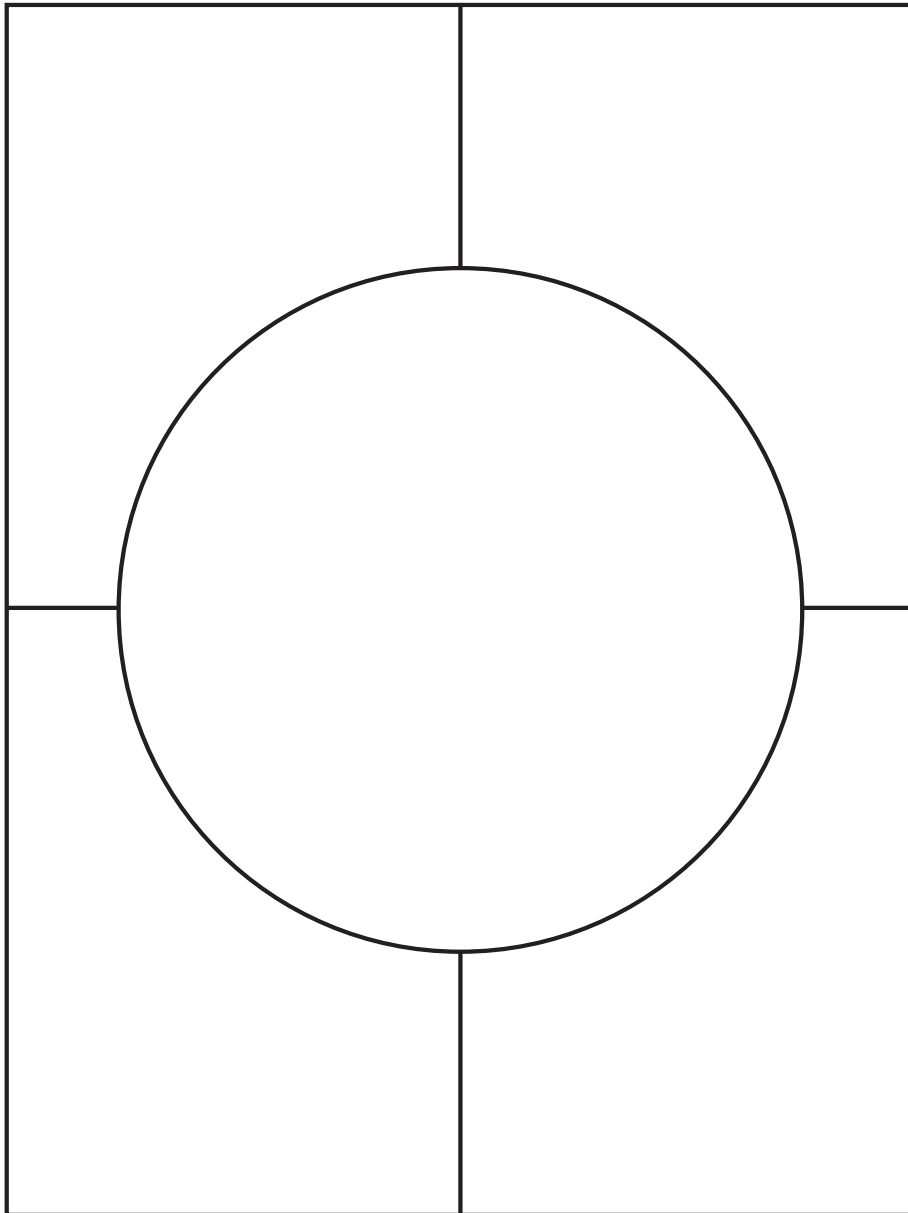
## NORTH-EAST MONSOON – IRUVAI MOOSUN

DATE	NAKAIY	FISHING	WEATHER
10 Dec. 22 Dec.	Mula	Good. Live bait is abundant in the north.	Strong winds with rough seas. Wind blows from north-east.
23 Dec. 05 Jan.	Furahalha	Good in the north of Maldives.	Strong winds with rough seas.
06 Jan. 18 Jan.	Uthura-halha	Average.	Strong winds with rough seas.
19 Jan. 31 Jan.	Huvan	Good. Mainly in the east of Maldives.	Rough seas with moderate winds from north-east.
01 Feb. 13 Feb.	Dhinasha	Good for shark fishing.	Moderate seas with little blowing.
14 Feb. 26 Feb.	Hiyavihaa	Good. Schools closer to the coasts.	Calm seas with little rain. Wind blowing from south-west.
27 Feb. 11 Mar.	Fura-badhuruva	Very good.	Small storms accompanied with thunder and lightning.
12 Mar. 25 Mar.	Fas-badhuruva	Very good.	Storm on the 3 <sup>rd</sup> or 4 <sup>th</sup> day with moderate winds and thunder.
26 Mar. 07 April	Reyva	Good. Mainly in the north of Maldives.	Stormy with gusts of wind from north-west.

## 1.2

TEACHER INFORMATION SHEET  
PLACEMATS

The placemat is drawn on A3 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.

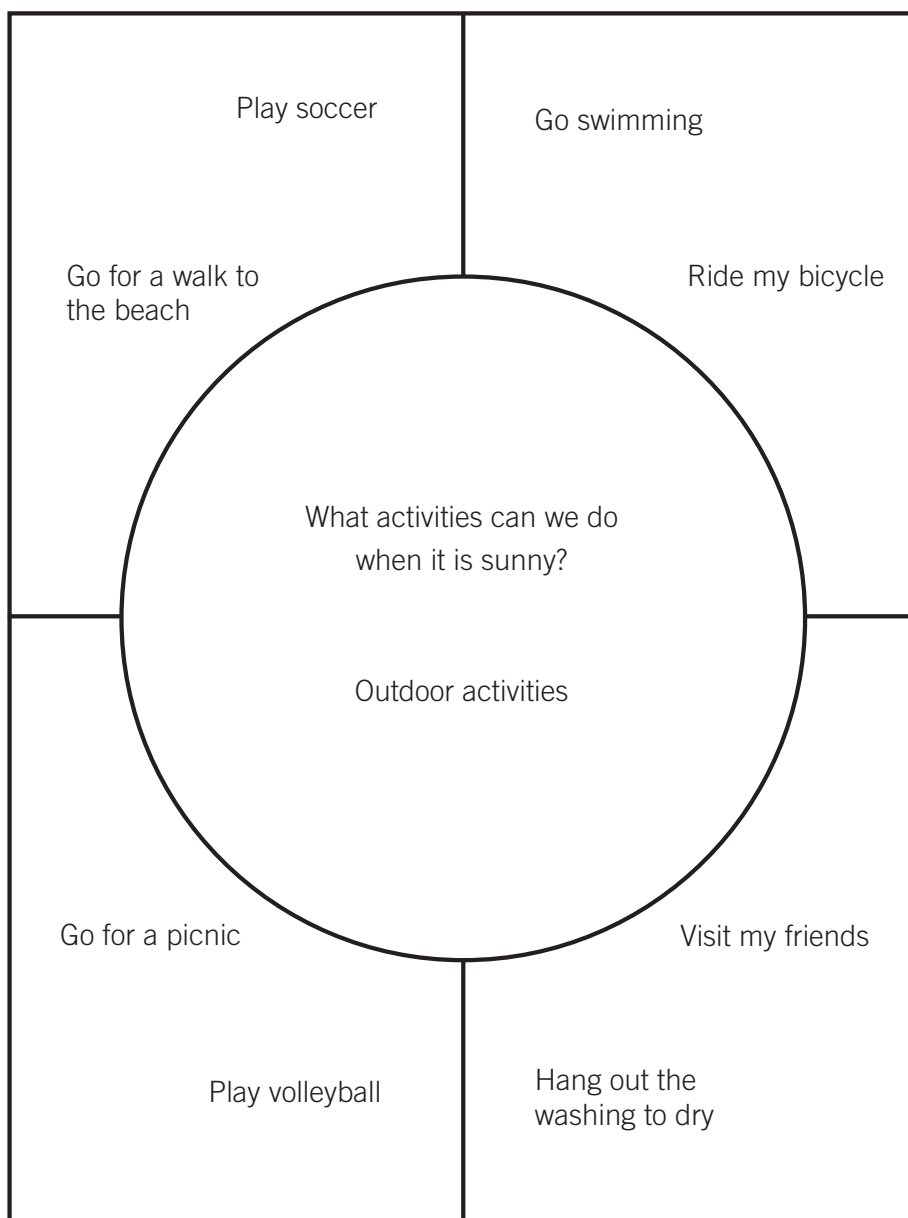


# 1.2

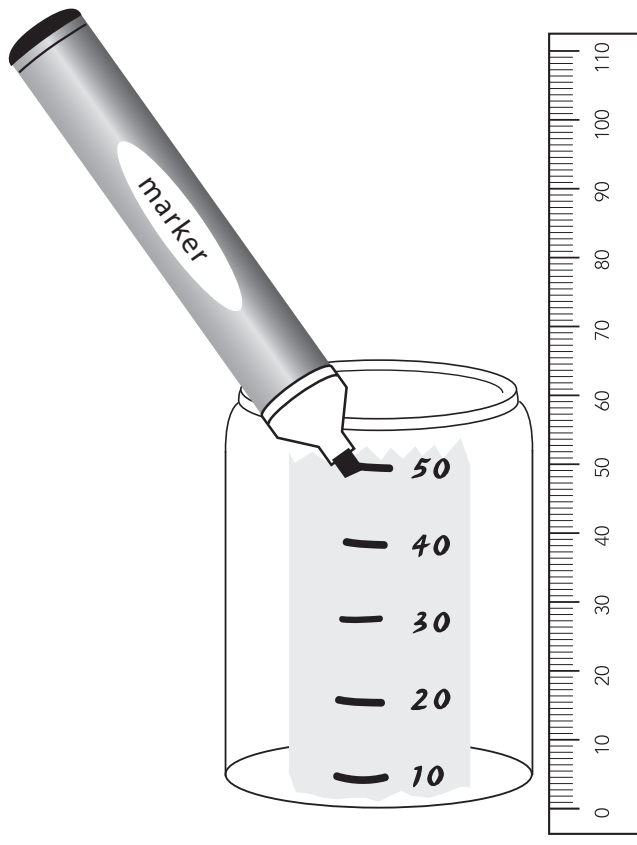
## EXAMPLE OF COMPLETED TEACHER INFORMATION SHEET

### PLACEMATS

The placemat is drawn on A3 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.



