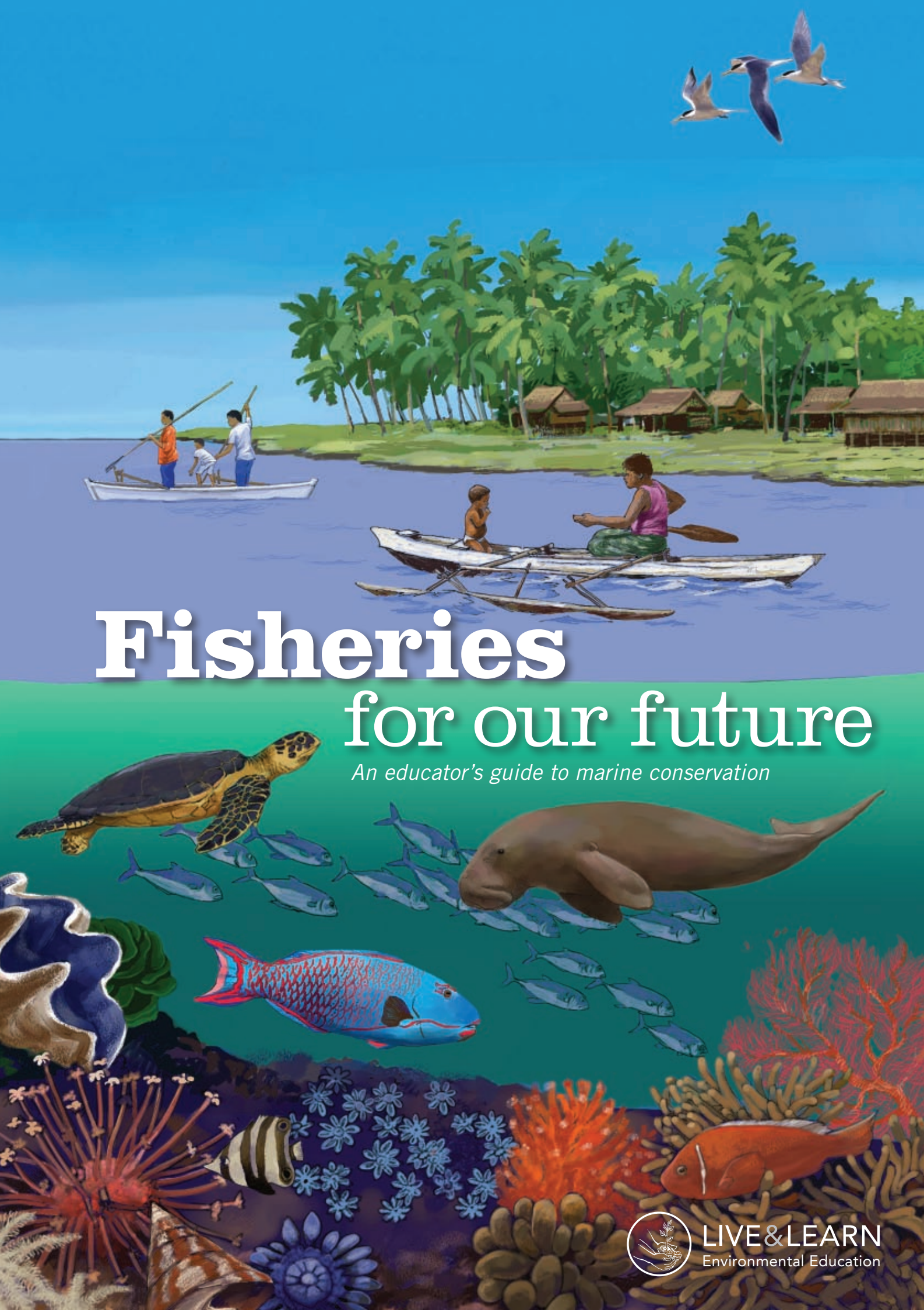

Fisheries for our future

An educator's guide to marine conservation

LIVE&LEARN
Environmental Education

This Project/Programme is funded by the Packard Foundation

Resource developed by:

LIVE&LEARN
Environmental Education

August 2010

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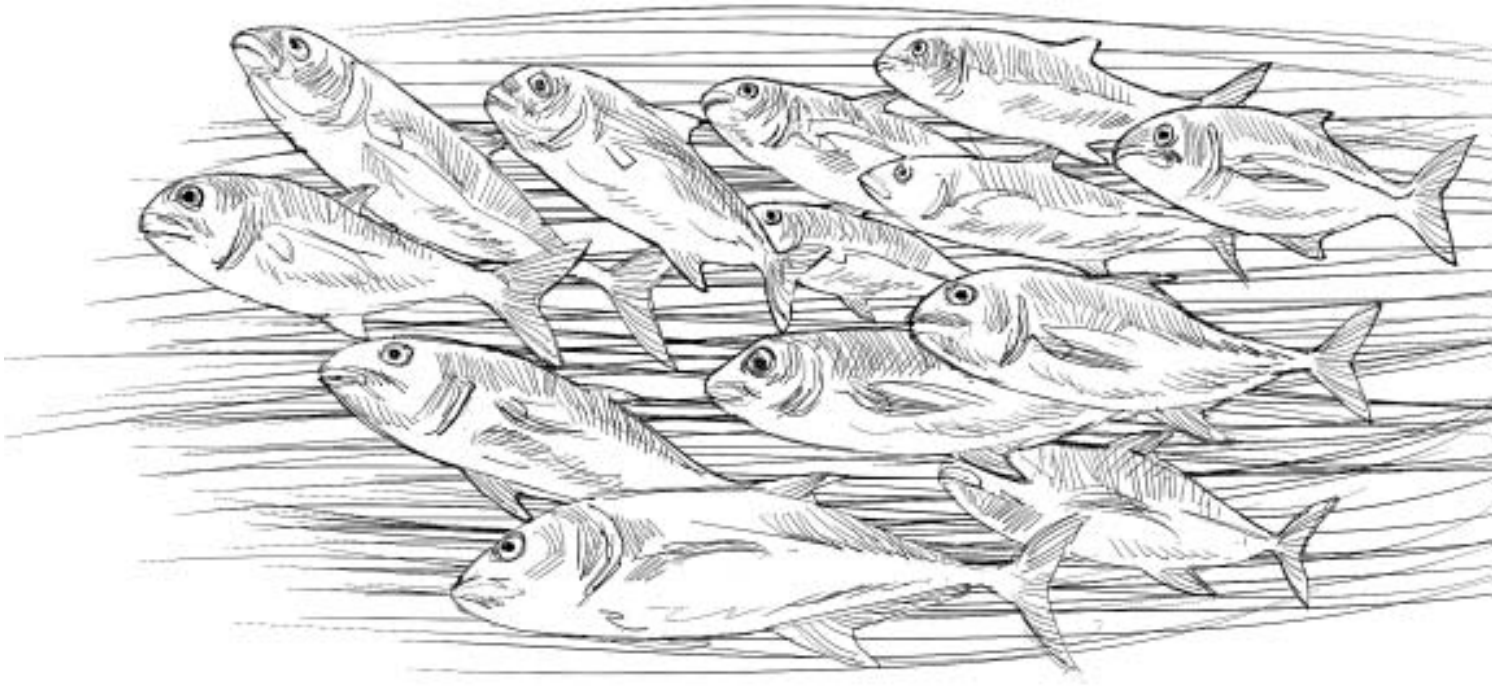

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for our future

An educator's guide to marine conservation

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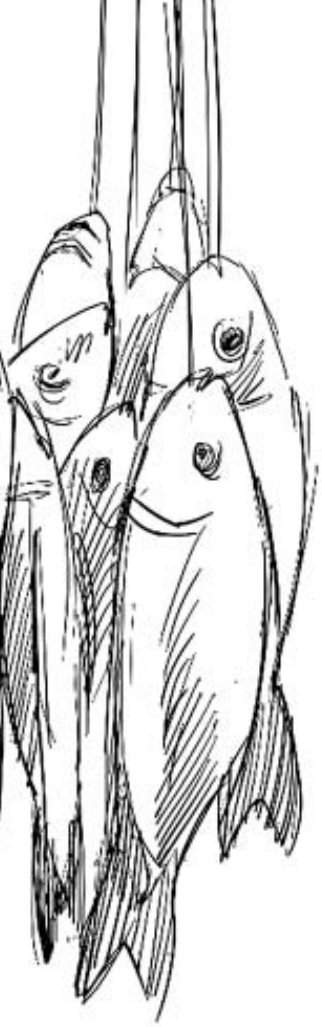
Contents



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Introduction

Fisheries for our Future *– An Educator's Guide to Marine Conservation* provides teachers and students with the opportunity to learn about, investigate and take action regarding issues affecting marine conservation in the South Pacific. The South Pacific Marine environment is thought to be one of the most unique and varied in the world. The region is rich in coral reefs and marine life, and has a number of species that are found nowhere else in the world.

With a marine area four times larger than its land area, Pacific Island communities rely heavily on the marine environment to provide food and income. Fish and shellfish are food for locals and are also sold commercially. Coral islands and reefs support a growing tourism industry.

However, the marine environment is under pressure from increasing human populations and development. The biggest issues currently facing marine conservation include pollution, unsustainable fishing practices and climate change. Live & Learn Environmental Education believes that education is one of the best tools to address these threats.

We hope this resource opens your students' minds to the amazing marine environments in the Pacific and helps them to gain the skills, knowledge and confidence they need to combat the challenges facing the marine environment.

About Live & Learn Environmental Education

Live & Learn Environmental Education is a non-government, not-for-profit organisation which aims to promote greater understanding of environmental and human sustainability through education and communication. Live & Learn was founded in 1992 and has offices in Vanuatu, Solomon Islands, Papua New Guinea, Fiji, Cambodia, Vietnam, Indonesia and the Maldives.

Live & Learn focuses on integrating environmental, cultural and development concepts in environmental education programs for the younger generation of the South Pacific community. This is done through action-based programs, which build skills for problem solving, dialogue building and linking knowledge to change for sustainability.

For further information about Live & Learn: http://www.livelearn.org

Development team

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Marine conservation

Marine conservation is the protection and preservation of ecosystems in our oceans and seas, it focuses on limiting human-caused damage, restoring marine ecosystems and preserving vulnerable marine species.

Acknowledgements

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- Climate Change Division, Ministry of Environment, Conservation and Meteorology (Solomon Islands)
- Locally Managed Marine Area (LMMA) Network
- World Wildlife Fund (WWF) South Pacific Programme
- Foundation for the People of South Pacific International
- South Pacific Regional Environment Program (SPREP)
- Mahonia Na Dari
- The University of the South Pacific.

Purpose

The purpose of the modules and activities in this book are to provide teachers in the South Pacific with a resource that supports education about marine conservation issues in the region. The goal of the resource is not to tell students what to think, but to introduce marine conservation issues and encourage students to develop values, attitudes and skills that help them to understand how their decisions affect the marine environment.

Fisheries for our Future – An Educator's Guide to Marine Conservation aims to encourage the development of:

- awareness of and sensitivity to the marine environment and related social and economic issues
- knowledge and understanding of the marine environment and the impact people have on it
- attitudes and ***values*** that show concern for the marine environment
- skills involved in identifying, investigating and problem solving in marine related issues
- a sense of responsibility through ***participation*** and ***action*** in addressing marine issues.

Who is the resource for?

This resource is designed to help teachers present the concepts of sustainability, and the marine environment and its conservation to students of an upper primary and junior secondary level (grades 5 to 9). However, many of the activities could be adapted for use with younger or older age groups.

The concepts are presented in two stages. Teacher's Fact Sheets clarify concepts for teachers. The second stage contains class activities. These develop students' knowledge, skills, attitudes and behaviours towards helping conserve local marine environments.

How to use the resource

The teaching components of this resource are divided into modules. Each module deals with an issue affecting marine conservation in the South Pacific. These modules are:

Module 1: Unsustainable fishing practices

Module 2: Land originated marine pollution

Module 3: Climate change

Module 4: Discovering Marine Protected Areas (MPAs)

The modules are designed to be used by teachers during relevant teaching sessions. It is not intended that the *Fisheries for our Future* modules be taught as a separate subject. We acknowledge that school curriculums are already overcrowded. The modules can be taught within existing curriculums, maximising opportunities for marine conservation education.

Each module contains learning outcomes which will closely match the learning outcomes in the existing curriculum. These could be used to help teachers choose the activities that could be carried out during lessons.

The modules can work together as a holistic marine conservation unit or can stand alone as individual themes of study. We encourage you to adapt the activities, combine them with other resources, draw on local issues relevant to your students and design units that best meet your curriculum and particular educational objectives.

Below is an overview of the structure of the resource and its individual activities.

Teacher's fact sheets

Teacher's fact sheets are short texts that introduce the concept and can be used as preparation for the learning activity. This resource assumes that schools currently have little access to written information on marine conservation, so an effort has been made to provide all the basic information required to conduct the activities. However, teachers with better access to information sources may like to use other materials or references to help them to prepare for the learning activities.

The Teacher's fact sheets are not designed to be written onto the blackboard for students to copy down. However, much of the information will be relevant to pass on to students.

Suggested timing

This gives an idea of how long the teacher will need to prepare for and deliver the activity. This is only a suggested time. The time needed to deliver the activity could be more or less depending on individual requirements.

Subject areas

Subject areas suggest where in the curriculum the activity can be taught. This is a general subject area only that has been included as a guide. You will need to look at the outcomes of the activities and those in your country's curriculum to make specific links.

Glossary words

A number of words and phrases are italicised and bolded throughout the resource. These glossary words are important terms that teachers or students may not be familiar with. Definitions for these words can be found in the glossary on pages 128.

Glossary words can be used as a resource bank for spelling, comprehension and other activities for building language skills.

Materials

This lists materials or equipment teachers will need to conduct the activity. This will also describe how to prepare the materials prior to starting the activity. Every effort has been made to ensure that schools will be able to find the materials needed for the activities easily.

Activity summary

This describes the purpose of the activity and what types of learning might occur.

Outcomes

Outcomes used in this resource closely match learning outcomes in existing curriculums. The outcomes describe what students should be able to do after taking part in the activity. Where an activity may achieve multiple learning outcomes, each learning outcome will be stated here.

Procedure

Includes step-by-step instructions and suggestions on how to carry out the activity.

Assessment ideas

Assessment ideas offer strategies for evaluation. Some of the *Tuning in* or *Student reflection* activities are used to spur interest or to gauge students' understanding, and do not require assessment. Assessment ideas may also include examples of excellent, satisfactory, and unsatisfactory results. These examples are to be used as a guide only, as each teacher and school will have their own assessment criteria for particular subjects and activities.

Teaching approaches

Education should challenge students to think critically and creatively about their world, to question how and why we do things and to consider how things might be done differently. It should promote positive change (both personal and within communities), encourage respect and tolerance of others, and help students develop knowledge, skills and commitments that enable them to participate effectively in society, and to develop an understanding of their rights and responsibilities.

This resource is built on a set of underlying principles about education, which develop the concepts mentioned above. Teachers using the modules and supporting activities will notice many familiar educational strategies and approaches. Detailed below are some important approaches used in best practice environmental education that may enhance your teaching. These include:

- education for sustainability
- education '*in, about and for*' the environment
- critical thinking

Education for sustainability

Education for sustainability is more than teaching awareness about the environment. It also seeks to develop students' values, attitudes and skills towards conserving our marine environment.

- considering different learning styles
- encouraging experiential learning.

Education for sustainability

Most of the activities in the *Fisheries for our Future* resource involve education for sustainability as an approach to teaching and learning. Education for sustainability is more than teaching awareness about the environment. It also seeks to develop students' values, attitudes and skills towards conserving our marine environment.

Education for sustainability recognises that all members of the community, including students, need to work together to take action for the environment. Education for sustainability also acknowledges that environmental problems and solutions are closely linked to economic, social and political factors. For example, a development that brings money into a community may mean that people can pay school fees and have access to better health care. But if the development also destroys the surrounding coral reef, then the financial benefits may be short-lived. Recognising this, *Fisheries for our Future* tries to identify the factors that link humans, our quality of life and the marine environment together.

Education for sustainability establishes a lifelong process of learning, action and reflection. It can help students to actively acquire and reflect on knowledge and skills, whilst directing their own learning. This approach empowers both teachers and students to improve the learning environment, while developing and practicing important life skills.

Education '*in, about and for*' the environment

The following are three well-accepted approaches to environmental education, described as:

- education *in* the environment
- education *about* the environment
- education *for* the environment.

Education *in* the environment provides students with hands-on experience in the environment. It aims to increase students' awareness and appreciation of the environment through direct contact with plants, animals and natural areas. This practical learning for students focuses on developing skills for collecting information, such as mapping, sketching, and conducting surveys and interviews, as well as cooperation and teamwork skills.

Education in the environment also provides students with enjoyable experiences that help them to 'connect' with nature, and encourages positive values including empathy and care. This approach to environmental education is common in traditional school excursions or field trips.

Education *about* the environment is about increasing students' knowledge of the environment. It focuses on facts, concepts and theories, by introducing natural systems and processes and the impacts of human activities on them. It also allows students to develop technical skills such as observation, measurement and classification. This approach to environmental education is common in subjects such as geography and science in secondary school.

Critical thinking

Critical thinking involves developing skills and methods for making decisions based on thoughtful and logical reasoning.

Education *for* the environment links students' knowledge and values to change, and builds on education in and about the environment. This approach aims to further develop students' feelings of concern and responsibility for the environment.

Education for the environment encourages students to make lifestyle choices that have positive environmental impacts. Although education in and about the environment help students develop appropriate knowledge, attitudes, values and skills, this does not generally lead to students taking positive actions and making choices that protect the environment. Education for the environment provides students with the motivation and ability to be involved in practical action and to make choices that help solve environmental problems.

Activities in this resource acknowledge the importance of linking knowledge to changes in behaviour, and use all three approaches to help deepen students' understanding of environmental problems and to stimulate personal action.

Critical thinking

Critical thinking involves developing skills and methods for making decisions based on thoughtful and logical reasoning. For a student to think critically, they need information and knowledge. Using this information, the student is then able to come up with options and decide upon the best action to take. Critical thinking skills allow students to act on their own beliefs. In our modern world, people are presented with a lot of different information. It is important that we are able to make choices and judgements that lead to decisions based on our own values and perceptions, rather than being influenced by others.

Critical thinking can be taught or developed by allowing students to discover their own values and perceptions about situations and then come up with their own decisions and ideas. To assist in the development of these skills teachers need to present real-life situations and guide students in discovering their own knowledge. Rather than simply transmitting knowledge, teachers should be facilitators of knowledge. Teachers can do this through good questioning techniques that encourage higher-level thinking and problem solving. Teachers need to encourage interactions among students so they have opportunities to debate, challenge one another's ideas and, in the process, clarify their own ideas. Critical thinking skills can be developed through activities such as debates, role-plays, dramas, field trips and other cooperative learning activities. A number of the activities in this resource provide opportunities for students to develop and practice critical thinking skills.

Learning styles and multiple intelligences

Most teachers will know that not all students learn in the same way. One of the goals of this resource is to help students to develop a good understanding of marine conservation issues, regardless of how they learn best. In order to do this, it was necessary to cater for a variety of learning styles and intelligences. The modules contain a mix of activities and teaching strategies ranging from hands-on discovery to small group discussions.

Inquiry-learning model

The teacher's job in an inquiry learning environment is not to provide knowledge, but instead to help students discover knowledge themselves.

For example, collecting climate witness stories in Module 3 is likely to appeal most to active learners who like to interact with others. The creation of a wall mural in Module 2 will probably be of most interest to imaginative learners who thrive on creative expression. In addition to recognising different learning styles, the activities emphasise strategies that promote the variety of strengths your students already have and help them to develop new strengths.

The inquiry-learning model

This resource uses the teaching and learning techniques mentioned above and incorporates them into an activity structure that follows an inquiry-learning model. Inquiry learning requires students to work together to solve problems rather than receiving direct instructions from the teacher. The teacher's job in an inquiry-learning environment is therefore not to provide knowledge, but instead to help students discover knowledge themselves.

As teachers, we know that students learn better when they are actively engaged in their learning and have a chance to take part in varied experiences. Lessons based on inquiry learning models provide opportunities for students to do this.

Several inquiry-learning models were considered when developing the relevant activities in this resource. Where appropriate, the activities follow the sequence below, organised under the headings of 'Tuning in', 'Searching for answers', 'Trying solutions' and 'Student reflection'.

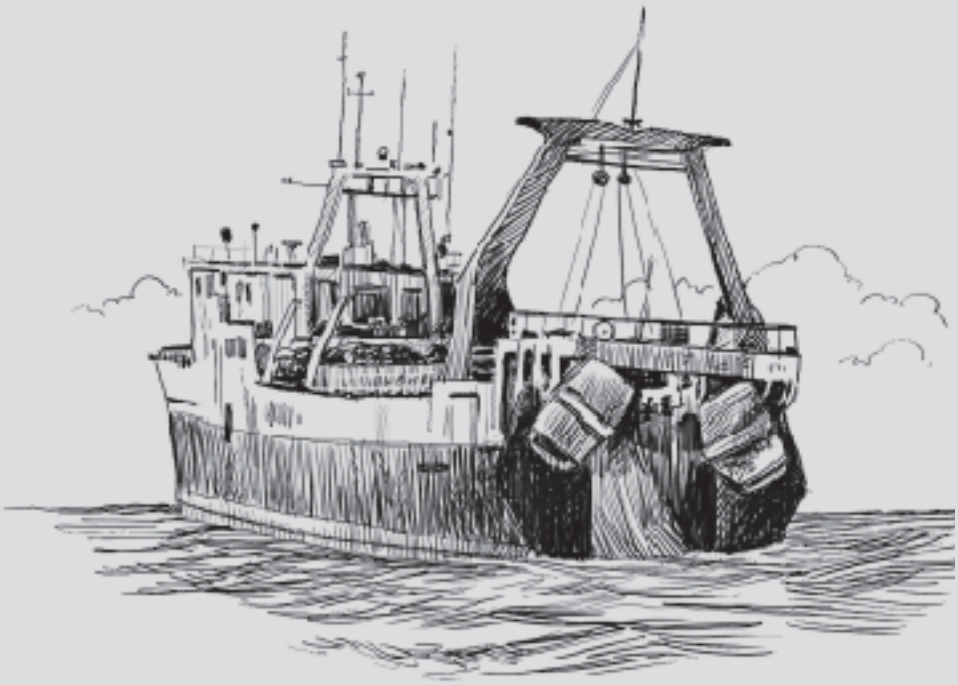
In some modules more than one activity is provided under these headings. Teachers are not expected to carry out all activities – one activity from each heading is adequate to facilitate an inquiry learning process.

Tuning in: An introduction that engages students with a situation or issue. It is here that the situation is defined or redefined and students are given opportunity to consider the problem and work out what they already know. This section aims to raise students' curiosity and motivation to learn.

Searching for answers: Students can take part in an experience or activity that helps them to increase their knowledge or understanding of the topic.

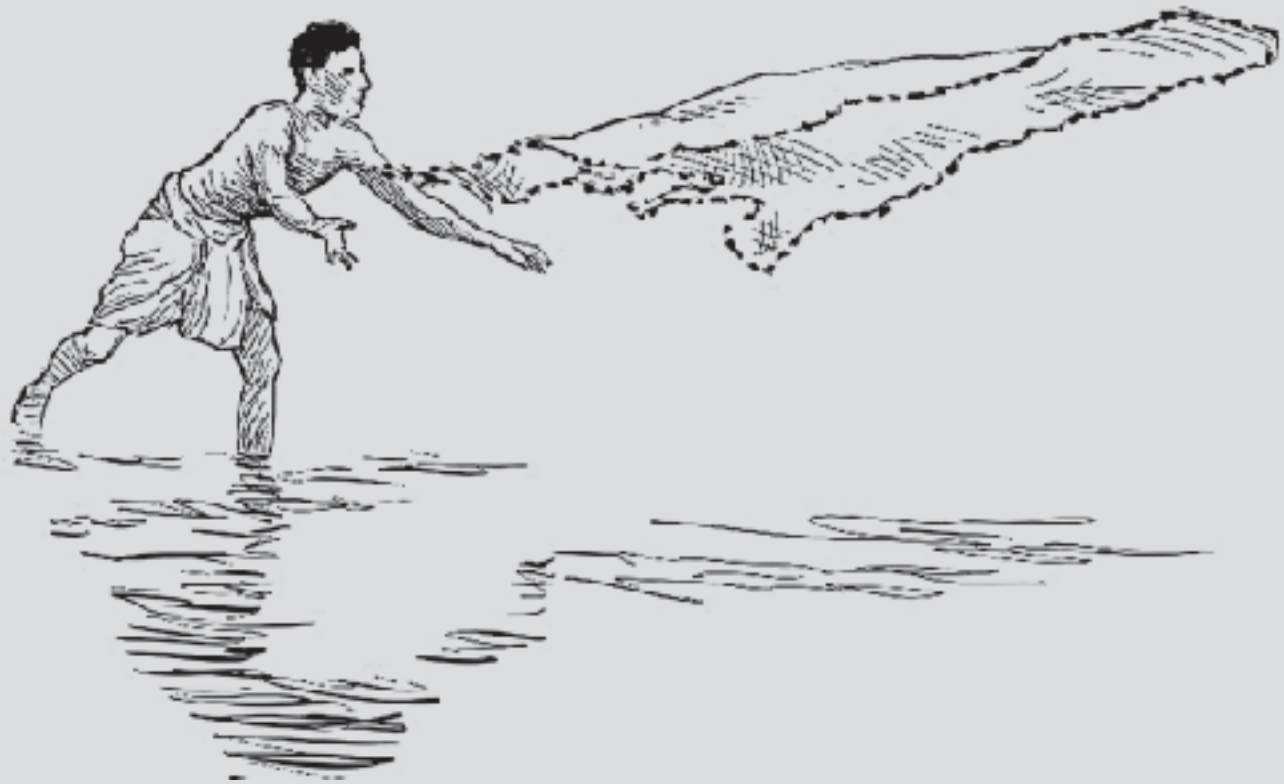
Trying solutions: Eventually students settle on a possible solution and try it out. This gives students an opportunity to apply what they have learned to familiar or new situations, and to practice any new skills.

Student reflection: Students have a chance to reflect on what has been learned and how it can be applied to other situations, and to plan actions based on their learning.