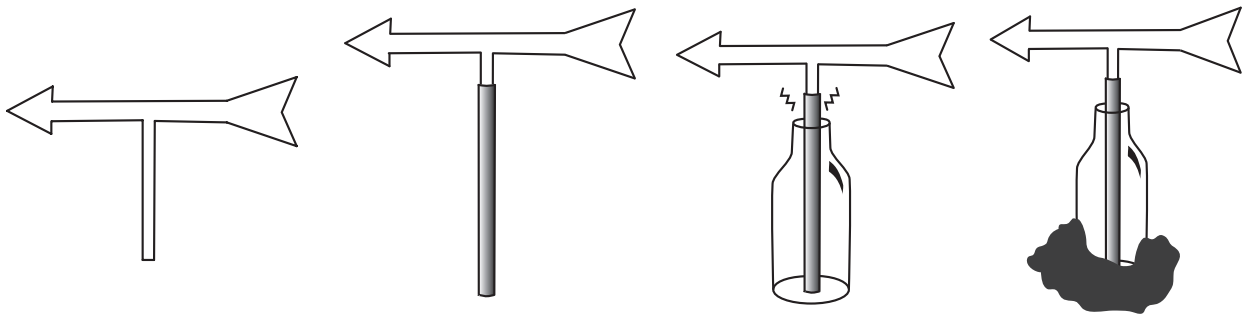
## 1.3

TEACHER INFORMATION SHEET  
MAKING A RAIN GAUGE

1. Provide each student with a jar (or encourage them all to bring jars from home for this activity).
2. On the side of the jar (or on a piece of tape stuck to the side of the jar), students need to carefully measure and mark centimeter increments.
3. Leave the jar, without a lid, in a place where it is exposed to any rainfall (i.e. not under a tree or roof).
4. Encourage students to check the level of water in the jar at the same time each day.
5. Remind them to pour out the water after they have taken the daily reading!

# 1.4

## TEACHER INFORMATION SHEET MAKING A WIND VANE



A weather vane is also called a wind vane. It is a tool for measuring wind direction. It spins on a rod and points in the direction from which the wind comes.

The weather vane is one of the oldest weather tools. The part of the vane that turns into the wind is usually shaped like an arrow. The other end is wide so it will catch the smallest breeze. The breeze turns the arrow until it catches both sides of the wide end equally. The arrow always points into the wind. The arrow tells you the direction from which the wind is coming.

### Materials

- paper and pencil
- scissors
- cardboard
- compass
- plastic soft drink bottle
- plastic drinking straw
- shallow bucket or jar filled with rocks
- felt marking pen

### Procedure

With the scissors, carefully cut an arrow. Bend the tab slightly so the arrow turns easily when you put it in one end of the straw. Put the other end of the straw in the bottle. Remove enough rocks from the bucket or jar to make room for the bottle. Pile the rocks back around the bottle so it won't be blown over. (See illustrations above.)

A compass always point north. Use your compass to find north, and then mark the four sides of the bottle E, W, N, and S with a felt pen.

# 2

# SAFEGUARDING DRINKING WATER

**Grades:** 1 to 3

**Number of lessons:** 4 to 6 lessons

## Purpose

This module is designed for the students to appreciate water as a precious, rare resource and as a vital condition for all healthy life. The students will realise that the amount of water available as drinking water is very small, is diminishing, and is threatened by pollution of various kinds. The purpose is for the students to learn about the kinds of threats to their drinking water, and how they and their community can collect and protect it.

## Key questions

The key focus questions of this module are:

- Why is water essential to all life?
- What threats are there to our drinking water?
- How can we collect drinking water?
- How can we protect our drinking water?

## Links with other modules

Resources from the Environment

## Toolbox

### Physical materials

Globe of the Earth, Measuring cylinders (capacity 1000ml) and 4 small transparent containers. (not less than 28ml)

### Flip Charts

Weather, Water, Waste and Energy Flip Chart

## Preparation

Familiarise yourself with the topic, the information and the activities provided. Decide on which activities to choose.

Practice the art of reading a story aloud, or of telling a story without a book or paper. For activity 4, you have the option of reading a story aloud or of telling it freely. If you decide to read aloud, it is advisable to practice this a few times. Story telling on the other hand is an art which requires some more practice but which can be learnt. Here are a few hints to help you.

- Read your story several times silently and concentrate on key events in the story line, characters and their personalities, and the different voices you may want to use.
- Then, read it out aloud. Choose your own voice for the story. Decide on the parts that need emphasis, consider pauses, openings and closings.
- Telling the story does not mean learning it word-for-word
- Write notes on the structure of the story and practice telling it without the book or paper, focusing on the opening and the closing of the story.



- Practice saying your story out loud which will help with decisions on what needs emphasis, what should be softened, what needs a different voice altogether, and so on.
- Recording of your story telling and listening to it can be useful in this learning process.
- You can also practice telling the story to an audience and ask for their feedback.

## 2.1 TUNING IN

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

*Teacher Information Sheet 2.1* contains a number of facts that can help the teacher feed the discussion with information on water as an essential element of all life, considering the individual and community level as well as the global context. The following three activities are designed to facilitate the understanding of drinking water as a limited and scarce resource.

### ACTIVITY 1: EXPLORING THE GLOBE

**Purpose:** To develop an understanding of the location of different types of water on Earth.

**Time:** Approx. 10 minutes

**Materials Required:** Globe of Earth

**Resource / Information Sheets:** N/A

#### Procedure

Look at the globe or the images with the students. See if they can find where they live. Have them point out lakes, rivers, swamps and oceans around the world. Explain that these are called surface waters.

Ask the students if they know which kinds of water bodies are salt water and which are freshwater.

Ask the students if they think there is more water or land on the globe. Is there water beneath the surface of the ground that we cannot see on the globe?



*The Maldives is surrounded by the Indian Ocean.*

### ACTIVITY 2: TOSS THE GLOBE

**Purpose:** To develop an understanding that Earth is a water planet.

**Time: Approx.:** 15-20 minutes

**Materials Required:** Globe of Earth

**Resource / Information Sheets:** N/A

#### Procedure

Arrange all students in a circle. Teacher stands in the middle and tosses a globe of the earth to the children, one at a time. Each child will throw back the globe (toss) to the teacher.

When each child catches the globe, ask him or her to explain how they feel when they think of water, and tell the group where their right thumb had landed (land or ocean).

The proportion of thumbs landing on ocean and land will be tallied up on the board by one of the children.



*Tossing the globe.*

Eg.,

	Land	Water
	III	IIII
Total		
Percentage		

This random survey of the planet will be a reasonably accurate estimation of the actual surface of the Earth covered by ocean and land (71% and 29%).

### ACTIVITY 3: EXPLORING THE GLOBE: WATER DEMONSTRATION

**Purpose:** To appreciate the limited amount of water available as drinking water.

**Time:** Approx. 1 hour

**Materials Required:** Six measuring cylinders, or two 1000ml measuring cylinders & four other smaller transparent containers

**Resource / Information Sheets:** N/A

#### Procedure

Organise six measuring cylinders, or two measuring cylinders and four other smaller transparent containers. If you don't have these, try making your own measuring cylinders by graduating (marking) small plastic bottles by pouring in 1ml of water into them one at a time and marking the levels with a marker pen. (Maybe the Science or mathematics teacher can help make a 1ml measuring instrument. 1 cubic centimetre is equal to 1ml.)

Fill a 1000ml marked cylinder with coloured water to the 1000ml line. This represents all of the Earth's supply of water.

Pour 28ml (2.8% of 1000ml) of the total water into another 1000ml cylinder. This represents the Earth's total fresh water supply. The rest of the 972ml of water is saltwater that is normally found in the oceans.

Divide the 28ml of water into small containers as follows:

- 23ml for the icecap and glaciers (frozen freshwater)
- 4ml for ground water (freshwater deep underground)
- 2 drops for surface water (lakes, rivers, streams, swamps)
- 1 drop for water in the atmosphere and in the soil

Give the students time to appreciate the visualisation of the ratios and discuss. You can add the following activities:

- Calculate the percentages of the Earth's water on a separate sheet of paper and discuss these.
- Distribute graph paper. And ask students to create a bar graph that shows 97% ocean, 2.3% ice caps and glaciers, and 0.7% fresh water.

(Be sure to reuse the water from the cylinders and cups, e.g. water plants with it.)

#### Questions for reflection

- Ask students if the numbers surprised them. Did they realise that such a small percentage of the water in the world is fresh?
- Which of the freshwater cylinders represents the most freshwater on Earth?
- Is this a source of freshwater commonly used by humans for their general use? Why or Why not?
- Why isn't all fresh water usable? (Some is not easy to get at; it may be frozen or trapped in unyielding soils or bedrock fractures. Some water is too polluted to use.)
- Where is most of the Earth's water found?
- Is this water source readily available for drinking, cleaning or cooking? Why or why not?

- Why do we need to take care of the surface water/ground water? (Water is very important for humans, plants/crops, and animals. If we waste water or pollute it, we may find that there is less and less of it available for us to use.)

The question arising from the above and to be discussed with the students is: How do we make sure we have enough drinking water now and in the future? List with the students what they need to do next and what they need to find out to proceed.

Make sure that the students insert the findings of their activities and discussions in their exercise books.

## 2.2 DECIDING DIRECTIONS

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

### ACTIVITY 4: EVERYBODY NEEDS DRINKING WATER ALWAYS

**Purpose:** To analyze and rewrite the outcomes of the Water story.

**Time:** Approx. 30 minutes

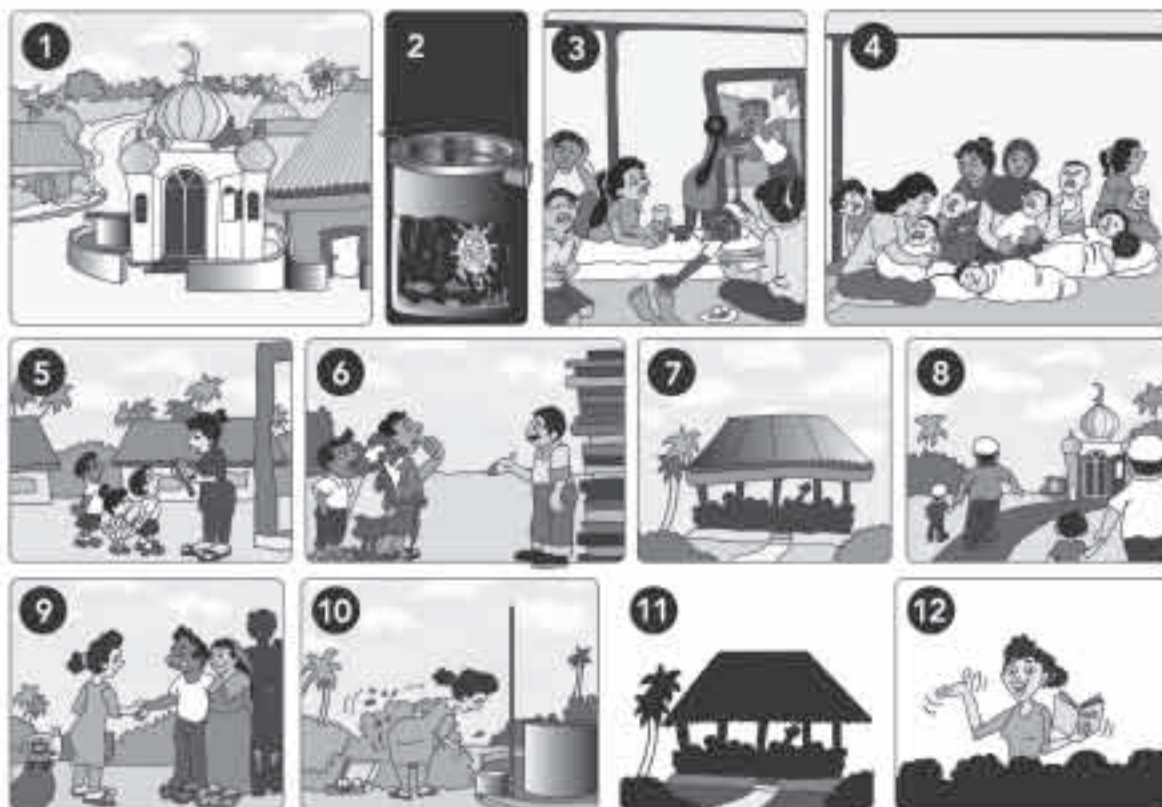
**Materials Required:** Weather, Water, Waste, Energy Flip Chart