1 Unsustainable fishing practices

It has been estimated by the United Nations Food and Agriculture Organisation that over 70% of the world's fish stocks are either fully exploited or depleted.



Module introduction

Fishing is a vital activity

The word fishing does not only apply to fish, it refers to the act of catching any sea creature that humans use. This includes shellfish, crab, octopus, bêche-de-mer (sea cucumber), sea turtles and even dugongs. The world's ***fisheries*** are an important source of food, jobs, fun and culture. Fishing is not only important to the health of the planet but also to the world's economy.

- Fish and seafood products are among the world's most widely traded goods, worth billions of dollars every year.
- Fishing is a major source of employment. Over 38 million people rely directly on fisheries for employment. Most of these people are supporting families and communities.
- One billion people rely on marine fish as an important source of protein.
- According to the United Nations' Food and Agriculture Organization (FAO), the amount of fish caught worldwide in 2000 would fill 37,000 Olympic-sized swimming pools.

What do we mean by 'unsustainable fishing practices'?

In this module we will focus on '***unsustainable*** fishing practices,' which refers to taking too many fish, or fishing in a way that destroys ***habitat*** that fish need to survive. ***Sustainable*** fishing requires carefully managing the numbers of fish being caught or killed, protecting critical habitat, reducing ***pollution*** and keeping ocean ***ecosystems*** working. In other words, sustainable fishing means both preventing ***overfishing*** and reducing the harm we do to the ocean.

Overfishing occurs when fish and other sea creatures are caught or killed at a rate faster than they can reproduce. This means that the ***populations*** of these creatures will decline, and in the future we will not be able to continue catching them. If we use more ***resources*** than the ocean can produce, it will no longer be able to sustain itself. Humans are already creating this situation. Human populations are increasing across the world. As a result, demand for food is also increasing. In order to meet this demand, humans have developed better and more efficient methods of harvesting sea creatures, This puts an enormous amount of pressure on the oceans' resources.

Several fishing practices used in the Pacific can severely damage marine ecosystems and lead to more fish being killed than are needed. These practices include ***dynamite fishing***, poison rope fishing, smashing coral, ***bottom trawling***, illegal fishing and ***by-catch***. All of these activities threaten not only the fish but also other marine ***organisms*** that live in the oceans. These practices are popular because they involve little labour, but they can destroy marine habitats and often result in by-catch, whereby ***species*** not intentionally being fished are also caught.

Many Pacific Island people live in villages on the coast, and most of the people in these villages depend on the ocean for food. However, unsustainable fishing practices are making this food supply unreliable, as popular fishing sites no longer house as many fish as they did in the past.

Impacts on the marine environment

Unsustainable fishing has many negative effects on the marine environment. When the population of one species of fish declines, this also affects other species of fish that live in the same ecosystem. For example, if populations of a small fish disappear, all of the larger fish that normally feed upon it will also be affected.

Some methods of fishing also destroy coral, such as dynamite fishing and bottom trawling. These methods destroy the reef habitat that fish need for food, shelter and reproduction. Therefore the fish depending on the reef will disappear and will not return until the reef recovers. This can take many years.

Practices such as bottom trawling result in unwanted by-catch, most of which is thrown back into the ocean wounded or dead. This is a waste of vital resources and disrupts the ecosystem.

Unless we change our practices, more fisheries will become overfished and more ocean habitats will be ruined. Change is urgently needed.

This module explores the concept of unsustainable fishing, including the effect it has on marine environments, the practices that can be considered unsustainable, why unsustainable fishing occurs and actions that can be taken to reduce these practices and the damage that they cause.

The module contains six activities and supporting information to assist the teacher:	
Tuning in:	Overharvesting case study
Searching for answers:	Past–present–future (Option 1) Think–pair–share writing task (Option 2)
Trying solutions:	Awareness ***campaign*** (Option 1) Letters to the Editor (Option 2)
Student reflection:	A fishy tale

The sponge is a common species harvested from the wild for use as bath sponge.

Tuning in

Overharvesting case study

Suggested timing:
45 minutes

Subject areas:
Language Studies, Science, Social Science

Glossary words:
habitat, organisms, population, resource, species, sustainable, unsustainable

Materials:
- Trochus picture story (supplied)
- Trochus case study (supplied)
- paper or exercise book
- pen or pencil.

Activity summary:

Students are introduced to the concept of unsustainable fishing practices by considering a series of pictures showing harvesting of Trochus shell and answering a number of questions.

Outcomes:

Students will be able to:

- define ***sustainable*** and ***unsustainable***
- identify unsustainable practices and the impacts they have on fish and people.

Procedure:

Before the lesson

Teachers should read the Trochus case study (supplied) to become familiar with the issue of overharvesting. You can use this case study for the class activity, or you could write your own case study about an unsustainable fishing issue in your local community.

On the day of the lesson

1. Either make enough copies of the Trochus picture story (see page 20) for each pair of students to have a copy, or ask students to sit in a circle on the floor. Stand or sit in the middle of the circle so the whole class can see the picture.

2. If your class has a good reading level you might choose to let them read the Trochus case study, instead of giving them the picture story.

3. Give your students enough time to properly read through the case study or look at the picture story.

4. Ask students the following focus questions and encourage them to write down their answers.

   - What do you think is happening in the picture story/case study?
   - Why do you think it is happening?
   - Do you think it is a good or bad situation? Why?
   - What other types of sea creature could be vulnerable to this type of situation?
   - Does this happen in our own village? If yes, ask the students to explain.

5. Encourage students to share their ideas with the rest of the class. Allow enough time to ensure that everyone has a chance to share their ideas.

6. Introduce and define the terms 'sustainable' and 'unsustainable.' Having a good understanding of these terms is important for the students to continue through other activities in this module.

Sustainable means using a ***resource***, such as catching fish, while making sure that the resource will also be available for future generations of people to use.

For example, when fish are caught in a sustainable way, we take care to only catch as many as we need and we protect the ***habitat*** of the fish. This means that there are plenty of fish left in the habitat and those fish can continue to breed.

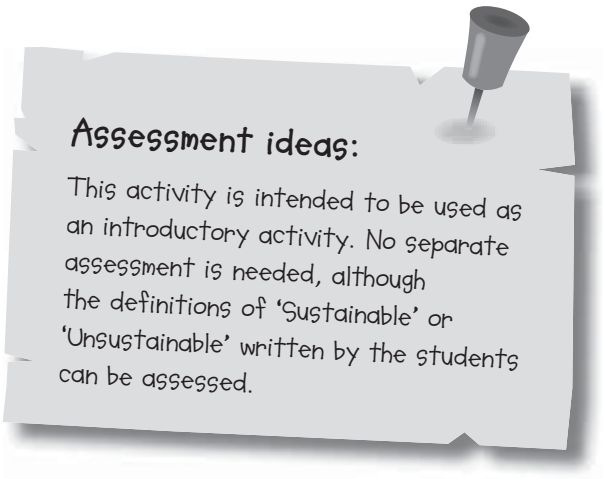
Unsustainable means using a resource, but creating a situation where it will run out, and will not be available for future generations of people to use.

For example, when fish are caught in an unsustainable way, too many are caught or perhaps the habitat of the fish is damaged. This means that not enough fish are left, and the fish will not be available for future generations.

7. Conclude the activity by asking your students to write a definition of the words 'sustainable' and 'unsustainable' using their own words in their exercise books. Students' definitions should look something like:

Taking or using too much of a resource meaning it will not be available in the future is a problem and this is unsustainable.

Using a resource so there is enough for everyone to use now and in the future is sustainable.



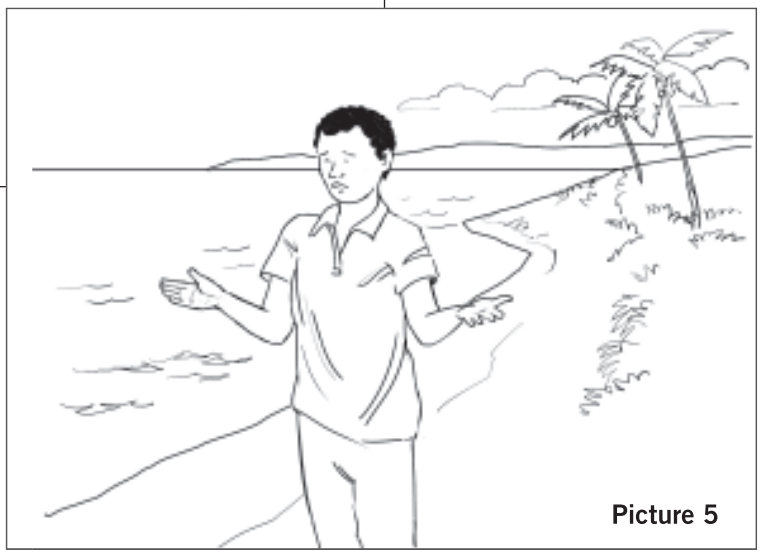
Trochus picture story

Picture 1

Picture 2

Picture 3

Picture 4



Picture 5

Case Study:

Case study: Trochus harvesting in Vanuatu

There have been many cases of overfishing or overharvesting of marine resources in the Pacific Islands. These include ***species*** of fish, shells and other marine ***organisms*** that are used to sell or trade.

We can all probably think of an example of a fish or shell that used to be plentiful and now is either completely lost or very rare as a result of overharvesting.

This is what happened to trochus in many of the reefs in Vanuatu. Trochus shells are a commercial item used to make buttons. The meat of the trochus is a tasty treat and is eaten by the local people. These two factors have put too much pressure on the ***population*** of trochus around Epi Island, Vanuatu.

Trochus shell has been collected by the local people and used as a source of food for many generations. In the late 1940s, following the arrival of commercial buyers in Port Vila, trochus shells began to be harvested for button manufacture. The buttons were a much-needed source of income for the rural population. Many people wanted to collect trochus and sell the shells. Trochus shells become brittle when they are large, so young trochus with small shells were harvested to make the buttons. During the 1980s button factories were built in Port Vila, increasing the demand for trochus. Unfortunately people did not understand what would happen if too many trochus were taken, so the harvesting was not managed. The people of Epi Island did not know how many was too many until it was too late.

Many trochus were harvested. Those that were left were too far apart to breed and allow the population to recover. This has led to widespread loss of trochus in many places. The loss of trochus meant that there was no more income from the button industry. More importantly, it also meant that a significant traditional food source had been lost.

Fortunately, some places in Vanuatu still have trochus and many areas are conducting breeding programs to ensure there will be trochus on Vanuatu reefs for generations to come.

A diver harvesting trochus.

Teacher's fact sheet:

Techniques for gathering local knowledge

What is local knowledge?

Local knowledge is the knowledge that people in a community have about the world around them. They have developed this knowledge over time, and continue to develop it. This includes the way people see and understand their surroundings, the way they solve problems and how they process new information. It also includes the way that knowledge is developed, stored, used and passed on to others.

Local knowledge is:

- based on experience
- often tested over time
- suited to the local environment and culture
- held by individuals or communities
- lively and changing.

Local knowledge is broader than traditional or indigenous knowledge. All communities possess local knowledge – rural and urban, settled and nomadic, original inhabitants and new settlers.

Why is local knowledge important?

Local knowledge is an important source of information because it is easily accessible and unique to the people who live in the local community and the situations or experiences they will encounter.

Local knowledge is passed down from generation to generation and can help explain the reasons for and consequences of changes that have occurred over time. This helps the community to make informed choices based on previous experiences.

Local knowledge is valuable in assisting students to make connections with information sources outside of the school environment. This helps to prepare them to participate in their own community, society and culture. The school does not need a great library or the internet to access local knowledge, it can be accessed through the people in the community.

A community meeting is a great place to gather local knowledge.

Gathering local knowledge

In the Pacific Islands, there are many ways to gather local knowledge.

- Making observations of how things are done in the local community.
- Developing and handing out ***survey*** forms as a way of collecting information (however, this may be limited by the ability of community members to read and write)
- Holding a focus group of around 8-12 people, and encouraging participants to provide information during a directed group discussion. Participants are generally chosen based on their ability to provide knowledge or insight into an issue.
- Interviewing members of the community. This method is not limited by the reading or writing ability of the person being interviewed.

The following are some tips for conducting an interview:

Before the interview/class visit

- When you contact the interviewee, tell them your name, your organisation/school, your position in that organisation and the purpose of the interview.
- Tell them how you got their contact information and why they were chosen for the interview (whether it was a random selection or if there was a particular reason).
- Ask them if it is ok to interview them.
- Arrange the time for the interview.
- Make sure the interview questions are ready in advance. Limit the number of questions to about eight.
- If the interviewers are going to work in pairs, decide who is going to take notes and who will ask the questions.
- Do a little research about the community in which you will gather information or about the interviewee to avoid asking inappropriate questions.