**Resource / Information Sheets:** N/A

#### Procedure

Read or tell the water story in the water section of the Weather, Water, Waste and Energy Flip Chart (*water, water everywhere, but not a drop to drink*). You can read the story out to the students, however, telling the story may be more compelling and engaging (how to prepare for this, see Section Preparation above).

Storytelling is regarded as a key teaching strategy for achieving the objectives of education. Stories are a way of knowing, an organiser of knowledge, a way of passing on knowledge, of developing ideas and concepts, of reaching our emotions and feelings about issues, of reflecting the soul of a culture and the consciousness of people. Importantly, for this module, stories can help to initiate communication and help find solutions to problems and investigate alternatives.



Water story from Weather, Water, Waste and Energy Flip Chart.

After reading or telling of the story, organise the children in pairs, small groups or individually, and ask them to discuss and write down responses to the following points:

- What do you like or do not like about the story?
- What is the relevance of water in this story?
- What are the main messages in this story?
- Invent an ending that is not desirable. What could happen to the actors in this story if there was no positive outcome?

### Extension

Re-write the story in a different way:

- A negative outcome.
- Create a new title for your story.

Collect the points the students are making, write them on a board, have the students record those points and their new stories.

## 2.3 FINDING OUT

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

### ACTIVITY 5: SECURING DRINKING WATER ON OUR ISLANDS

**Purpose:** To discuss and share ideas of how to secure drinking water.

**Time:** Approx. 15 minutes initially, then ongoing over 3 days

**Materials Required:** N/A

**Resource / Information Sheets:** 2.1 Student Resource Sheet - Our drinking water supply  
2.2 Student Resource Sheet - What do we use drinking water for and how much?

#### Procedure

The main freshwater source on coral islands has always been the water lens. Work through the pages on water on the Weather, Water, Waste and Energy Flip Chart.

Discuss what problems there are for us today with well water and what else we can do to secure safe drinking water. The students discuss where their families' and their school's drinking water comes from. Identify and name the sources (well water, rainwater, bottled water, desalinated water). Have the students record how much drinking water they consume over a day or a week using *Student Resource Sheets 2.1 and 2.2*

Use *Student Resource Sheet 2.1* for the students and *Student Resource Sheet 2.2*. The students monitor their drinking water use over a period of three days and calculate the average use. The resource sheets can be adapted according to age level, and more complicated mathematical calculations can be undertaken, such as the drinking water use over a week, month or year, for the family and the whole island community.

The key questions to be discussed then are:

- What are the problems associated with each source of drinking water?
- How do we make sure we have enough drinking water now and in the future?
- What do we need to know next in order to be able to act?

Organise note taking on the black board in tables and in their exercise books.

## Extension

The students research how different people source their freshwater either locally, regionally or World wide, e.g. the Aborigines in Central Australia or the Kalahari Bushmen.

More advanced mathematical calculations can be undertaken, such as the drinking water use over a week, month or year, for the family and the whole island community.

## 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.

### ACTIVITY 6: PROBLEMS WITH UNSAFE DRINKING WATER

**Purpose:** To identify and discuss problems with unsafe drinking water.

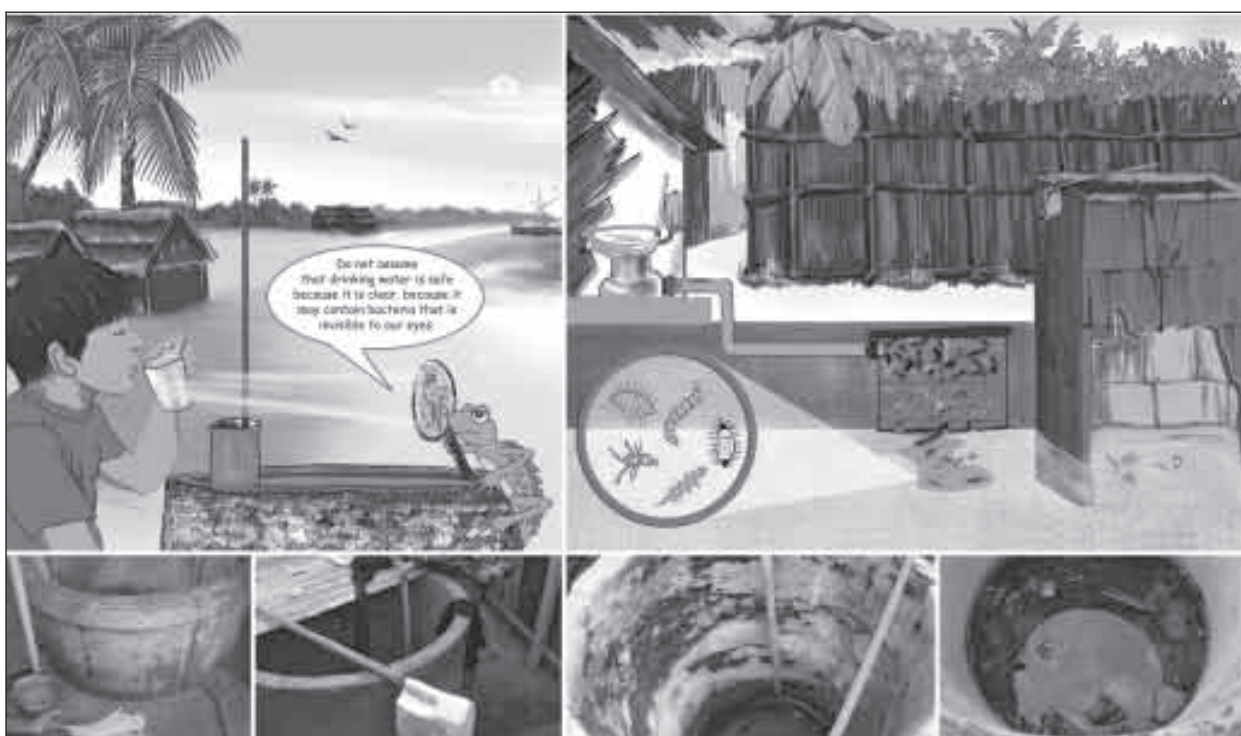
**Time:** Approx. 20-25 minutes

**Materials Required:** N/A

**Resource / Information Sheets:** 2.2 Teacher Information Sheet - Use of well water and water related to diseases  
2.3 Teacher Information Sheet -Questions and issues for safeguarding drinking water

#### Procedure

The page on 'Well contamination' in the Weather, Water, Waste and Energy Flip Chart and *Teacher Information Sheet 2.2* provides you with some information on the issues relevant here. Design a resource sheet for the students suited to the age level and relevant for the key points of this stage of this module. Guiding questions are listed in *Teacher Information Sheet 2.3* (to be adapted by the teacher to design student resource sheets)



Well contamination page from the Weather, Water, Waste and Energy Flip Chart.

The key questions for discussions are:

- Have you encountered any difficulties in obtaining drinking water on your island?
- Why is this so?
- Have there been illnesses in your family due to the consumption of unsafe drinking water?

You can also discuss why it is important to have safe drinking water. The first and most important benefit is health. Secondary benefits include:

- There will be less days where people are unable to work due to water related illnesses;
- Less of a family's income will be spent on medicine to treat water related illnesses; and
- More time will be available to girls and woman for either education or work if sources of water close to home are available.

Thus, availability of clean drinking water also helps to break the poverty cycle, by freeing up people from the burden of disease and freeing up time for education, work or investment in the family.

## 2.5 DRAWING CONCLUSIONS

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

### ACTIVITY 7: THE PROBLEM AREAS

**Purpose:** Students identify solutions to threats to drinking water.

**Time:** Approx. 30 minutes

**Materials Required:** Weather, Water, Waste, Energy Flip Chart

**Resource / Information Sheets:** N/A

#### Procedure

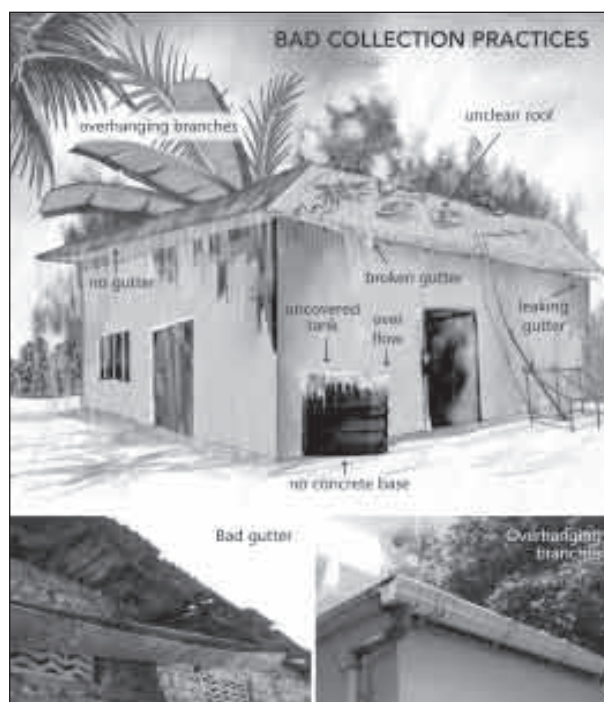
Work through the pages on 'Rainwater Collection' and 'Saving Water' in the Weather, Water, Waste and Energy Flip Chart.