During the interview/class visit

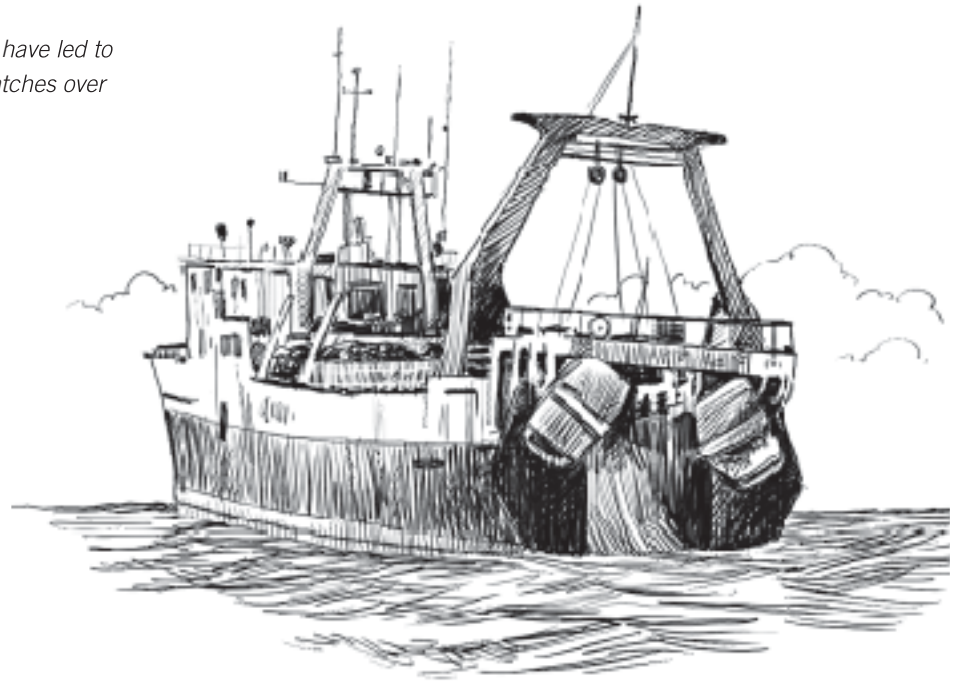
- Be polite and considerate.
- Before beginning the interview, explain how the information will be used.
- Ask questions in a clear voice and give the interviewee time to think before answering.
- Let the interviewee answer the questions themselves without being prompted.
- At the end of the interview, thank the person for their time.

After the interview/class visit

- Send a thank you note a few days after the interview.
- If the interview was conducted in pairs, each pair should meet soon after the interview to compare notes, thoughts and information.

It is very important when gathering local knowledge that the people concerned with the issues (e.g. fishermen, businessmen, etc) are involved in the process and fully understand the purpose of the interview or survey.

Advances in technology have led to an increase in fishing catches over the past 50 years.



Searching for answers

(Option 1): Past – present – future

Suggested timing:

90 minutes

Subject areas:

Language Studies, Social Science, Maths

Glossary words:

chronological, population, predictions, resources

Materials:

- paper or pages in an exercise book
- pen or pencil
- rulers
- coloured pencils (optional)
- marker pens (optional)
- glue (optional)
- pictures from old magazines, pamphlets, posters (optional).

Activity summary:

This activity allows students to construct a timeline recording changes in the availability of fish or other marine resources in their community. Students then make predictions about the future using information they know about current fishing practices.

Outcomes:

Students will be able to:

- describe the impacts of changes to the environment
- outline the effects of changes in community lifestyles over a period of time.

Background:

A timeline is a ***chronological*** listing of key events in the history of a community or area over many years. The timeline assists community discussion and examination of past trends, actions, problems and achievements. It is useful in planning and decision making to think back on these past events and experiences and look at how they influence present attitudes and actions.

In developing a timeline, community members record events dating back as many generations as villagers can recall. Group discussions of the timeline provide a good opportunity to ask elders about things that have happened in the past and how the community has responded.

Procedure:

Before the lesson:

1. Contact a prominent community member (e.g. elder, chief or church leader) or local government officer and ask for the best person to come and talk to the students about the history of the area, particularly about fishing and marine resources.
2. When you contact this person explain what you would like them to talk to your students about. Tell them that students will be creating a timeline from the information they provide.
3. Organise a day and time for your guest speaker to come in and talk to your class.

On the day of the lesson:

1. Begin the lesson by introducing the concept of chronological order. Draw an example of a timeline on the board.
2. Ask for a volunteer to tell you the first thing that they did when they woke up today. Mark this on the timeline.
3. Then ask the student to tell you what they did after that, and so on, until the student has brought you up to the present moment in time. Every time the student gives you an event, write it down on the timeline.
4. Finish this part of the activity by reiterating what chronological order is: *presenting or arranging information in the order that things occur or happened*. Explain that students are about to create a timeline of the availability of fish or other marine resources in your area over time.
5. Introduce the guest speaker to your class. Encourage students to ask questions to help them to gather the information they need for their timeline.
6. Start the timeline by asking the guest speaker to identify an important event in the history of the community and the year it occurred. This does not have to be the earliest activity remembered – it is just to get a reference point.
7. Invite your guest speaker to talk about the events that shaped and influenced individual and community activities related to the availability of fish and other marine resources. Discussion may start off slowly but the following prompt questions may be used to speed the process along:
   - When did people first settle in the village, and where did they come from?
   - Have there been any serious cyclones, floods or other natural disasters?
   - What are some of the development activities that have occurred in the community? (e.g. land clearing, building projects, etc)
   - What was fishing like when the speaker was very young? (e.g. numbers of fish, methods used to catch fish).
   - How has fishing changed over their lifetime? What do they think it is like now?
   - Has anything happened over time that may have affected fish numbers, such as more fishermen, new technologies, declaration or lifting of tabu areas, changes in fishing methods, ***population*** increase, changing farming practices, different methods of waste disposal, new industry occurring.

Table representation of timeline

Timeline					
Factor or event	*Before 1960*	*1960-1970*	*1970-1980*	*1980-2000*	*2000-now*

8. Split your students into small groups of 4 or 5 students and ask them to prepare their timeline. Start by turning a piece of paper sideways. Draw a horizontal line across the middle of the paper, and mark sections on it, with one section for each time period. Alternatively, you can record the information in a table: Refer to table example (above).
9. If the timeline has one time period that has more interesting events than the others, expand one section (or more) in order to include extra events.
10. From the stories told by your guest speaker, each group of students should construct a timeline by marking the time periods (starting with the earliest and latest dates, then adding the intermediate time periods). Students can then add the events that happened at each important date.
11. If there is difficulty in establishing dates for particular events, try to relate them to better-known events such as World War II, independence, establishment of the church or the death of an important person.
12. Information can be recorded on timelines by writing in events, drawing pictures, or gluing on pictures cut out from old magazines, pamphlets or posters.

Assessment ideas:

The timelines produced should serve as one means of assessment.

Also, students' participation in the group sessions can be assessed:

- unsatisfactory – the student did not participate.
- satisfactory – the student participated.
- excellent – the student was centrally involved in the group session.

The development of new technologies and the availability of new materials have changed they way people catch fish.

Teacher's fact sheet:

Unsustainable fishing practices

Unsustainable fishing practices are activities that reduce fish stocks and damage or destroy marine ***habitats***. Unsustainable fishing includes poor ***fisheries*** management and harmful fishing practices. Many fishing practices are extremely destructive to delicate habitats – particularly vital fish breeding grounds such as coral reefs and sea grass meadows. Below are some examples of fishing practices that are considered unsustainable.

Poor fisheries management

Fisheries management refer to rules and regulations, usually set by governments, which aim to make the best use of fisheries without damaging fish stocks in the future. This includes measures such as limiting types of fishing gear that can be used, the amount of fish that can be taken and the size of fish that can be harvested.

Valuable fish stocks, as well as a number of other marine ***species***, are threatened by poor fisheries management. Several of the world's oceans are affected by ***overfishing***, with a number of important commercial fish ***populations*** having already dropped to a level where their survival is threatened and fishing is no longer profitable. This is due to a failure to manage fisheries to ensure that they are ***sustainable*** into the future.

Some of the current fisheries management problems in the Pacific include:

- the number and size of fish and marine resources that are being harvested
- the types and amounts of fishing gear being used
- fisheries groups not paying attention to scientific advice on fish quotas, which set rules about how many fish can be caught
- international regulations not covering fishing in international waters, which means they are open-access common areas for everyone
- many countries not signing, putting into practice, or enforcing existing national and international fisheries management rules
- people supporting poor management by buying fish from unsustainable fisheries.

Overfishing

Overfishing means taking too many fish. When a stock of fish or other marine creatures is overfished, it means that more have been taken from the population than can be replaced by natural reproduction. The United Nations believes that almost every commercially important fish species around the world is overfished. Overfishing one species can impact on many other species in the ***ecosystem***. For example, the overfishing of parrot fish in some areas of the Solomon Islands has caused problems for the coral reef ecosystem. Small parrot fish remove algae from reef surfaces, which prevents algae from over growing. Larger parrot fish remove and redistribute coral fragments, which cleans up the reef surface. A decline in parrot fish numbers in reef ecosystems may have disastrous consequences given the vital roles they play. See 'The Green Snail' case study on page 29 for an example of the consequences of overharvesting.

Parrot fish

Destructive fishing practices

Bottom trawling

Bottom trawling fishing involves pulling a large net along the ocean floor. Bottom trawling is believed to be the most destructive of all forms of fishing, as it damages all habitats on the ocean floor and destroys the populations of many bottom dwelling creatures.

Bottom trawling changes the water quality because it disturbs nutrients and ***sediments*** that have settled on the sea floor. It also results in many species being caught, not just the ones that the fishermen are targeting. These unwanted species, known as ***by-catch***, are killed, or injured and thrown back, leading to a terrible waste. Damage to so many different species affects the food web within the ecosystem.

By-catch

Not all of the marine species caught in fishing nets, in traps or on lines are kept and used. Up to 27 million tonnes of marine life is caught and discarded overboard each year. This waste equals nearly one third of all the fish caught by humans worldwide. These unwanted fish and other species are called by-catch. The species that a fisherman intends to catch is called the ***target species***. By-catch can include juveniles of the target species that have not yet had a chance to grow and reproduce. By-catch also includes other species of fish, birds, turtles and marine mammals that are accidentally caught. By-catch is caused by certain types of fishing gear and methods that catch more than just the target species.

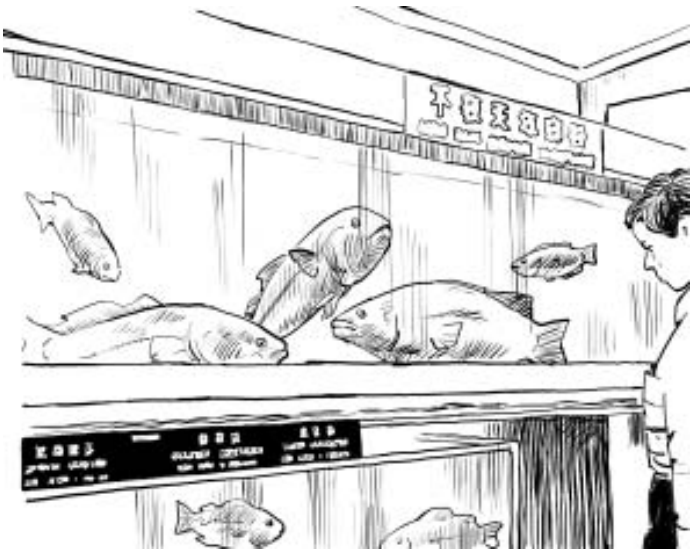
Blast fishing or dynamite fishing

Blast fishing, or ***dynamite fishing***, as it is often called, is the practice of using explosives to stun and kill fish. Some fishermen use store bought dynamite while others make their own from simple household materials. The explosion creates shock waves underwater that rupture the fish' swim bladder, stunning the fish. The swim bladder is what helps fish to swim underwater. Some fish are killed instantly and float to the surface, while others simply sink to the ocean floor.

Blast fishing destroys the marine environment, as it can kill large numbers of fish and other marine ***organisms***, and can also damage or destroy coral reefs and other marine habitats. Blast fishing is also dangerous for the fisherman. Home-made dynamite can sometimes go off without warning, injuring the fisherman.

Cyanide/pesticide fishing

Cyanide fishing involves fishermen squirting a chemical called sodium cyanide into the water. The sodium cyanide stuns fish without killing them, making them easy to catch. Cyanide fishing on coral reefs was first used in the 1960s to supply the international aquarium trade. Since the early 1980s, cyanide fishing has been used to supply live reef fish to restaurants in a number of Asian countries. For each live fish caught using cyanide, a square metre of their coral reef habitat is destroyed.



Other poisons, such as bleach or pesticides, are also used to catch fish for personal use. This occurs in many places in the Pacific Islands where pesticides are used to manage crops. The poison is put into the water and the fish are collected after they die or are stunned by the effects of the poison. The poison can then be passed through the fish into the people who eat them. The poison also kills many other plants and animals that are not collected. These plants and animals are left to die unnecessarily and never used.

Crushing coral

Crushing coral, or muro ami, is a fishing technique that is used on coral reefs. Free divers bang a reef with rocks, sticks and other objects in order to lure fish into nets. Coral crushing also occurs when people fishing or collecting shellfish smash and break coral to get access to the animals taking shelter underneath. Coral can also be damaged when fishermen walk on it to access different fishing areas or when boats and anchors are not used with care and collide with or drag across coral. The practice of coral crushing has devastating and long lasting effects on the reef, as well as on other marine organisms that live on the coral and depend on it for food.

Poison rope fishing

Poison rope fishing is a practice that occurs across the Pacific using a number of different local plants. The following example is from Papua New Guinea.

Poison rope, or derris root, comes from a vine which grows in most low land areas of Papua New Guniea. It is now grown by many villagers for the purpose of catching fish. The roots of the plant contain rotenone, a strong insecticide and fish poison.

The roots or stems of the plant are beaten to a pulp.

Poison rope fishing

The pulp is placed in the water, under coral, stones or jammed into crevices and holes on reefs. Any fish in the area that come into contact with the pulp are stunned and float to the surface, where they are easily collected.

This technique is also used in rivers and streams. The poison is introduced upstream and travels downstream, stunning fish, eels and prawns. Unfortunately, like cyanide or pesticide fishing, poison rope also kills non-target species, including the coral that many fish need for food and shelter. The poison rope allows a quick catch, but causes the health of the habitat and number of fish to decline.

What's next?

Many governments have started to impose regulations, quotas and better monitoring for fisheries. But while some countries are now making a huge effort to stop overfishing and destructive fishing practices, it is still a serious problem and much more needs to be done.

Case Study

Case study: The Green Snail

The Green Snail can grow to over 20 cm in diameter and over 2 kg in weight. It takes about five years for this amazing animal to start to reproduce.

The decline of green snails is well documented in Lelepa Island in Vanuatu where green snails have traditionally been harvested for food. The taste and amount of meat per snail made it one of the local's favourite meals.

In more modern times, companies in Vanuatu's capital Port Vila began buying the shells for export. Shells were exported to countries for making crafts and jewellery. People on Lelepa began to harvest their green snails not only to eat but also to sell. This was a popular source of income for people on the island because they were easy to harvest and people also got to enjoy the meat of the shell before they sold it. In the 1990s, people started to notice a serious decline in green snail populations.

In 2007, a team of scientists from Japan, with the help of community members from Lelepa, conducted a survey around the island and surrounding traditional areas.

In five days of surveying, only one live green snail was found.

No one knows exactly when the population of green snail disappeared. Sadly, the green snail is now gone from Lelepa's waters.

'Poison Rope' is a destructive fishing technique which kills fish indiscriminately and also affects corals.

Searching for answers

(Option 2): Think–pair–share writing task

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science, Science

Glossary words:
Marine Protected Area (MPA), opinion, unsustainable

Materials:
- pen or pencil
- paper or exercise book
- Role-play scenario cards (page 33).

Activity summary:

Students use the Think–pair–share strategy to develop their own ideas about an ***unsustainable*** fishing practice in their community. Using these ideas as inspiration, students conduct research to produce a writing task or carry out a role-play.

Outcomes:

Students will be able to:

- think about and investigate an issue to gain a better understanding, form an ***opinion***, share their ideas with others and express their ideas in writing.

Procedure:

1. Ask the class to select and think about a local fishing practice that they believe is unsustainable. You may like to give an introductory talk to the class or provide examples of unsustainable practices. Alternatively, they may already have some ideas from the Trochus case study presented in earlier class discussions.

2. Begin this activity with a Think–pair–share session. This is a cooperative learning approach, which allows students to think about a question/idea/issue and share their thoughts with a partner before discussion in a small group.

3. Once your students have thought of a local fishing practice that they believe is unsustainable, allow them some time to think individually about the issue. They might like to write down some of their ideas. Allow approximately 5 minutes for this task.

4. Now ask your students to form pairs. Have students face their partners and share their ideas and thoughts about the issue. Allow approximately 10 minutes.

5. Now ask your pairs of students to contribute their ideas to a larger group or the whole class. Allow approximately 20 minutes. Record the ideas on the blackboard so everyone can see them.

6. Use the shared list as the basis of a written task or a class drama. Students can carry out further research and write a report, story or a newspaper article or conduct a role play about the issue. See ideas below.

Alternative 1: Written report/essay

Have the students write a report about the unsustainable fishing practice, including the following sections:

- What is the practice? What do we think, feel, hope and fear in relation to this particular practice? What do others who are involved think, feel and say?
- Why do we think this practice is used? Why do we and others think, feel and act the way we do? What and who has influenced us and others involved?
- How it is unsustainable? What problems does it cause?
- How does the student feel about the practice? Are there others that have a different point of view about this issue? Do other people have different values, needs or understandings that affect the issue?
- What can be done? What are the possible courses of action we can take?
  What are others already doing? Which course of action is most likely to achieve our vision of a preferred future?
- How will we do it? How will we put into practice our plan of action in school, at home or in the community? How will we work together? Whose help will we need? How do we know if we are being successful?

Students may need to carry out research or conduct interviews to gather information to assist them in completing their report.

Alternative 2: Creative writing

Have your students use the following as a starter to a piece of journal writing:

'Some of the ideas or thoughts I had about unsustainable fishing before talking with others in the class are different now. They include …'

Or,

Have your students write a conversation between two or more people that have different viewpoints about an unsustainable fishing practice.

Alternative 3: Role-play/drama

Divide the students into small groups (about four groups). Provide each group with a scenario card. Each card has a story involving characters that have differing values about the same fishing practice/marine resource. (See 'Scenario Cards' on page 33).

In their group, students should discuss what is happening in their 'Scenario Card'. The groups should put together a role-play of the characters as they are explained on the group's scenario card. Each group presents their role-play, expressing the opinions and values of the characters to the rest of the class.

You might like to spread the role-plays over a number of lessons.

After each group presents their role-play, the class can spend some time discussing the points of views presented and identifying areas where there are similar values and areas where there are differences.

Alternative 4: Newspaper article

Have students imagine that they are journalists who have been asked to inform the community about an unsustainable fishing practice and the problems it causes.

To create a newspaper article, students should;

- outline the purpose of their article
- choose an article topic
- research the article
- write the article
- edit the article, and have a friend proofread it
- rewrite the article
- do a spell check.

Formula for a well-written news article:

First paragraph

In your first paragraph (one or two sentences) tell who, what, when, where and why. Try to get the reader interested by beginning with a funny, clever or surprising statement.

Second/third/fourth paragraphs

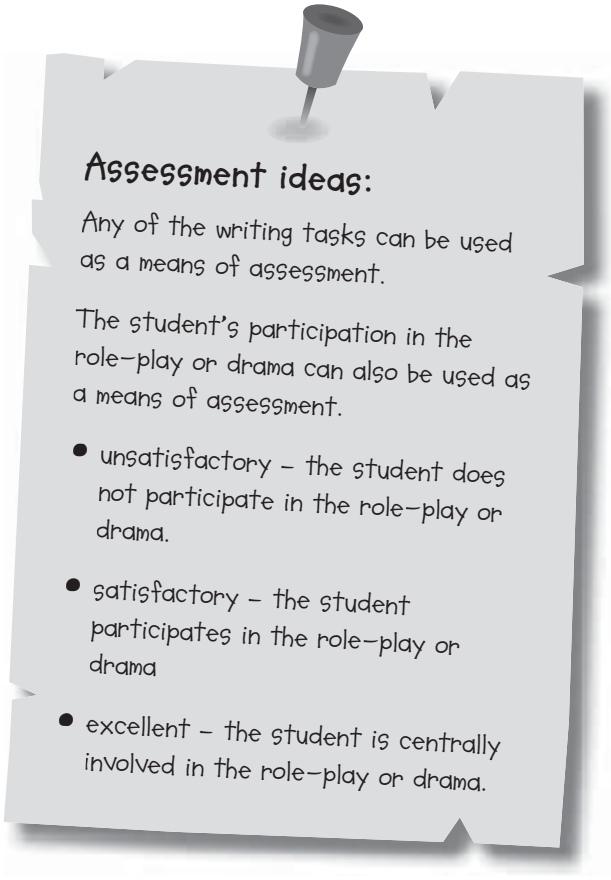
Give the reader the details. Include one or two quotes from people you interviewed. Write in the third person (he, she, it, they). Never ever state your opinion. Use quotes to express others' opinions.

Last paragraph

Conclude the article properly – don't leave the reader wondering. Don't say 'In conclusion' or 'To finish', as this is not very interesting.
Try ending with a quote or a memorable phrase.

- use active words (verbs that show what's really happening)
- take notes during interviews. Write down quotes
- tell the really interesting information first.

Source: Media Awareness Network: Writing a News Story / Grades 6-9 / Lesson Plan. http://www.media-awareness.ca



Role-play scenario cards

Two communities

There was a reef between two communities. Both communities used to collect trochus. One community valued the trochus as a customary food in their marriage ceremony. If the trochus was missing from the ceremony, it was believed that the marriage would not be happy, and that the reputation of the bride's and groom's families would be harmed. The other community gathered trochus to sell for button making. They took too many trochus, leaving only a few for custom feasts for the other community.

Tourist and fisherman

A tourist went swimming and diving on a reef. She enjoyed seeing the colourful fish and coral. Then along came a fisherman who caught many fish in his net. He caught fish of all sizes and took them all home to feed his family.

The tourist was not happy about the fisherman catching so many fish. She complained to the village chief, but the fisherman argued that he had a responsibility to feed his family.

Conservation officer and community

There was an uninhabited island that was rich in marine resources. Because of the environmental value of the area, a conservation officer wanted to preserve it by making it a Marine Protected Area (MPA). The people from a nearby island did not want the law passed, because they used the reef there to catch their food. If the island was declared a Marine Protected Area, the people would no longer be allowed to fish on the reef.

Family and fishing boat

A family lived close to a good fishing area and regularly caught fish and collected shellfish for food. The family had a very small boat and fished by hand. They only caught enough fish to feed their family for a day. A commercial fishing boat came into the area looking for new places to fish. The commercial fishermen were so happy with the amount of fish they found, they started to use big nets, catching many fish of different sizes and types. The next time the family went out to fish they could only catch very small fish and had to travel a very long way out to sea to find them.

Decision makers take note of letters to the editor to gauge public opinions on an issue.

Trying solutions

(Option 1): Letter to the editor

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science

Glossary words:
unsustainable

Materials:
- paper or exercise books
- pens or pencils
- examples of newspapers or letters to the editor (optional).

Activity summary:

In this activity, students will write a letter to the editor expressing their concerns about unsustainable fishing practices, for publication in a local newspaper. This activity allows students to analyse information about the impacts of unsustainable fishing practices in their local community. They then bring these issues to the attention of the general community by writing a letter to the editor.

Outcomes:

Students will be able to:

- recognise the role of the media and how the media can help promote an issue in their community.

Background

The purpose of letters to the editor in newspapers is to give the general public an opportunity to present their views and respond to current issues. Writing a letter to the editor is one of the easiest ways to express your opinion to hundreds of readers.

Letters to the editor are also important because they are read and monitored carefully by decision makers and community leaders who assume that each letter to the editor represents many other people who share the views expressed in the letter.

For the purpose of the exercise it does not matter if the letter is actually submitted for publication. The activity gives students the opportunity to present an argument, with supporting evidence, outlining the problem of unsustainable fishing practices in the local community. If it is appropriate and you feel the letters are well written, you might decide to submit them to a local newspaper for consideration.

Procedure:

1. Begin the activity by introducing the idea of letters to the editor to your students. You might bring in copies of the letters page of local newspapers for your students to read.
2. Introduce students to the format of a letter to the editor. Refer to the 'Tips on getting published' box, on page 36.
3. Hold a discussion with your class about possible points of view or positions to be taken on unsustainable fishing issues.
4. Split your students up into small groups of 3 – 4 students and ask each group to complete a plan for their letter in note form. Encourage the group to share their ideas.
5. Individual students write their own letter using the following format as a guide;
   - purpose of the letter (may be included as a Reference to 'RE: ...')
   - your opinion or point of view
   - arguments to support this opinion and to persuade the reader to agree with your point of view. Each new idea should have a new paragraph.
   - Conclude by restating your opinion and make a recommendation or suggestion.
   - Letters should not be more than 200 words and should include the writer's name and address at the top of the page.
   - Encourage your students to try to come up with an eye-catching title for their letter.
6. Give your students the opportunity to share their letters with the rest of the class
7. Well-expressed letters could be submitted to the school newsletter or local paper for publication. See boxed text below for some helpful tips for getting letters published.

   As an alternative to students writing a letter to the editor, you could ask your students to draw a cartoon strip expressing their concerns about unsustainable fishing practices, for publication in a local newspaper.

Assessment ideas:

The written piece should be used as the means of assessment.

- unsatisfactory – student fails to demonstrate an understanding of the issue and does not present his or her opinion
- satisfactory – student demonstrates an understanding of the issue and presents his or her personal opinion
- excellent – the student demonstrates a good understanding of the issue and clearly presents his or her personal opinion.

Tips on getting published

- Think about whether there have been any related issues in the paper or on the news recently. If you can connect your letter to a current issue you will have a better chance of getting it published.
- To give your letter the best chance of being published, keep it under 200 words – less than 150 is even better.
- Be clear and logical - your letter needs an opening, middle and end.
- You must grab the readers' attention in the first sentence and persuade them in following paragraphs.
- Letters should begin with a summary of the issue and a statement outlining the writer's point of view.
- This summary is followed by an argument which provides supporting evidence. Try to include facts and figures that back up your argument.
- Each new paragraph presents a new idea, so the point of view is developed logically.
- Remember that if the information isn't essential, you don't need it.
- Read the newspaper you are writing to and look at the kinds of letters they have published. This is a good guide to the style of letter the editor likes to see.
- The concluding paragraph or last sentence is often a call for action, and uses a strong tone.
- Newspapers receive more letters than they have space to publish, so don't give up if your letter doesn't appear – keep writing!