The key questions are:

- What are the threats to our drinking water?
- What can we do to improve our drinking water situation?
- Whose responsibility is it to improve our drinking water situation?

The students discuss and learn about threats to their drinking water, what the best options are for obtaining drinking water, and measures the community, family and school can apply to safeguard their drinking water. In short:

- Rainwater harvesting is considered to be the preferred source of potable water supply, and designed to provide optimum drought resilience with easy to follow safety instructions for drinking water.
- Wells face salination problems and contamination from septic tank discharge, waste, excreta and so their protection must be improved.



*Bad rainwater collection practices.*

- As another option, desalination is possible, but it is the least preferred option outside of Malé and tourist resorts due to cost, maintenance and governance problems. The use of desalination as anything other than an emergency measure is considered unsustainable.

Decide with the students about the most appropriate solution for their island situation.

Make sure of note taking/ painting/ drawing/ collaging in their exercise books.

## 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.

### ACTIVITY 8: PLANNING AN AWARENESS CAMPAIGN OR OTHER ACTION

**Purpose:** To plan and implement an action plan to safeguard drinking water.

**Time:** Approx. 2 hours

**Materials Required:** Pens, paper, markers

**Resource / Information Sheets:** N/A

#### Procedure

By now, the students will have a good understanding of the issues surrounding their drinking water. They are now in the position to formulate an action plan of what they can do to safeguard their drinking water. They identify here what they need to do at home, at school, or at the community level to improve their drinking water situation. 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. This could include, for example,

- Devise an educational event (an information day for the parents conducted by the students).
- 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, a TV or radio advertisement and perform as role play to the class and the parents.

Make a recording of this.

#### Extension

Discuss the effectiveness of the campaign along the lines of the following proposed questions:

*What was good? What went well? What is the main message conveyed? Do you agree with this message? What can be improved? What would you like to do next?*

## 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: LESSONS LEARNT

**Purpose:** To reflect upon what students have learnt.

**Time:** Approx. 20 minutes

**Materials Required:** Pen and paper

**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 books. 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 subject on safeguarding drinking water?
- What did you not like about this subject of the Module?
- What was the most important thing that you have learnt?
- What do they see as most important to improve the drinking water situation on this island?





# STUDENT RESOURCE SHEET

## OUR DRINKING WATER SUPPLY

Identify the water sources used at home and at school. Tick as appropriate.

	At home	At school
Well water		
Rainwater		
Bottled water		
Desalinated water		
Other		

Answer the following questions;

Have there been any water related illnesses in your family?

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What is your preferred drinking water source?

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Why do you prefer this drinking water source?

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# 2.1

## EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

### OUR DRINKING WATER SUPPLY

Identify the water sources used at home and at school. Tick as appropriate.

	At home	At school
Well water		
Rainwater	✓	✓
Bottled water	✓	
Desalinated water		
Other		

SAFEGUARDING DRINKING WATER

Answer the following questions;

Have there been any water related illnesses in your family?

My younger brother was sick last year when he drank water from the well after playing soccer.

What is your preferred drinking water source?

I prefer to drink bottled water, but I also like rainwater.

Why do you prefer this drinking water source?

Bottled water tastes nicer and it is clean.



# STUDENT RESOURCE SHEET

## WHAT DO WE USE DRINKING WATER FOR AND HOW MUCH?

Monitor the use of drinking water over a period of 3 days and calculate the average use.

	Date:		Date:		Date:	
	Number of times	litres used	Number of times	litres used	Number of times	litres used
Cooking						
Drinking (yourself)						
Drinking (family)						
-----						
-----						
		Total:		Total:		Total:
Average litres of water used a day:						

SAFEGUARDING  
DRINKING WATER

# 2.2

## EXAMPLE OF COMPLETED STUDENT RESOURCE SHEET

### WHAT DO WE USE DRINKING WATER FOR AND HOW MUCH?

Monitor the use of drinking water over a period of 3 days and calculate the average use.

SAFEGUARDING DRINKING WATER

	Date: 10-4-2008		Date: 11-4-2008		Date: 12-4-2008	
	Number of times	litres used	Number of times	litres used	Number of times	litres used
Cooking	2 times	20 litres	3 times	30 litres	2 times	20 litres
Drinking (yourself)	5 times	1 litres	5 times	1.5 litres	6 times	2 litres
Drinking (family)	8 times	3 litres	6 times	2.5 litres	6 times	2.5 litres
-----						
-----						
		Total: 24		Total: 34		Total: 24.5
Average litres of water used a day: 20.83						

# 2.1

## TEACHER INFORMATION SHEET DRINKING WATER IS ESSENTIAL

The availability of drinking water is one of the most important issues for people and all life on Earth. This section of the module is designed for the students to appreciate water as a precious resource and as a vital condition for all healthy life. On the one hand, water seems such a common substance: it covers more than 70% of the Earth's surface and the Maldives are surrounded by it. On the other hand, the amount of fresh water that is available is very small, it is diminishing, and it is threatened by pollution of various kinds. Therefore, particularly on small island communities with limited space, students need to develop an understanding of water as a precious resource that requires safeguarding, of the kinds of threats to their drinking water, and how they and their community can collect and protect it.

Looking from space onto the planet Earth, this planet is a blue one. This is because planet Earth is a water planet. But also humans are mostly water. As adults, it accounts for

about 72% of our body weight, roughly the same percentage of the surface of the Earth that is covered by water. Water moves in a never-ending cycle; nature recycles it over and over again. The water we drink may have been a drink for a dinosaur. Today, we have approximately the same amount of water as when the Earth was formed; Earth will not get any more water.

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

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

Water fit for human consumption is called drinking water or 'potable water'. Water that is not fit for drinking but is not harmful for humans when used for food preparation is called safe water.



*Drinking water is a precious resource.*

While a person can survive several weeks without food, no one can go more than 4 days without drinking water. To function properly, the body requires between one and seven litres of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors. Most of this is ingested through foods or beverages other than drinking straight water. It is not clear how much water intake is needed by healthy people, but for those people who do not have kidney problems, it is rather difficult to drink too much water. However, in warm humid weather, specially while exercising it is dangerous to drink too little.

As water can contain many different substances, it can taste or smell very differently. In fact, humans and other animals have developed their senses to be able to evaluate the drinkability of water: animals generally dislike the taste of salty sea water and the putrid swamps and favour the purer water of a mountain spring or aquifer. The taste advertised in spring water or mineral water comes from the minerals present, while pure H<sub>2</sub>O is tasteless. As such, purity in spring and mineral water refers to purity from toxins, pollutants, and microbes.

### Consequences of the pollution of drinking water

Earth's freshwater supply is limited and threatened by pollution and habitat destruction. Large amounts of habitats like wetlands, that recharge and purify ground water, have been destroyed. In the developing world, 90% of all wastewater still goes untreated into local rivers and streams. Some 50 countries, with roughly a third of the world's population, also suffer from medium or high water stress, and 17 of these extract more water annually than is recharged through their natural water cycles. The strain affects surface freshwater bodies like rivers and lakes, but it also degrades groundwater resources.

Because of overpopulation in many regions of the world, mass consumption and water pollution, the availability of drinking water per capita is inadequate and shrinking. UNESCO's World Water Development Report (WWDR, 2003) indicates that, in the next 20 years, the quantity of water available to everyone is predicted to decrease by 30%. Therefore, water is a strategic resource and an important element in many political conflicts. There is a long history of conflict over water, including efforts to gain access to water.

Fresh water—now more precious than ever in our history for its extensive use in agriculture, high-tech manufacturing, and energy production—is increasingly receiving attention as a resource requiring better management and sustainable use.

Contaminated drinking water represents a major human health hazard in many parts of the world. The World Health Organization estimates that 1.2 billion people are without access to safe drinking water. Significant numbers of illnesses and deaths are reported annually as a result of waterborne diseases. Diarrhoea-related illnesses alone are estimated to cause two million deaths per year. The majority of these deaths occur in young children.

Most countries have accepted the Millennium Development goal of halving by 2015 the number of people worldwide who do not have access to safe water and sanitation. Even if this difficult goal is met, it will still leave more than an estimated half a billion people without access to safe drinking water supplies and over 1 billion without access to adequate sanitation facilities. Poor water quality and bad sanitation are deadly; some 5 million deaths a year are caused by polluted drinking water.

An estimated 6,000 children die each day because of unsafe water supply, sanitation and hygiene. In 2004, the UK charity Water Aid reported that a child dies every 15 seconds from easily preventable water-related diseases. Among the most common of these water-related diseases, malaria continues to take its toll. There are some 100 million cases of malaria with between 1 and 2 million deaths each year. To this can be added almost 4 billion cases of diarrhoea worldwide, killing 2.2 million people.

*(Sources: [http://www.epa.gov/gmpo/edresources/water\\_5.html](http://www.epa.gov/gmpo/edresources/water_5.html)  
<http://en.wikipedia.org/wiki/Water>)*

# 2.2

## TEACHER INFORMATION SHEET

### USE OF WELL WATER AND WATER RELATED DISEASES

Well water is used by all households in the Maldives. Most communities use the well water for all non-drinking uses such as washing, bathing and toileting. Well water provides about 90% of the household water needs. Well water is therefore very important to the household.

#### Health risks from drinking contaminated water

Unfortunately, all surveys of well water show that well water is of worse quality than rainwater. It usually has about 100 times more bacteria in it and is 100 times more salty than rainwater. Some wells also contain contamination from septic tanks. Due to the presence of bacteria and other compounds from septic tank discharge it is always better to drink rainwater than well water.

If you drink well water that contains too much bacteria then it will make you sick, and give you diarrhoea and vomiting. This can lead to dehydration and for vulnerable people (children and the elderly) even death. When people get infected with diseases such as diarrhoea, typhoid and hepatitis A, their excreta will contain large amounts of the germs which cause the disease.

When people defecate in the open, flies will feed on the excreta and can carry excreta on their bodies. When they touch food excreta and germs are passed on the food. Where there are germs there is always a risk of disease. During the rainy season, excreta may be washed away by rainwater and can run into wells, thus contaminating the wells.

In many cultures it is believed that children's faeces are harmless and do not cause disease. This is not true. A child's faeces contain as many germs as an adult's, and it is very important to collect and dispose of children's faeces quickly and safely.

Many common diseases that can give diarrhoea can spread from one person to another. Disposing of excreta safely, preventing faecal contamination of water supplies and improving personal hygiene particularly hand washing with soap (at critical times such as after going to the toilet, before eating and food preparation) would greatly reduce spread of diseases significantly.

Water which is too salty will make you vomit, and may make your skin itchy and sore. Most well water in the Maldives is not too salty for drinking. Your health post may be able to test your well for salt. People can drink salty water with a



*Drinking contaminated well water can make you sick.*

conductivity reading up to 2,500  $\mu\text{S}/\text{cm}$ . (WHO guidelines suggest a maximum Chloride content of 250 mg/l for potable uses which equates to a salinity of approximately 1,500  $\mu\text{S}/\text{cm}$ . However experience in other small island states confirms whilst this is desirable, a more realistic limit is 2,500  $\mu\text{S}/\text{cm}$ .)

## Waterborne diseases

We are often unaware of how unsafe our water supplies can be to our health. There are five broad categories of water related diseases:

- Group 1:** Waterborne infections e.g. cholera, typhoid and infective hepatitis.
- Group 2:** Water-shortage diseases e.g. skin infections, trachoma.
- Group 3:** Water-impounding diseases e.g. schistosomiasis, guinea worm.
- Group 4:** Water-arthropod diseases e.g. malaria
- Group 5:** Chemical contaminants in excess or shortage e.g. fluoride.

Some examples of water related diseases common in the Maldives

### Typhoid

Typhoid is an infection of the intestinal tract and bloodstream caused by bacteria. Clean water, hygiene, and good sanitation prevent the spread of typhoid. Contaminated water is a major reason for the spread of the disease. People become infected after eating food or drinking beverages that have been handled by a person who is infected or by drinking water that has been contaminated by sewage containing the bacteria. Typhoid is common in the Maldives, principally because of the problem of unsafe drinking-water and inadequate sewage disposal.

### Diarrhoea

Diarrhoea is the passage of loose or liquid stools more frequently than is normal for the individual. It is primarily a symptom of gastrointestinal infection. Depending on the type of infection, the diarrhoea may be watery (for example in cholera) or passed with blood (for example in dysentery). Severe diarrhoea may be life threatening due to fluid loss in watery diarrhoea, particularly in infants and young children, the malnourished and people with impaired immunity. Diarrhoea is a symptom of infection caused by a host of

bacterial, viral and parasitic organisms most of which can be spread by contaminated water. It is more common when there is a shortage of clean water for drinking, cooking and cleaning and basic hygiene is important in prevention. Water contaminated with human faeces for example from municipal sewage, septic tanks and latrines is of special concern. Diarrhoea can also spread from person to person, aggravated by poor personal hygiene. Water can contaminate food during irrigation, and fish and seafood from polluted water may also contribute to the disease.

### Cholera

Cholera (also called Asiatic cholera) is a water-borne disease caused by the bacterium *Vibrio cholerae*, which is typically ingested by drinking contaminated water, or by eating improperly cooked fish, especially shellfish. The infection is often mild or without symptoms, but sometimes it can be severe. It has a short incubation period, from less than one day to five days, and produces an enterotoxin that causes a copious, painless, watery diarrhoea that can quickly lead to severe dehydration. Approximately one in 20 infected persons has severe disease characterized by profuse watery diarrhoea, vomiting, and leg cramps. In these persons, rapid loss of body fluids leads to dehydration and shock. Without treatment, death can occur within hours.

Most persons infected with *V. cholerae* do not become ill, although the bacterium is present in their faeces for 7-14 days. When illness does occur, more than 90% of episodes are of mild or moderate severity and are difficult to distinguish clinically from other types of acute diarrhoea. Less than 10% of ill persons develop typical cholera with signs of moderate or severe dehydration.

### Hepatitis A

Hepatitis A is an enterovirus and can be transmitted through contaminated food and water. It causes an acute form of hepatitis (inflammation of the liver), does not have a chronic stage, and will not cause any permanent damage to the liver. Young children who catch hepatitis A often have a milder form of the disease, usually lasting from 1-3 weeks, whereas adults tend to experience a much more severe form of the disease. They are often confined to bed and minimal activity for about 4 weeks and have to stop their work for one to three months or longer. Many adults take up to 6-12 months and occasionally longer to recover entirely.

### Skin problems

There can also be skin problems due to high salinity levels.



# 2.3

## TEACHER INFORMATION SHEET

### QUESTIONS AND ISSUES FOR SAFEGUARDING DRINKING WATER

(To be adapted by the teacher to design student resource sheets) Can be enhanced by the students with paintings, drawings, graphs, related newspaper articles, stories, and others.

Below is a list of questions and issues from which you can choose and design a number of student resource sheets and in a way suited to the age level, the level of knowledge and understanding of the students, and the topics covered in this module. Some can be considered guiding questions for you to develop your own questions or break them down into several questions.

#### Analysis of a story

You could present a written story featuring water that the students are analysing as per their Tuning In activities and answer the following questions (to be adapted according to the story):

- What do you like or do not like about the story?
- How does it relate to water?
- How is water portrayed in this story?
- What is the relevance or meaning of water in this story?
- What does the story tell us about our relationship to water?
- What are the uses of water here?
- What role does drinking water play in the story?
- How is drinking water being treated?
- How do the characters in the story relate to the drinking water?
- Who controls the availability of water?
- What conflict is there in relation to drinking water?
- How is this conflict being solved?
- What alternative resolutions are there?

#### Drinking water – global context

- Why is water a precious resource?
- Why is there so little drinking water available?
- Why are the drinking water resources diminishing?

The above questions can also be adapted in a simpler form, for example:

- What is one of the most important elements we need for a healthy life?

- How much drinking water is available on the planet?
- Is there enough drinking water for all and forever?
- What are the consequences of not having access to safe drinking water?

You can create more variations of the questions above, and in relation to the activities of the Tuning In section.

#### Drinking water in the Maldives

- What kinds of drinking water are available in the Maldives?
- Where does the safest drinking water come from?
- What are the problems with well water? Or: Why is it better to drink rainwater rather than well water?
- Have there been any diseases because of drinking polluted water?
- What are the common diseases that people in the Maldives experience when their drinking water is polluted? What happens to you when you are ill?
- What are the threats to drinking water?
- What are the best options for obtaining drinking water?
- Do you drink rainwater?
- Do you collect your own rainwater?
- Do you drink well water?

#### Well water in the Maldives

- Explain how the freshwater lens is created.
- Is there a risk of the water in the freshwater lens turning salty? Why?
- Why does the groundwater salinity vary?
- Why does well water get more salty during the dry season?
- Why are Dhani wells usually fresher than pumped wells?
- How much water can we take before the well gets salty?
- How can I make my well less salty?

Refer to the Weather, Water, Waste, Energy Flip Chart page 'Freshwater lens'

#### Well contamination and how to prevent it

- Is there a risk of contamination to your groundwater? Explain any risks.

- Explain how the well is built and functions and why it is susceptible to contamination based on that.
- Explain the risk of contamination through septic tank discharge.
- Explain the risk of contamination based on the location of the well.
- Are there any additional sources of contamination?
- List actions to reduce well contamination and to improve the water quality.

*Refer to the Weather, Water, Waste, Energy Flip Chart page 'Well water contamination'*

### Rainwater drinking supplies

- Explain the benefits of catching rainwater and how you can do that.
- What threats are there to your rainwater?
- How can you disinfect your rainwater and when is it necessary to do so?
- How do you keep rainwater clean? Explain the use of roof and roof gutters, downpipe filters, the 'First Flush' technique, the 'First Flush' valve, position of the tank and the tap, spill collector, increasing of gutter area, second tank, overflow redirection.
- Is there a use for communal tanks and how can that be organised?
- Is your water tank big enough for your family?
- How could you increase the amount of rainwater collected at home?

*Refer to the Weather, Water, Waste, Energy Flip Chart page 'Rainwater collection'*

### Responsibilities

- Whose responsibility is it to look after drinking water on your island?
- How can we make sure that those responsibilities are met by those responsible?

### Action

- What can you do personally to safeguard drinking water?
- What can your family do?
- What can your school do?
- What can your community do?
- What can the Maldives do?
- What can be done at the global level to safeguard drinking water? (For example, even though the students may not have discussed details on this issue, they may be able to realise that education and community action is something that can be done anywhere.)

*Refer to the Weather, Water, Waste, Energy Flip Chart page 'Saving Water'*

# 3

# WATER QUALITY MONITORING

**Grades:** 4 to 5

**Number of lessons:** 4 to 6

## Purpose

The students are developing skills and knowledge for monitoring the quality of their drinking water. This will increase their understanding of the important relationship between healthy water and healthy people. They will realise that water is not always safe to drink, and that there are ways to look after and manage their drinking water. This builds the foundation for developing capacity to look after their own, their families' and their communities' health, ensuring a good quality of life and provide for sustainable development. The students will develop a sense of responsibility for healthy water, healthy people, healthy environments and for community action.

## Key questions

Key focus questions for this section are:

- Why is there a need to look after the quality of our water?
- Whose responsibility is it to look after the quality of our water?
- How do I know that water is safe?
- How can I look after the quality of our water?
- What can I and our community do to keep our water safe and maintain a good quality of water for the future?

## Links with other Modules

Resources from the Environment

## Toolbox

### Physical materials

Water test kits (H<sub>2</sub>S paper strips in small bottles)

### Flip Charts

Weather, Water, Waste and Energy Flip Chart

## Preparation

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

Learn to conduct the H<sub>2</sub>S paper strip water test and practice until you feel confident using and teaching it.

Think about opportunities for the students to continue creating entries in their exercise books throughout the series of activities in this section: headings, stories, thoughts, information and facts, key words, drawings, paintings, collages, poems or other artwork.

You could liaise with the Practical Arts teacher who can support some of the 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.

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....

## 3.1 TUNING IN

The following activity helps to engage and focus students' interest on the topic.

### ACTIVITY 1: THE CYCLE OF POOR WATER QUALITY AND POOR QUALITY OF LIFE

**Purpose:** To understand the relationships between poor water quality and the quality of life.

**Time:** Approx. 35-40 minutes

**Materials Required:** Coloured pens and pencils, glue and scissors, 16 clear cups, 8 clear cups with (50ml capacity), Weather, Water, Waste and Energy Flip Chart

**Resource/ Information Sheets:** 3.1 Student Resource Sheet - Picture cards to cut out

#### Procedure

Begin by showing Weather, Water, Waste and Energy Flip Chart 'Water, water, everywhere but not a drop good enough to drink'. Discuss the picture story with the students:

- What is happening in this story?
- Have they had similar experiences of illness in the family?
- Did they know why they have been ill?
- If not, what did they do to find out?
- What are the consequences of being ill?
- How does ill health affect the family, the community and the children?