Source: http://www.oxfam.org.au/act/diy-campaigning/make-your-mark-in-the-media/writing-a-letter-to-the-editor

Trying solutions

(Option 2): Awareness campaign

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science, Art

Glossary words:
target audience, unsustainable

Materials:

- paper
- drawing material or paints
- scissors and glue (optional)
- examples of public education materials to show students (optional).

Activity summary:

In this activity students will create their own awareness poster or sign about unsustainable fishing practices. This will not only reinforce students' understanding of unsustainable practices, but will also encourage them to introduce the concept to others while developing their creativity.

Outcomes:

Students will be able to:

- design and create materials to educate others about unsustainable fishing practices.

Procedure:

1. Explain to your class that a very effective way of getting people to practice good behaviour is to have public service announcements or awareness campaigns.

2. You might like to give examples of public service announcements or awareness campaigns from your community that your students will be aware of. Examples do not have to be about the environment

or unsustainable fishing, they just need to give students an idea. Health and hygiene campaigns present many good examples.

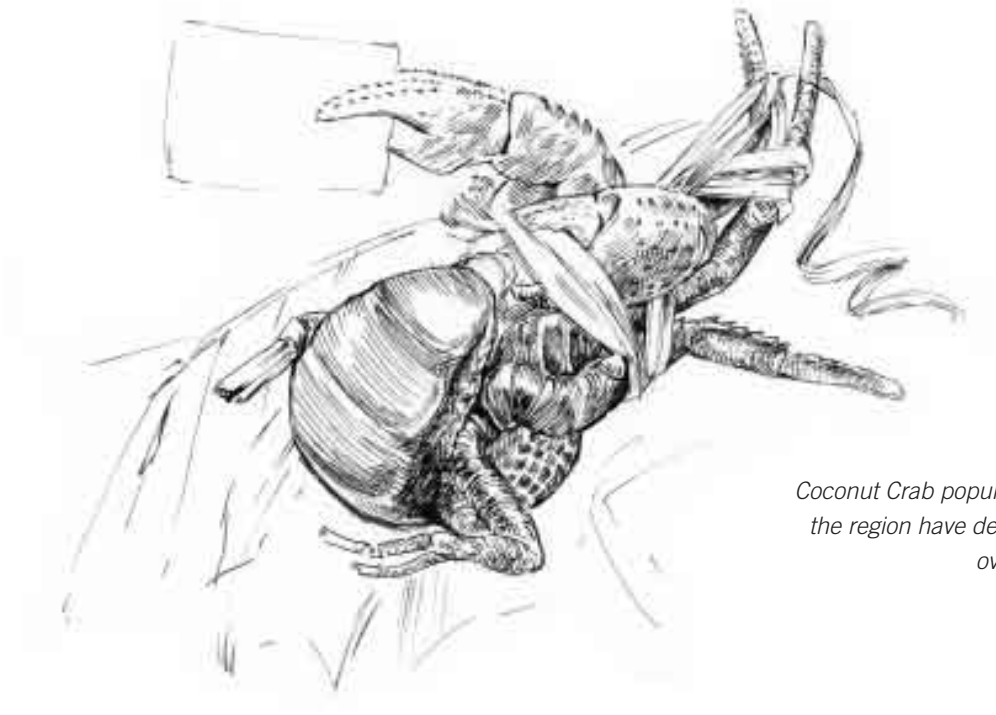
3. Tell your students that they will be designing their own materials (posters, small signs, banners) to help educate others about the dangers of unsustainable fishing practices.
4. Remember that it is difficult to run an effective awareness campaign aimed at the general public, because people have different communication needs and different ideas about an issue. Encourage your class to tailor their poster or sign to a specific audience. Some examples of audiences that you might like to target are:
   - commercial fishermen
   - village/local fishermen
   - mammas
   - market stall holders
   - community leaders
   - people who buy fish products (shop at the market)
   - others that are relevant in your community.
5. Your class can work as individuals, pairs or small groups according to the size of the class and the availability of materials.
6. Ask each individual, pair or small group to think about which unsustainable fishing issue they would like their awareness campaign to focus on. Have them share their idea with the rest of the class.
7. You can either give suggestions of possible topics or let students decide for themselves. Themes could include 'Poison rope fishing kills more than fish' or 'Don't take more than you need', for example. Encourage students to create materials that will be useful in addressing the issue in your own school or community.
8. Before students design their public education materials, encourage them to decide who their audience is. They should also decide what their message will be and if they need examples to help get their message across.
9. Before the students start, have the class brainstorm what makes an interesting and effective public information product. You might like to get examples from other organisations to give the students some inspiration.

   Good, interesting and effective public information products:
   - present a clear message that is easy to read
   - relate the message to people's lives
   - are attractive and will catch people's attention.
10. Have students create draft versions of their public education materials before working on a final version. Encourage them to be creative and to use colour, drawings, paints or other methods to make their work attractive.
11. When your students' public education materials are complete, place them around your school or community in areas that are relevant to the issue and where the materials are likely to be seen by the ***target audience***.

Assessment ideas:

The posters, small signs or banners produced by the students should be used as the means of assessment. Compare the materials produced to the tips for effective public information products from step 9.

- unsatisfactory – the student does not demonstrate an understanding of an effective public information product
- satisfactory – the student demonstrates a clear understanding of an effective public information product
- excellent – the student demonstrates a clear understanding of an effective public information product by presenting a creative product with a strong and accurate message.



Coconut Crab populations across the region have declined due to overharvesting.

Student reflection

A fishy tale

Suggested timing:
45 minutes

Subject areas:
Language Studies, Social Science

Glossary words:
extinction, species, unsustainable

Materials:
- paper or exercise book
- pen or pencil
- coloured pencils (optional).

Activity summary:

Through a short creative writing activity, students consider the consequences of ***unsustainable*** fishing practices on marine ***species***.

Outcomes:

Students will be able to:

- consider the impact of unsustainable fishing practices on certain plant and animal species.

Procedure:

1. Tell the students that you would like them to imagine they are a Wahoo Fish, Tuna, Coconut Crab, Giant Clam, Hawksbill Turtle, Trochus or some other marine species that exists in your area that your students are familiar with.

2. Ask them to imagine that it is 20 years into the future and as a result of unsustainable fishing practices the number of their species has dropped considerably.

3. Ask the students to write a letter from their marine species to the humans whose fishing practices have decreased the number of their species. Students can write to someone who has caused the damage, such as a villager or a fisherman, or they can choose a community leader, such as a chief, who did not prevent the damage from happening.

4. The letter should explain what has happened to the marine species, how they feel and what they think should be done to stop the damage from getting worse, and ultimately leading to the worst possible outcome – ***extinction*** of your species.

5. Give students around 15-20 minutes to write their letter before encouraging them to share their letters with the rest of the class.

6. You might also like to give your students the opportunity to draw a picture that illustrates the story in their letter.

Assessment ideas:

Use this activity as a summary activity. No separate assessment is needed, although the letter written by students in this activity can be assessed.

2 Land originated marine pollution

Land-based pollution accounts for up to 80% of all marine pollution. Most of the waste we produce on land eventually reaches the oceans, either through deliberate dumping or from run-off into drains and rivers.

Pigs cause pollution when they are kept too close to a river.

Module introduction

What is pollution?

Pollution refers to any material or substance that is produced by human activity and released into the environment with potentially harmful effects. Pollution includes waste materials that are released into the environment either accidentally or on purpose. Some kinds of pollution are easy to see, such as oil spills, an overflowing rubbish dump or plastic washed up on the beach. But many serious pollution problems are harder to see. These include things such as pesticides or other toxic chemicals in the water or soil.

Many people believe that the most serious polluters are big industries, factories or mines. While industry can be an important source of pollution, most pollution comes from the activities of regular people. Pollution can come from litter, poorly designed toilets or lack of toilets, domesticated animals such as pigs, and household detergents and chemicals used in gardens and agriculture. These are often the main sources of pollution in Pacific Island countries. This means that all individuals have a role to play in reducing the amount of pollution in the environment.

The Pacific is a beautiful place, and has less pollution than many parts of the world. However, the level of pollution is growing. To help understand where ***pollutants*** are coming from, pollution can be broadly divided into two types: ***point-source*** and ***non-point source pollution***.

Point source pollution comes from a single, clearly identifiable source, such as a factory pipe, mining dump site or pit toilet (bush toilet).

Non-point source (or diffuse) pollution comes from a much broader source, such as weed killers or ***fertilisers*** spread out over crops or gardens, oil and grease building up and washing into water from roads. Non-point source pollution is much harder to identify and treat.

Water pollution occurs when substances are released into fresh water or the ocean and have harmful effects. Pollutants can be suspended or dissolved in the water, or they can drop to the bottom and build up. Some major contributors to water pollution are factories, mining, pesticides, fertilisers, human sewage, oil spills, ***urban*** drainage systems, household chemicals and animal waste. This module will focus on water pollution and its effect on marine environments.

Effects of pollution on marine environments

People once assumed that the ocean was large enough that all pollutants would be diluted and spread out without causing any harm. But pollutants do not disappear. When people throw their rubbish away they rarely consider where it will end up. The waste or pollution that we put down the drain or into the rivers and oceans all has consequences. From plastic bags to pesticides, most of the waste we produce on land eventually reaches the oceans, either through deliberate dumping or from run-off into drains and rivers.

This pollution has numerous effects on marine environments. Below are just a few examples:

- Littering and the improper disposal of rubbish result in plastics and other waste entering oceans and water systems and killing marine life. Plastics can become entangled on coral reefs and can even be consumed by turtles, fish or sea birds, who often mistake them for jellyfish.
- Leachate (the liquid that drains or 'leaches') from factories, ***landfill*** and waste disposal systems often ends up in waterways and the ocean. This can poison marine life and marine ***habitats*** especially if it is not properly treated.
- Nutrients and phosphate run-off from artificial fertilisers, human waste and even household detergents can cause sudden spurts of algal growth, called ***algal blooms***. The blooms can be toxic and can kill fish and potentially pass through the food chain to humans. Algal blooms can also prevent sunlight reaching other ***organisms*** beneath the water, and can smother coral.
- Toxic chemicals entering the oceans can build up in food chains. When bigger fish eat smaller fish that are ***contaminated*** with toxic chemicals, the bigger fish can also become poisoned. These fish may in turn be eaten by other fish or by mammals or birds, and the poison gets passed on. The contamination becomes more concentrated as the toxins pass up the food chain, and can leave some animals unable to breed and more vulnerable to disease.
- Used engine oil can end up in waterways if not disposed of properly. Large quantities of oils and petroleum products can be picked up by stormwater runoff, especially from roads, and enter streams, rivers and eventually the ocean. Just five litres of oil can contaminate 3.5 million litres of water. Oil sits on the surface of water and blocks out oxygen. Because oils and petroleum are toxic, they can also kill plants and animals. Oil spills can affect the development of marine organisms, making them more vulnerable to diseases. They can also affect the ability of some of marine organisms to reproduce.

This module explores the sources and causes of marine pollution, the impacts it has on the marine environment and actions that can be taken to reduce the occurrence of and the damage caused by pollution.

Rubbish washed up on the beach is a common problem in the Pacific

The module contains six activities and supporting information to assist the teacher:	
Tuning in:	What is water pollution?
Searching for answers:	Story of a river (Option 1) Pollution survey (Option 2)
Trying solutions:	Beach clean up (Option 1) Litter education (Option 2)
Student reflection:	What can I do?

Soil washed from land that has been cleared for farming or through logging is a common source of marine pollution.

Tuning in

What is water pollution?

Suggested timing:
45 minutes

Subject areas:
Health, Science, Social Science

Glossary words:
fertiliser, pollutants, pollution

Materials:

- 11 glass jars with screw top lids, or 11 empty plastic bottles with lids
- fine tip permanent marker (or labels for the jars/bottles)
- tweezers (optional)
- water
- vegetable oil
- materials that commonly end up in our waterways (rubbish, leaves, food etc.)
- paper or exercise book
- pen or pencil
- blackboard.

Activity summary:

In this activity, students will test a number of materials in water and observe if the properties of the materials and water change. Students will analyse and discuss the results.

Outcomes:

Students will be able to:

- identify types and sources of marine ***pollution*** and their impact on the environment
- define pollution.

Procedure:

1. Tell your students that they are going to conduct an experiment in the classroom to find out if common school yard and household rubbish and garden waste pollutes water.

2. As a class, set up the jars or bottles in preparation for the experiment. Each jar or bottle needs to be almost full with water. Set the jars up in a place that will not be disturbed for the duration of the experiment (about a week).

3. Using the school's rubbish collection methods (e.g. bins, rubbish pit), students collect some items of rubbish and garden waste that are common in the school yard. Items should include food, plastic, paper, leaves, grass clippings etc. Students could also take a sample of material from a gutter on the side of the road near the school.

4. Ask students to select ten materials for testing. The materials should represent the rubbish and garden waste in the school.

5. Now ask your students to suggest how each material might respond to being left in water over time. Record suggestions on the blackboard, and once everyone has had a chance to contribute their ideas, ask them to record their own ideas in their exercise books.

6. Place one of the materials collected into each jar of water. There should be at least 10 times as much water as there is material in each jar. Label the jars so that you know which material went into each one. The 11th jar will contain water and vegetable oil. The vegetable oil will be used in place of engine oil, because engine oil is difficult to dispose of.

7. For health and safety reasons, ensure that the lids on the jars are screwed on. Children should not open and smell the contents.