Alternatively, you can ask students to write about an experience that they have had (or observed elsewhere), where poor quality water was used for drinking or washing. What are the possible health effects of using poor quality water? Why should we be concerned about water quality? Ill health has been identified as a contributor to poverty. To break the poverty cycle, health is of utmost importance. The students are likely to identify the following experiences, or can be prompted into discussion of those:

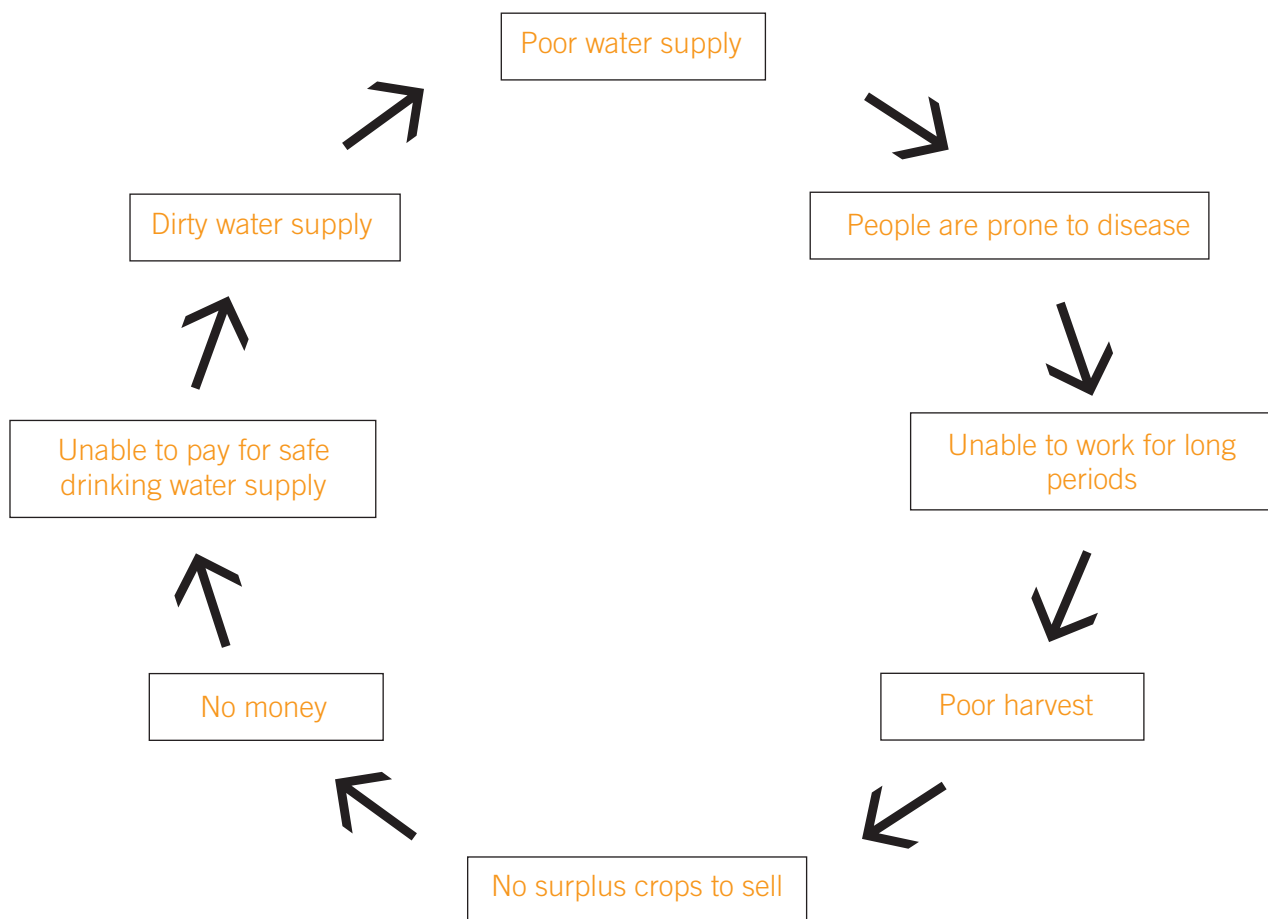
- Adults: Unable to work for long periods, unable to earn money; not being able to look after the children
- Students: Not being able to go to school; unable to achieve in school; not being able to achieve in sports
- Siblings also fall ill



*The water story from the Weather, Water, Waste and Energy Flip Chart.*

Give out *Student Resource Sheet 3.1* picture cards. Use the cards and develop with the students a cycle of ill health and poverty. Demonstrate this on the board. A cycle of ill health and poverty could look something like this (the students use the pictures):

Conclude this section with establishing what is the main cause of the cycle of ill health and poverty? Ask students to record this activity.



## 3.2 DECIDING DIRECTIONS

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

### ACTIVITY 2: WATER COLLECTED FROM VARIOUS SOURCES

**Purpose:** To make observations about water collected from various sources.

**Time:** Approx. 25-30 minutes.

**Materials Required:** Coloured pens and pencils, paper glue, scissors, 16 clear cups, Weather, Water, Waste and Energy Flip Chart page 'Water Monitoring'

**Resource/ Information Sheets:** 3.2 Student Resource Sheet - How I use water

#### Procedure

Ask students, Is good water quality visible? Discuss the 'Water Monitoring' Flip Chart page with the students and explain that in many cases, people do not have a choice between different qualities of water and need to use what is available to them. Unfortunately, we cannot see from the appearance alone whether our water is of drinking water quality.

Collect various water samples from different sources and qualities, and label accordingly (for example: rainwater from a tank, water from a well, grey water or used water from washing clothes or dishes, salt water, muddy water, water from a stagnant pool or puddle). Make sure to wash your hands after you have collected these samples.



*Well water is one source of water that be collected for this activity.*

Place the samples of water on the table. The source of each sample should not be made known to the students at this stage yet.

Ask the students to look at the samples carefully and fill in the table of *Student Resource Sheet 3.2*

What would they use each sample for just by looking at their appearance, using a blue pen (*In Student Resource sheet 3.2*). After recording their observations, reveal the actual source of each sample and ask if they would like to make any changes.

Allow them to make the necessary changes using a red pen.

Have the students answer the questions on *Student Resource Sheet 3.2*.

### ACTIVITY 3: VARIOUS SUBSTANCES ADDED TO WATER

**Purpose:** To investigate what happens when different substances are added to water.

**Time:** Approx. 45-50 minutes.

**Materials Required:** 8 clear cups with (50ml capacity), ½ teaspoon of each of the following for each group of students (these can be provided in a clear and labelled cup): rice grains, salt, vinegar, tea leaves, white sugar, washing powder.

**Resource/Information Sheets:** 3.3 Student Resource Sheet, Visible and invisible pollution of water – prediction and observation table

#### Procedure

The students will realise that some kinds of pollution in water can be easily seen but not others. Students will investigate what happens when different substances are added to water. Water's cohesive qualities mean that it is able to dissolve certain substances. Not all solids can be dissolved in water. When substances dissolve in water, such as salt and sugar, the mixture is called a solution. When substances do not dissolve but settle to the bottom, such as soil and sand, the mixture is called a suspension. Sometimes when substances dissolve in water, they can be hard to see. They are also hard to remove. This poses a problem when you need to remove invisible or dissolved pollution from water.

For each group of students you will need:

- 8 clear cups with 50ml of water
- ½ teaspoon of each of the following (these can be provided in a clear and labelled cup):
  - rice grains
  - salt
  - vinegar
  - tea leaves
  - white sugar
  - washing powder.

Give out *Student Resource Sheet 3.3* prediction and observation table, and introduce the properties of water.

Explain to the students that you are going to add one substance to each cup of water.

Before you do this, ask the students to predict whether the substance will dissolve or not, whether it will be visible in water or not, or whether any colouring will occur. Ask the students to fill out their table on *Student Resource Sheet 3.3*: accordingly.

Add each substance to a cup with 50ml of water each and gently swirl each one.

The students observe and record what happens to each of the added substances.

Discuss the results with the students and compare the predictions with observations.

Some substances dissolve in water forming a solution, some do not (i.e. they remain a suspension).

Substances and pollutants that do not dissolve in water are easier to see. This makes it easier to identify polluted water and these pollutants are easier to remove.

It is more difficult to identify pollutants such as nitrates that dissolve in water because they are harder to see.

Moreover, some substances like bacteria cannot be seen with the naked eye.

It will become apparent that water needs to be tested to make sure it is safe to drink when there is reason for concern. Remind the students during the discussions that it is easier to prevent pollution rather than trying to remove it. Ask students to record this activity.

### 3.3 FINDING OUT

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

#### ACTIVITY 4: WHO IS RESPONSIBLE FOR OUR WATER QUALITY AND HOW TO TEST IT

**Purpose:** To learn how to test water quality and to discuss who should take responsibility for water quality.

**Time:** Approx. 40-50 minutes.

**Materials Required:** Weather, Water, Waste and Energy Flip Chart

**Resource/ Information Sheets:** N/A

#### Procedure

Based on the following, work with the students in discussions and dialogue through the Weather, Water, Waste and Energy Flip Chart pages on 'water';

- Why and when do we need to test our drinking water?
- What we can use the H<sub>2</sub>S test for?
- How the H<sub>2</sub>S paper strip test works?

Based on the following, work with the students in discussions and dialogue through the Weather, Water, Waste and Energy Flip Chart page on 'Water Monitoring'. For example:

Write down a statement on a piece of paper that says: 'the Maldives Government is responsible for looking after the water quality on our island'.

At one end of the room place the sign that reads 'strongly agree' and at the opposite end place the sign that says 'strongly disagree.' Draw a line between the two signs using chalk or masking tape.

Present students with the statement 'the Health Post is responsible for looking after the water quality on our island' and tell them that they must consider this and decide if they support it or reject it. If they strongly agree they should stand closest to the strongly agree sign, if they strongly disagree they should stand at the opposite end of the room. They can also choose to stand anywhere else on the line in-between the two extreme opinions which represents a continuum (e.g. agree to some extent), or in the middle (agree and disagree to the same extent). NOTE: it is important to tell the students that there is no 'right or wrong' answer, however, they must think of reasons for their position.

Ask the students to provide their reasons for why they have decided to stand on their position on the line. If the students are clustered in groups, you may give them time to discuss their reasons between themselves and then select a spokesperson.

After each student or group speaks, the others should be encouraged to ask them questions. Allow each student or group the opportunity to have their say.

Having considered a range of opinions, encourage the students to change their point of view (where they stand on the line and on the issue). Explain the importance and value of considering a range of ideas and being prepared to change your mind. Ask the students, if you changed your minds, what were some of the things that made you change?

Optional: repeat the activity using other questions/issues that you develop. Here are some more examples: 'Teachers are responsible for the school environment,' 'Rubbish dumping is a more important issue than water.' Ask students to record this activity.

The image shows a flip chart titled "WATER MONITORING" with four activity panels.   
**ACTIVITY 1: EVAPORATION** shows a sun, a bucket of water, and a house with a window.   
**ACTIVITY 2: TRANSPIRATION** shows a plant with water droplets on its leaves.   
**ACTIVITY 3: WATER TEST KIT** includes a diagram of a water drop with a face, a test kit box, and a list of items: 1. Test kit, 2. Test bottles, 3. Test strips, 4. Test tubes, 5. Test tubes rack, 6. Test kit instructions.   
**ACTIVITY 4: pH LEVEL TESTING** shows a hand holding a test strip, a test tube rack, and a pH scale from 0 to 14. The scale is color-coded: 0-6 (red to yellow), 7 (green), 8-14 (blue to purple).

Water monitoring page from Weather, Water, Waste and Energy Flip Chart.

### 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 5: CONDUCTING THE H<sub>2</sub>S PAPER STRIP TEST

**Purpose:** To plan how to use the H<sub>2</sub>S paper strip test to test water quality.

**Time:** Approx. 10-20 minutes

**Materials Required:** Weather, Water, Waste and Energy Flip Chart page 'Water Monitoring'

**Resource/Information sheet:** 3.1 Teacher Information Sheet- The H<sub>2</sub>S Paper Strip Test

#### Procedure

From the above discussion it should be clear that we all share responsibility for looking after the quality of our water, and that we have tools at our hands to do so. We are learning to test our water by using the H<sub>2</sub>S paper strip test.

You will need to organise with the students the checking of the test bottles and recording of the results over three consecutive days following this activity. Organise a dark space in the classroom or nearby where the test bottles can be stored because the sun's rays can kill the bacteria inside the test bottles and you will not get a true result.



## ACTIVITY 6: HOW CLEAN IS OUR WATER?

**Purpose:** To test faecal contamination in water using the H<sub>2</sub>S paper strip test.

**Time:** Approx. 30-40 minutes initially, then 10 minutes each day for 3 days

**Materials Required:** H<sub>2</sub>S Paper Strip Test bottles and Instruction guide

**Resource/ Information Sheets:** 3.2 Teacher Information Sheet- The H<sub>2</sub>S Paper Strip Test Instruction Guide, 3.4 Student Resource Sheet -The H<sub>2</sub>S test result record sheet

### Procedure

We are testing for faecal contamination in drinking water using the H<sub>2</sub>S Paper Strip Test.

You will need:

- H<sub>2</sub>S Paper Strip Test bottles
- instruction guide
- result recording sheets (*Student Resource Sheet 3.4: The H<sub>2</sub>S test result record sheet*).

Divide the students into several groups. Each group should assign a group leader who makes sure that the group stays on track with their activity and who records the results over three consecutive days.

Distribute the H<sub>2</sub>S Paper Strip test bottles and instruction guide and result recording sheets, one for each student to record their results and explain how to fill out the sheets.

Take the students outside and collect samples of source water (e.g. well water, rainwater tank water, bottled water) in the community or on the school grounds, and others can test the cleanliness of their hands. Allocate each group to the various water sources and one to test their hands. (Pour clean – boiled and cooled – water over unwashed hands and test it, and have them wash their hands with soap and repeat the exercise.) Make sure to wash your hands after you have collected these samples.

Use the *H<sub>2</sub>S Paper Strip Test Instruction Guide*. Assign someone in the group to read out the instructions for carrying out the test. Follow the steps carefully.

After the water testing gather the students and discuss the activity and their results.

- Were they able to follow the instructions?
- Were any of the water sources located nearby a waste heap or toilet?

Clarify that the group leader will need to record the results over the following three days.

At the end of the testing, all students will transcribe the results onto their results recording sheets.



*Teacher testing tap water from a school source with a H<sub>2</sub>S bottle.*

## 3.5 DRAWING CONCLUSIONS

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

### ACTIVITY 7: OUR ROLES AND RESPONSIBILITIES AND WATER QUALITY

**Purpose:** To draw conclusions about roles and responsibilities for water quality.

**Time:** Approx. 20-25 minutes

**Materials Required:** N/A

**Resource/ Information Sheets:** N/A

#### Procedure

It is important that everyone understands why freshwater is essential for life and is very valuable. Until everyone sees the value in looking after our water supplies, it will be very difficult to encourage people to learn and practice the skills needed to maintain and improve water quality.

If the water source is contaminated, what can be done? You can discuss here community action and who in the community is responsible for what.

How to clean the water so that it is safe for drinking? Suffice to say here for the students that the bacteria can be killed by simply boiling water or adding bleach (chlorine) to the water, e.g. into the well. However, boiling water is not always feasible. It costs time, requires firewood or other fuel and too often is simply not practical. We use bleach (chlorine) to clean the water, but this should be done by an adult or older youth under strict adherence to the instructions. With a longer term focus, using new technology and practicing different behaviour are two ways in which water resources can be improved and maintained.

## 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.

### ACTIVITY 8: RAISING AWARENESS AND INFORMING THE COMMUNITY

**Purpose:** To plan and implement an instrument it an activity to raise awareness within the community.

**Time:** Approx. 2 hours.

**Materials Required:** Pens, papers, coloured pencils.

**Resource/ Information Sheets:** N/A

#### Procedure

The students can use the test results and the concepts they have learnt about to get involved with the community, to inform and raise awareness and contribute to behaviour change, for example by:

- making a poster or mural showing the problems with water quality and how to fix them,
- presenting the results at school or community meetings,
- sharing the results with other groups who are testing water,
- educating people who are contributing to the problems and water quality impacts,
- modifying their own actions or practices at the school, or
- creating a media campaign to educate the community.

You will need writing paper and pens, maybe a tape recorder.

Discuss with the students the following:

- characteristics of a radio presentation that is designed to raise the awareness of the community (if possible, try to record one and play it to the students for analysis)
- how words and text are being presented on the radio (drama, chorus, all the actors saying one of the lines together to give the line more emphasis, or the use of different voices for each line).

Ask the students to identify at least four of the themes of this topic that they have learnt about.

Divide into groups and design a radio segment on one of the themes.

Finally, you can record the products on tape and then play them back, perform them to the group or the community, or try to get on the local radio.

## 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 9: THE QUALITY OF OUR WATER, OUR FUTURE AND US

**Purpose:** To evaluate and reflect on what students have learnt.

**Time:** Approx. 10-15 minutes

**Materials Required:** Pen, paper

**Resource/ Information Sheets:** N/A

#### Procedure

Ask them to complete the finalised questions:

- What did you like about this section of the Module?
- What did you not like about this section of the Module?
- What was the most important thing that you have learnt?

The following key issues should be considered: the value of water, need to look after the quality of our water, roles and responsibilities of the individual stakeholders, future perspectives. When the students present their answers to the group, all contributions are valued.

# 3.1

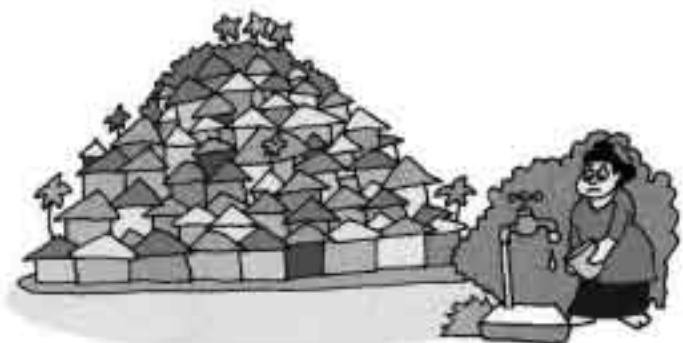
## STUDENT RESOURCE SHEET

### PICTURES TO CUT OUT

Develop a cycle of ill health and poverty



Unable to work for long periods





# STUDENT RESOURCE SHEET

## HOW I USE WATER

Observe the water samples placed on the front table and write down what you would use each sample for by putting a tick or ticks under each column. (Use blue pen here.)

Sample	Drinking	Washing or cooking	Watering plants	Brushing teeth	Flushing toilet	Shower	Washing equipment
1							
2							
3							
4							
5							
6							
7							

Which sample/s did you put down as suitable for the following use/s?

Drinking ..... Brushing teeth .....

Washing equipment ..... Would you wash your bicycle in salt water? .....

Why: .....

After being told the actual source of the samples would you make any changes? Use red pen for the new ticks.

.....  
.....

Write down reasons for making those changes for each one that you had to change.

.....  
.....

What is the important message that you have learnt?

.....  
.....



## STUDENT RESOURCE SHEET

### VISIBLE AND INVISIBLE POLLUTION OF WATER – PREDICTION AND OBSERVATION TABLE

When you add the following substances to water:

- rice grains
- salt
- vinegar
- tea leaves
- white sugar
- washing powder

Predict (tick with blue pen) whether they are dissolving or not dissolving, whether they are visible in water or not, whether they cause water to change colour or not.

Next, note down in the same table the actually observed changes in red if your prediction was not correct.

Prediction (blue) and Observation (red)

	Solution (dissolving)	Suspension (not dissolving)	visible	invisible	Colouring (tick and write down colour)
rice grains					
Salt					
vinegar					
tea leaves					
white sugar					
washing powder					

# 3.4

## STUDENT RESOURCE SHEET THE H<sub>2</sub>S TEST RESULT RECORD SHEET

For proper testing, filling in the Result Record Sheet as completely and accurately as possible is very important.

You need to write down the following:

- Fill in the address or where you are doing the water sampling e.g. N. Manadhoo, Health Centre
- Write in your sample number in the first column.
- Fill in the type of water that you are sampling e.g. rainwater.
- Record the date and time of sampling.

The “Notes” column can be used for other information like the source of contamination or if there is a latrine built within a short distance from the drinking water source.

Indicate under “Remarks” if the water is visibly turbid, coloured, or contains solids or materials in suspension. Also, note any problem at the sampling site like a leaking tap, unclean area, drainage problems etc.

Notes: Indicate the distance between the water source and any other sources of pollution like a compost pit, septic tank, toilet, farm or agricultural plot.

# 3.4

## STUDENT RESOURCE SHEET THE H<sub>2</sub>S PAPERSTRIP TEST RESULT SHEET

Address: .....

.....

Name of Water Monitor: .....

.....

Sample Number	Type of water source (deep well - borehole, rainwater etc.)	Date	Time	Location (place where the sample is collected)	Remarks	Day 1 Date: Time:	Day 2 Date: Time:	Day 3 Date: Time:
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Notes:

(-) indicate a negative- the water is clear;

(+) light brown, a reaction has started;

(++) the paper strip is now dark brown;

(+++) the paper strip and the water is visibly black/ the reaction is very fast.



# 3.1

## TEACHER INFORMATION SHEET THE H<sub>2</sub>S PAPER STRIP TEST

Microbial pollution of drinking water is due to the presence of faecal matter in the water supply. It is possible to test water for most micro-organisms of faecal origin but these tests are very costly and require more sophisticated laboratory equipment that is not available everywhere. Water is therefore tested for suitable microbial indicators such as coliform bacteria which is present in the faecal matter of warm blooded animals including humans. Since coliform bacteria commonly inhabits the gastrointestinal tract of warm-blooded animals, they have generally been accepted as indicators of faecal contamination and as a marker for other, possibly pathogenic micro-organisms. Another organism present in faecal matter is sulphate reducing bacteria that have been found to occur in high numbers of up to a thousand million organisms per mg of human faeces, which is almost the same as coliform bacteria and hence shall be considered as an indicator.