8. Over the next week, set aside a time each day for the students to observe and record the changes that occur in each jar. Students can record observations in a table like the one below:

Material used in the water		
Date	***Changes to the material***	***Changes to the water***
Day 1		

9. After the week has passed, ask the students to examine the results, and record their analysis in their exercise books. The results can be sorted into:
    - materials that changed when placed in water
    - materials that did not change when placed in water
    - materials that caused the water to change (i.e. the water appeared to be polluted)
    - materials that didn't cause any noticeable changes to the water.
10. Hold a discussion with the students about their results. Use the following questions to stimulate the discussion:
    - How was the water polluted?
    - Did all ***pollutants*** act in the same way? How did they differ?
    - Could the materials that did not change in the water still be harmful? How long might they last in the water?
    - How might oil affect creatures living in water? What is it about the property of oil that makes it a major problem when it is spilt into the sea?
    - What affect might these common rubbish items have on creatures living in the ocean if they were to be released into the sea?

Disposal:

Jars that contained food or oil need to have the lids left on and should be disposed of in the rubbish (or buried).

The jars that contained garden waste can be emptied onto a garden bed. The jars can then be cleaned and reused.

The jars containing items such as plastic can have the rubbish removed and placed in a rubbish bin. The jars can then be cleaned and reused.

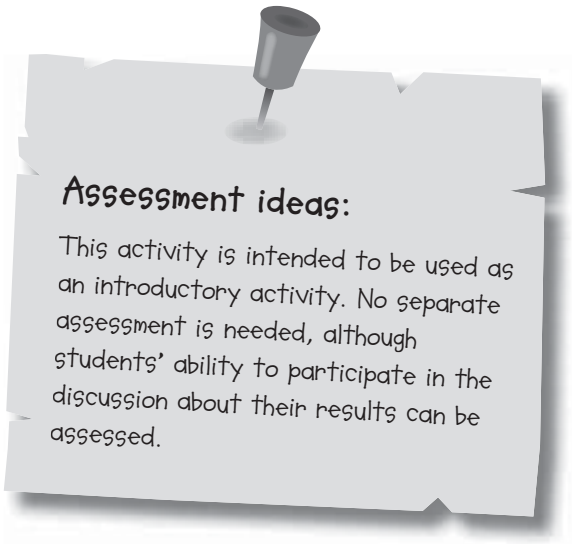
Extension demonstration for the teacher to conduct:

Set up another set of jars for the students to observe. Fill the jars with water and then add small amounts (about 1% compared to the volume of water) of the following to see if the water changes.

- ***fertiliser***
- liquid detergent
- shampoo
- insect spray

The jars will need to be placed by a window where they receive light. Changes may take a few weeks to occur.

Adapted from Australian Marine Environment Protection Association (AUSMEPA)
http://www.ausmepa.org.au/



Teacher's fact sheet:

Land originated marine pollution

The sea covers about 70% of the Earth's surface and is home to millions of fish, crustaceans (e.g. crabs), mammals (e.g. dolphins and whales), microorganisms and plants. Fishermen throughout the world catch millions of tonnes of fish every year and, in many Pacific countries, fish is the principal source of protein.

People have treated the sea as a dumping ground for thousands of years, offloading rubbish, sewage and, more recently, industrial waste. Most of the ***pollution*** that occurs in oceans and fresh water systems originates on land. The World Wide Fund for Nature reports that over 80% of marine pollution comes from land-based activities. This pollution finds its way into oceans and fresh water systems and causes harm not only to the marine life but to soil and fresh water organisms as well.

The following are some common types of land originated marine pollution:

Fertilisers

Fertilisers are substances used to improve soil fertility and help plants grow. They can be natural or man-made and may contain potassium, phosphorous or nitrogen. Although these elements occur naturally in the environment, too much can upset the balance. When fertilisers leak into water systems, they can create ***algal blooms*** that spread over the surface of the water and block out the sunlight. This means that those marine plants that use ***photosynthesis*** can no longer make their own food and may die. Fish and other marine ***organisms*** that depend on those plants for food and shelter will struggle to survive. As the marine plants die, they rot, which reduces the amount of oxygen in the water.

Pesticides

Pesticides are used to fight off pests and plant diseases. They are deliberately made to be ***toxic*** so that they kill unwanted pests. Some pesticides are made to kill only certain organisms, while others are not targeted at any one organism in particular and can harm all living things. Pesticides can seep into the ground and flow into water systems and the ocean, where they can kill marine plants and fish. The chemicals in pesticides and fertilisers can also become concentrated in marine plants, fish and other organisms. These chemicals can then travel up the food chain and eventually harm humans.

Solid waste

Solid waste, such as plastic bags, cans, glass bottles, shoes and packaging material, can also make its way into the sea if not disposed of correctly. Plastic rubbish, which decomposes very slowly, is often mistaken for food by marine animals. High concentrations of plastic material, particularly plastic bags, have been found blocking the breathing passages and stomachs of many marine ***species***, including whales, dolphins, dugongs, sea birds and turtles. This waste can also be washed back to shore, where it pollutes beaches and other coastal ***habitats***. See Case study 'Dirty plastic' on page 50 for more information.

Untreated sewage

Untreated sewage and waste water can cause nutrient enrichment when they are washed down rivers and out to sea. This means that the water receives more nutrients than the organisms that live in it need for normal life, growth and reproduction. Untreated sewage, like fertilisers, contains nutrients such as nitrogen and phosphorus, which can create outbreaks of algae. See Case study 'Seagrasses' on page 50 for more information. Sewage also contains bacteria and can sometimes carry viruses that can be harmful to people fishing or swimming in affected water.

Oil

Oil often gets into drains, either from leaking out of cars and being washed off the road when it rains, or by being deliberately tipped down the drain instead of being disposed of properly. The oil in the drain will eventually wash into rivers or streams and then out into the ocean. Similarly, oil that is spilt or leaked from machines such as generators can soak into the ground. The next time it rains, the oil and water soaks through the earth seeps out into rivers or streams and into the ocean. Although the effects of this are not as evident and widespread as those of direct oil spills on the ocean's surface, oil entering drains and rivers as waste and runoff from cities and industry also contributes to killing marine life. Oil spills from large ships and fishing vessels cause huge damage to the marine environment, but are actually only responsible for around 12% of the oil entering the seas each year.

Sedimentation

Sedimentation occurs when rivers, rain and resulting stormwater wash soil and other particles into the ocean. These particles eventually settle to form layers, or ***sediments***. The particles in the water cause cloudiness or 'turbidity'. This can block out light in the water, which may affect marine plants and other organisms. Marine animals that filter feed by straining out food particles from water can become 'clogged up' by sediment, which can cause problems with both breathing and feeding. Many young marine plants and animals attach themselves to hard surfaces like reefs to grow into adults. A thick layer of sediment may make it difficult for them to attach and grow. Sedimentation can become a serious problem when land has been cleared for farming or through logging. See Case study 'Seagrasses' on page 50 for more information.

Dredged material

When harbours and waterways are dredged, the materials that have been cleared away are simply dumped into the sea. Each year, dredges move over 200 million tonnes of material, which may contain high levels of harmful metals and chemicals. Dredging also creates sedimentation, which can be very damaging. Coral reefs can die if sediment blocks out light and smothers them.

Turtles are known to have suffered from getting trapped in or accidentally eating plastic.

Case Study:

Dirty plastics

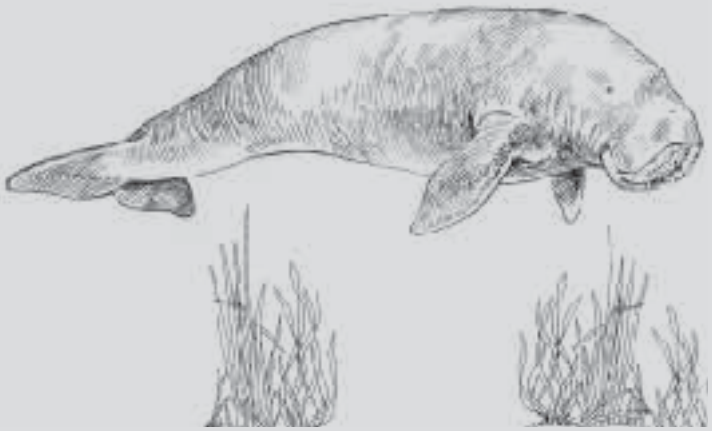
We use plastic every day, but plastics are very deadly in more ways than one. Plastic bags pose a great threat to marine life because they are non-biodegradable, taking between 300 and 400 years to break down. Throughout the world, plastic kills up to 1 million sea birds, 100,000 sea mammals and countless fish every year. According to Greenpeace, at least 267 species of marine animals – including seabirds, turtles, seals, sea lions, whales and fish – are known to have suffered from getting trapped in or accidentally eating plastic.

Many marine animals, including fish, birds, whales, seals and turtles, often mistake plastic bags as jellyfish and eat them thinking they are food, eventually dying from intestinal blockages. To make matters worse, when the animal that digested the plastic bag dies, the animal decays at a much faster rate than the bag. As a result, the bag is released back into the environment more or less intact and ready to be consumed by another animal.

Case Study:

Seagrasses: An important feature of the marine environment

Seagrasses are a very important feature of the environment. They keep the water clean and healthy, they recycle nutrients, and they provide shelter for marine animals and food for fish. Seagrasses also look after many diverse and very small organisms called epiphytes (plants) and epifauna (animals), which live and graze on the leaves, stems and root systems of the seagrass.



Seagrass acts in the same way as trees do to prevent land-based erosion. Tree roots hold soil together, and the roots of the seagrass hold sand together helping to reduce the movement of sand. Seagrasses also form an important nursery area where many species of commercially important fish can spend time growing before they move to the open ocean to live.

Dugongs rely on seagrass environments. Their breeding is very sensitive to the availability of seagrass food. When dugongs do not have enough to eat they delay breeding, which is a concern because they already have low breeding rates. A slight decrease in adult numbers can cause a serious decline in the whole population. Across the world, the dugong is listed as an animal which is vulnerable to extinction.

The two main threats to seagrass survival are:

1. **Increased nutrient levels** – The marine environment generally has very low levels of nutrients in the water. Therefore seagrasses have adapted to living in such an environment and are sensitive to any increase in nutrient levels. Pollution of coastal waters from stormwater run-off, sewage discharge and oil spills put the habitats of seagrass communities at risk.
2. **Sedimentation** - Sediments usually come from agricultural activities when soil flows into the river after a big rain. These sediments in the water also reduce the ability of sunlight to reach the seagrass, and seagrass needs sunlight to grow.

All rivers eventually flow into the ocean, taking care of them will help reduce marine pollution.

Searching for answers

(Option 1): Story of a river

Suggested timing:
45 minutes

Subject areas:
Language Studies, Health, Science, Social Science

Glossary words:
algal blooms, fertilisers, organisms, pollution, toxic, urban

Materials:

- small empty bottles no more than 600 millilitres capacity
- a transparent (see through) container or bowl (more than 2 litre capacity)
- 1 bottle of cola (full) or cold black coffee
- a cup of milk (or enough milk powder to make a cup of milk)
- extra coffee or tea
- cup of green cordial or juice
- a cup of yellow cordial or juice
- a bar of soap or some dishwashing detergent or washing powder
- scrap paper.

Activity summary:

In this activity, students will hear a story and see a demonstration that will encourage them to consider the sources and causes of ***pollution*** in the ocean. Students will then consider the role that they play in causing pollution.

Outcomes:

Students will be able to:

- recognise that human activities can affect water quality in rivers and oceans.

Procedure:

1. Read the following story and present the accompanying demonstration to the class. This will help students to understand the sources and effects of pollution.

2. Before you begin reading the story, prepare the following substances in the empty bottles:

   - Mix some coffee or tea with the milk to represent mud.
   - Put the soap into a bottle and pour in some water. Shake the bottle and then leave to mix. This bottle represents detergents.
   - In a third bottle, mix green cordial with water to represent pesticides. If you are using juice rather than cordial there is no need to mix it with water, you can use it in its original bottle.
   - In another bottle, mix yellow cordial with water to represent waste water. If you are using juice there is no need to mix it with water, you can use it in its original bottle.
   - Fill the last bottle with cola or black coffee to represent oil or fuel.
   - Prepare the larger transparent container by filling it with clean water.

3. Ask students to close their eyes and think about a healthy river in the forest or mountains. Read the beginning of the story of a river:

Imagine the gathering clouds rolling in from the sea and dropping their rain onto the mountain tops. The water forms tiny streams, which flow in to other streams, and then others, gradually getting larger all the time. Soon a river is born – your river.

Imagine what your river is like, healthy and untouched in the forest. Put your toes into your river. What does the water feel like as it flows past? Is it cold? Take a deep breath and smell the air. What does your river smell like? Is it fresh? Now dive into the water! Open your eyes and look around you. What do you see? What animals and plants can you see?

Allow one or two minutes for students to continue their imagination. Ask students to open their eyes and share a few of the things that they saw in their river. How did it make them feel?

4. Show students the container of water and explain how it represents the clear healthy water from their river. Ask the following questions:

   - Would you like to drink from this river?
   - Would you like to catch and eat fish from this river?
   - Would you like to sit down beside this river with your family to enjoy a picnic?