We conduct what is called a bacteriological test using the H<sub>2</sub>S (hydrogen sulphide) Paper Strip Test. The advantage of the H<sub>2</sub>S Paper Strip test is that it is low-cost, does not require samples to be shipped or refrigerated, it does not require a laboratory or expensive equipment, highly trained technicians, and most importantly, it is easy to understand and carry out in field.

The Hydrogen Sulphide (H<sub>2</sub>S) Paper Strip Test can be used to regularly monitor the quality of our water supply. The H<sub>2</sub>S Paper Strip Test was first used in India to test for coliform or bacterial contamination in potable water. Since then it has been used by many more communities globally and in the Maldives.

The H<sub>2</sub>S Paper Strip Test is intended to detect or quantify hydrogen sulphide-producing bacteria, considered to be associated with faecal contamination.

Hydrogen sulphide (H<sub>2</sub>S) occurs naturally in crude petroleum, natural gas, volcanic gases, and hot springs. It can result from bacterial breakdown of organic matter in the absence of oxygen. It is also produced by human and animal wastes. Bacteria found in your mouth and gastrointestinal tract produce hydrogen sulphide from bacteria decomposing materials that contain vegetable or animal proteins. Hydrogen sulphide can also result from industrial activities, such as food processing, coke ovens, paper mills, tanneries, and petroleum refineries. Hydrogen sulphide (H<sub>2</sub>S) is a flammable, colourless gas with a characteristic odor of rotten eggs. It is commonly known as sulphane, sulphur hydride,



*H<sub>2</sub>S Training program conducted in Nolvivaramfaru, by Live & Learn Environmental Education.*



sour gas, sulfurated hydrogen, hydrosulphuric acid, sewer gas and stink damp. Just a few breaths of air containing high levels of hydrogen sulphide gas can cause death. People can smell it at low levels.

### How does the H<sub>2</sub>S paper strip test work?

The Hydrogen Sulphide (H<sub>2</sub>S) Paper Strip Test uses a paper strip to check for coliform or bacterial contamination in drinking water sources. In order to check for the presence of coliform bacteria in water, a water sample is filled into the test bottle with the paper strip. Chemicals have been mixed into a solution and placed on the paper strip. The paper strip will react with the water sample by turning black if it comes into contact with hydrogen sulphide. If the water sample or paper-strip turns black, this indicates that hydrogen sulphide was produced. This means that it is likely that bacteria of faecal origin are present in the water, that is, the water has been contaminated with animal or human waste.

# 3.2

## TEACHER INFORMATION SHEET THE H<sub>2</sub>S PAPER STRIP TEST INSTRUCTION GUIDE

WEATHER

SAFEGUARDING  
DRINKING WATER

WATER QUALITY  
MONITORING

How do we carry out the H<sub>2</sub>S Paper Strip Test?

### Step 1: Fill in the details

- Fill in Sample number and date on the round sticker or sticker strip label and stick on the sample bottle. Be careful not to get the sticker wet!
- Record your Sample number, date, time, location and description of the water sampled on the Result Record Sheet.
- Record any other information e.g. turbidity, smell, source of pollution, faulty pump etc.

### Step 2: Collecting the Control

- A control is used to compare the colour change in the test samples, and to ensure that the sample bottles are not contaminated before use.
- You need to collect the control only once for each monitoring programme.
- Collect a sample of uncontaminated water e.g. distilled water, boiled water, bottled water, water treated with chlorine. This is to be used as the control.
- There may be a slight change in the colour of the sample to a pale yellow or light brown due to the colour change of the reagent. This is normal.

### Note!

- Do not open the test bottle until you are ready to fill them with your water sample
- Make sure that no contamination occurs by touching the mouth of the bottle.
- Do not hold the cap from the inside.

### Step 3: Collecting the water sample:

#### A. From the tap

- First clean the mouth or the outlet of the tap with a clean cloth.
- Turn on the tap and allow the water to flow for 15 to 20 seconds.



*Water samples tested using H<sub>2</sub>S paper strip test.*

- Collect sample water from the tap by filling the sample bottle up to the mark.
  - Fill the test bottle carefully, this is because the test bottle will fill very quickly to the marked line and may overflow.
  - If you do overfill the bottle, do not spill the water out and do not worry. Your result will still be valid.
  - Immediately close the sample bottle.
- #### B. From storage containers such as rainwater tanks and wells
- Rinse the container to collect the water several times.
  - Collect a sample of water from the container by filling the sample bottle up to the mark.
  - Close the sample bottle.
  - Place all the test samples in a dark place at room temperature.
  - Wash your hands!

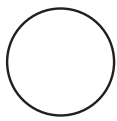
### Step 4: Check your results

- Check your test sample at the same time each day for 3 days for changes in colour.
- Record the date and time for each observation on your recording sheet and your result for each day.
- Compare the colour change with that of the control.
- Use the H<sub>2</sub>S Colour Code to indicate the degree of contamination.

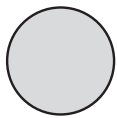
### Note!

Do not expose your bottles to direct sunlight. Store in a dark place. The sun's rays can kill the bacteria inside the test bottles and you will not get a true result.

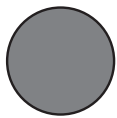
## Result card – H<sub>2</sub>S Colour Code



(-) no change.



(+) slight change, the Paper strip or water sample has turned light brown.



(++) the Paper strip or water sample is dark brown.



(++++) the Paper strip and the water sample are noticeably black.

### Step 5: What do your results mean?

- (-) If there is no colour change this indicates that the water is clean and free from bacterial contamination.
- (+) If the water has turned light brown, there is a possibility that bacteria, is present in the water. Wait for a few days and check again. Compare against the control.
- (++) If the colour change is dark brown then there is some amount of bacterial contamination in the drinking water. You may want to set up a regular monitoring programme and boil your drinking water! Conduct a sanitary survey to check whether your water source is protected from contamination.
- (++++) If the paper strip and the water sample are noticeably black then there is a very high risk of bacterial contamination in the drinking water, therefore, it is not safe for drinking. Take action! If there is a fast reaction- that is, the water solution and paper strip turns black overnight, that means that there is a high probability of bacteria present! Your water is contaminated! You should clean out your water storage containers, tanks or well and boil the water before you drink it! Conduct a sanitary survey to look for the source of contamination. Sample the water in your well, tanks and containers again after this to check if you have eliminated the contamination.

### Note!

- Keep the test bottles stored away from children! Do not put it in a place where a child can reach it!
- When you return the used test bottles, you will then get replacements.
- Do not open the used bottles!

# GLOSSARY

## **Aquifer**

A layer of rock, sand, or gravel through which ground water flows, containing enough water to supply wells.

## **Bedrock**

Solid rock lying beneath surface deposits of soil.

## **Cohesive**

The attraction of water molecules to each other.

## **Coliform bacteria**

A group of bacteria, of which E. coli is the most important member. Most coliforms are not harmful, but since they arise from faeces, they are useful as a test of faecal contamination, and particularly as a test for water pollution.

## **Contaminants**

To make something impure, unclean, or polluted, especially by mixing harmful impurities into it or by putting it into contact with something harmful.

## **Consumption**

Use of goods and services.

## **Current**

A steady flow of water in one direction.

## **Degrades**

To cause damage or destruction to part of the environment as a result of human activity.

## **Desalination**

The removal of salt (especially from sea water).

## **Dissolve**

To merge with a liquid; pass or make pass into solution.

## **Drought**

Dryness; dryness of the weather that affects the earth, and prevents the growth of plants.

## **Faecal contamination**

Polluted by bacteria or viruses originating from human waste (faeces).

## **Faeces/excreta**

Waste from humans and animals that consist of water, food residue and bacteria. One gram of faeces can contain 10, 000, 000 viruses, 1, 000, 000 bacteria, 1, 000 parasite cysts, 100 parasite eggs!

## **Germ**

A general term for different types of tiny organisms, or living things, commonly known as germs.

## **Grey water**

Domestic waste water from washing dishes, laundry and bathing. Grey water gets its name from its cloudy appearance and from its status as being neither fresh (potable water) nor heavily polluted (blackwater).

## **Hail**

Frozen rain-drops or small roundish masses of ice precipitated from the clouds.

## **Hazard**

Something that is potentially very dangerous.

## **Hygiene**

The practice of keeping oneself and one's surroundings clean, especially in order to prevent illnesses or the spread of diseases.

## **Humid**

Damp; moist; as, a humid air or atmosphere; somewhat wet or watery.

## **Microbes**

A microscopic organism, especially one that transmits a disease.

## **Misty/foggy**

Obscure; clouded

## **Organic matter**

Is matter that has come from a recently living organism.

## **Pathogen**

An agent of disease. A disease producer. The term pathogen most commonly is used to refer to infectious organisms (e.g. bacteria, viruses).

**Pollutants**

A substance that pollutes something, e.g. a chemical or waste product contaminating the air, soil, or water.

**Pollution**

The act or process of polluting or the state of being polluted, especially the contamination of soil, water, or the atmosphere by the discharge of harmful substances.

**Potable water**

Water suitable for drinking.

**Rain gauge**

An instrument for measuring the quantity of rain at any given place.

**Rain water harvesting**

Collecting rain water.

**Recharge**

Is the replenishment of an aquifer with water from the land surface.

**Sleet**

Partially melted snow (or a mixture of rain and snow).

**Suspension**

Particles of a substance are mixed with a fluid but are undissolved (e.g. tea leaves in water).

**Solution**

A mixture of two or more substances (e.g. salt dissolved in water).

**Sustainable**

Capable of being sustained or maintained.

**Swell**

To rise in waves, as the sea.

**Torrential**

Pouring in abundance; e.g., "torrential rains".

**Toxins**

A substance that accumulates in the body and causes it harm.

**Waste water**

Water that has been used (e.g. from toilet or washing machine).

**Waterborne diseases**

Caused by disease causing microbes which enter our bodies when contaminated drinking water is consumed.

**Water lens**

About a third of the rainfall will soak into the ground and infiltrate into the coral sand. This water collects in the sand and forms a body of fresh water. The freshwater is not very thick and it floats on salt water that is underneath it.

**Water quality**

Technical term that is based upon the characteristics of water in relation to guideline values of what is suitable for human consumption and other uses. Parts of water quality include microbial, biological, chemical, and physical aspects.

*Definitions from <http://www.answers.com/>*





All kids are gifted,  
some just open their packages earlier