5. Read aloud the next section of the story:

Your river starts to flow down the hills on its long journey to the sea. It passes by a place where a logging company has been working. The trees have been cut down and taken away to a timber mill to be made into paper. The logging company has cleared a large area of land, but has not started ***replanting****. The soil is left exposed. What will happen when heavy rain falls on the hillside?*

Choose a volunteer from the class and ask them to play the role of Mr Watson, the Logger. Explain that Mr Watson, the Logger is the manager of the logging company. He has not been very responsible in the management of his logging operation. Ask Mr Watson to add half a bottle of muddy water to the river. Explain that this represents the pollution caused by mud and soil running into the river. 'Mr Watson' then returns to his seat.

6. Read aloud the next section of the story:

Your river continues on its winding journey. Not far from the logged area, your river drops into a broad flood plain and is surrounded by many types of agriculture. Gardens line the banks in many places and people are working on the various crops, making sure they will produce a good ***yield****. Chemicals are being added to the crops to help the plants grow. When it rains, the water washes over the soil and plants. The chemicals are washed into your river. What types of chemicals have been added to the crops that could pollute your river?*

Encourage students to identify pesticides, weed killers and ***fertilisers*** as potential sources of pollution. Choose a volunteer from the class to play the role of Ms Gina, the Farmer. Explain that Ms Gina, the Farmer has been using large amounts of toxic fertilisers and pesticides on her crops, and not disposing of them properly. Ask Ms Gina to add half a bottle of green liquid (representing pesticides) to the river. Tell her to be careful, because the liquid is extremely toxic. 'Ms Gina' then returns to her seat.

7. Read aloud the next section of the story:

Now your river passes by a village. There are houses along the banks of the river and people are going about their daily business: washing, cooking, and taking care of animals and gardens. The pigpens are on the edge of the village and sit on the very edge of your river, which flows beneath them.

Ask the students what types of pollution they might expect to come from the village. Highlight rubbish (e.g. plastics), sewage, detergents, wastewater and animal waste as potential pollutants. Choose a student from the class to play the role of 'Ms Siwa, the Villager'.

Explain that Ms Siwa has not looked after her pigs responsibly and has allowed water from the pigpens to run into the river. Ms Siwa's toilet is also right on the river bank. Ask Ms Siwa to add half a bottle of yellow liquid to the river. This represents waste from the pigs and human waste seeping from the toilet. Tell her to block her nose because the liquid smells bad. 'Ms Siwa' then returns to her seat. Now explain that everyone in the village also contributes to pollution because rubbish and litter have not been disposed of properly. Ask every student in the class to tear off a small piece of the scrap paper and place it into the river.

8. Read aloud the next section of the story:

Now on flat land, your river moves into a more developed town. A large bridge crosses your river and buses, cars and trucks travel along its banks. Many people live in this town. The people have built new houses, opened shops and restaurants and established markets. Factories manufacture goods and supply services to meet the growing needs of the town. No one seems to pay much attention to your river. What types of pollution could be introduced to your river from ***urban*** *development?*

Encourage the students to discuss the various forms of river pollution such as factory waste, sewage, rubbish, and oil from vehicles. Choose a volunteer from the audience and ask them to play the role of 'Mr Fremie, the Factory Manager'. Explain that Mr Fremie has not managed his factory responsibly and has been releasing waste products into your river. Ask him to add half a bottle of black liquid to the river. The liquid represents urban wastes such as those from factories. 'Mr Fremie' then returns to his seat.

9. Read aloud the final part of the story:

Put your toes into your river. What does the water feel like as it flows past? Is it cold? Take a deep breath and smell the air. What does your river smell like? Does it smell bad? Now dive into the water! Open your eyes and look around you. What do you see? What animals and plants can you see?

Your river now flows out into the sea. The substances in the muddied waters tell their own story. The water spreads out and moves across fringing coral reefs where many types of fish, crabs, shellfish, corals, starfish and sea turtles live. The pesticides in the river flow into the sea and the soap can create ***algal blooms*** *that result in a disruption in the food chain. The water's surface is covered with algae.Some* ***organisms*** *that live beneath the algae depend on sunlight to make their food. They are dying slowly. The water on the coastline near the mouth of the river is muddy from the mud and soil in the river. There are no more colourful coral and very few small fish can be seen.*

Look along the coastline. What do you see? Is the ocean clear? What can you smell? How do you feel about what you see? Would you want to be a fish right now swimming in that water?

10. Ask students to close their eyes and return to their vision of the healthy river from the beginning of the story.

11. When you have finished the demonstration hold a discussion with your class using the questions below. You might also like to encourage your students to write responses down in their exercise books.
    - Is this story realistic? Why?
    - Who do you think is to blame for causing the pollution in the river and the sea?
    - Did this story teach you anything new about the causes of marine pollution?
12. Conclude this activity by conducting a thinking exercise. Students should work in small groups or pairs and consider the following question:

    'Who is responsible for fixing the problems in the river and in the sea?'
13. Encourage students to share their ideas with the rest of the class.

Assessment ideas:

Students' ability to respond to questions posed at the end of the story (either verbally or in writing) can be used as the assessment.

- unsatisfactory – the student cannot adequately answer the questions
- satisfactory – the student is able to address each question to a satisfactory level
- excellent – the student is able to fully address the questions and provide in-depth answers.

Conducting a survey of your area can help to identify the sources of local marine pollution.

Searching for answers

(Option 2): Pollution survey

Suggested timing:
90 minutes

Subject areas:
Language Studies, Health, Science, Social Science

Glossary words:
pollution, survey

Materials:

- paper or exercise books
- pen or pencil
- clipboard or something sturdy for students to lean on while writing.

Activity summary:

In this activity students will search for the many different types of ***pollution*** that exist in their local environment. This will increase their understanding of the many forms of pollution and where they come from.

Outcomes:

Students will be able to:

- identify types and sources of marine pollution and their impacts on the environment

Procedure:

1. Find a location near the school where you can take the class to conduct a pollution ***survey***.
2. Choose a place where students can walk for about 100 metres. Make sure the location is safe, and supervise students closely. The bank of a creek, a drain or along the beach would be ideal.
3. Before going out of the classroom to conduct the survey, ask your students to draw the table below in their exercise books. They can use this as a survey sheet.

Pollution Survey			
Type of pollution	***See, hear or smell***	***Describe in detail***	***Where does it come from?***

4. Out at the survey site, ask the students to walk through the chosen location (as individuals, pair or small groups). Tell the students to take notice of their surroundings, not only with their eyes, but with their ears and noses as well.
5. Using their survey sheet, students should list all the types of pollution that they can see, hear and smell.
6. The students should also write down a description of the pollution, including its colour and smell. They should also record where they think the pollution came from.
7. Return to the classroom after 10 to 15 minutes and discuss the findings. Then ask each student to make a table in their notebooks (see below) to examine the causes and effects of the pollution they have observed.

Pollution Survey			
Pollution	***Causes***	***Effects***	***Actions***
Describe the pollution, e.g. plastic bag	Where did it come from and why was it created?	How could it be harmful to plants, animals or humans?	What can we do to reduce this problem?

8. Ask the class to consider what actions they could take to reduce the problem of pollution, and have students add these to their table.
9. Reflect on the actions that students identified in the tables they created. Use these ideas to launch into one of the Trying Solutions activities in this module.

Assessment ideas:

The table created by the students in step 7 should be used as a means of assessment.

- unsatisfactory –the student cannot identify causes and effects of pollution or suggest actions to reduce pollution
- satisfactory – the student can identify causes and effects of pollution and suggest actions to reduce pollution
- excellent – the student clearly explains the causes or effects of pollution and suggests realistic and effective actions to reduce pollution.

Teacher's fact sheet:

What can you do to reduce marine pollution?

Marine ***pollution*** can be reduced significantly if everyone takes responsibility for their own actions, and protects the marine environment. There's plenty you can do, either on your own or in a group, to make a huge difference.

Clean up day

Picking up rubbish is an easy way to help reduce pollution on our beaches and in the ocean. You can pick up rubbish by yourself or in groups. Collecting information about the rubbish that you find records the kinds of rubbish being left behind and can also be helpful in finding out where it is coming from. This information can help find ways to reduce rubbish at the source. To find out more about holding your own clean-up go to Trying solutions: Clean up day, on page 59.

Reduce rubbish, pesticides and fertilizers

Studies have shown that about 80% of marine pollution comes from the land. So, one of the main ways to reduce marine pollution is to get rid of rubbish thoughtfully. If we reduce the amount of rubbish we produce and the amount of pesticides and fertilisers we use, less pollutants can make it into the ocean.

Every person can reduce their rubbish at home and at school by recycling and reusing paper, glass, cans and some plastic containers. Individuals can also add food scraps to compost in their garden. A good way to start is by taking your own reuseable bags to the store or market instead of getting plastic bags. Ask your students to make a personal commitment to doing these things. It will be a more powerful commitment if they write it down and display it in the classroom.

Put it in the bin

One way rubbish gets into our oceans is through stormwater drains. These drains collect and remove the rainwater from our streets. Almost anything can be carried away by the rainwater as it travels across roads and down gutters – cigarette butts, oil from cars and other bits of rubbish can all end up in stormwater drains. The drains then carry this rubbish to our rivers. The rivers can then carry the rubbish out to the sea. You can keep rubbish out of stormwater drains by putting your rubbish in the bin. If there is less rubbish on the street or schoolyard there is less chance it will be washed into the sea.

Take care of your rivers

All streams and rivers eventually flow into the ocean, so taking care of them can help reduce marine pollution. This includes picking up rubbish, if it is safe to do so, and/or planting trees near the river. Plants on the banks of rivers help to hold riverbanks together, making them stronger, and stopping soil from being eroded, or washed away.

Be careful when fishing

When fishing, all lines, plastic and packaging materials must be disposed of correctly to avoid trapping birds and harming marine life. You can make a difference by picking up rubbish and making sure you take your own rubbish home with you.

Also, keep boats regularly serviced and maintained to avoid excessive ***pollutants***, ***emissions*** and oil leaks from old or damaged outboard motors.

What else can I do?

Other things that you can do as an individual to reduce marine pollution are:

- do not throw plastic bags into rivers and the ocean
- avoid using artificial pesticides and ***fertilisers*** that can run off into water systems and the ocean
- report any oil spills that you see to the appropriate authorities so that they can properly clean them up
- do not dispose of chemicals down the drain or into fresh water systems or the ocean
- buy products that have little packaging
- create a safe place for the collection of ***toxic*** wastes such as batteries for proper disposal later.

Project ideas

There are dozens of different types of projects that your students could do to help reduce marine pollution in their own community, whilst also addressing a local and national problem.

Some projects might focus on teaching others about environmental issues. Some might help to directly improve the environment, such as a clean up day.

The following are suggestions of projects that you can do as a class or group:

- Organise a clean up day, which would include a clean up of the river and the coast.
- Hold a poster/poetry/essay/song writing competition with a theme that focuses on protecting marine environments.
- Give talks on the importance of keeping marine environments healthy, or invite an expert to give a talk.
- Start an environment ambassador's scheme, where students are chosen to be environment ambassadors and take charge of protecting the marine environment.
- Provide proper rubbish bins for your school or community.

The following steps will help you and your students to plan your own action project.

- Choose a topic for your project to focus on by collecting information from newspapers or other media, interviewing community members and parents, or contacting organisations and government agencies.
- Identify the goals and specific objectives of your action project and how you are going to achieve them.
- When would you like the project to start and to finish?
- Make a list of the tasks that need to be accomplished to meet each ***objective***. Think about completion dates, who will be responsible for each task and what equipment is needed.
- Identify people with specific skills or expertise who may be able to help.
- List ways to promote the project and generate support for it.
- Identify ways to assess the success of your project.

For more details about organising an action project take a look at 'Guidelines for establishing a climate action group' on page 99. These guidelines can be used to help you organise any kind of action project.

Rubbish, if not disposed of correctly ends up in the ocean and can also come back to shore, polluting beaches and other coastal habitats.

Trying solutions

(Option 1): Clean up day

Suggested timing:
4 hours

Subject areas:
Language Studies, Health, Science, Social Science

Glossary words:
pollution, recycled, urban

Materials:

- materials for promotional posters, such as pens, markers, paint, flip-chart paper, cardboard
- rubbish collection equipment, such as cartons, boxes, rice sacks, plastic bags
- rake or shovel (optional).

Activity summary:

Students organise and take part in a clean up day in their local area. Students will learn first-hand about the effects of ***pollution*** on marine environments and learn to take some responsibility for the waste they produce at home, at school and when shopping. You can conduct the clean up day around your school, your community or along a nearby beach.

Outcomes:

Students will be able to:

- identify types and sources of marine pollution and their impacts on the environment.

Procedure:

1. As a class, select a place that needs cleaning up. You could choose a beach near your school or community or perhaps a river or drain that may eventually run into the ocean. Drains and rivers near your community collect a great deal of litter that will be carried into the ocean.

2. Conduct a site visit to check for any potential dangers, such as dangerous animals, tidal variations, steep slopes, dangerous waste, building materials or objects. When planning the event, you should take all reasonable steps to consider the safety of students and volunteers by avoiding any safety risks in the area.

3. Once you are sure that your site is appropriate and safe, start to promote the event. This could include:

   - students making posters to be displayed in public places around your community
   - students producing leaflets and banners for distribution around your community
   - organising an environmental display at your local market by setting up a table with promotional material where people can find out more and ask questions
   - asking well-known local people, such as Chiefs, church leaders or Elders for their support. Try to get the community involved. For example, you could invite members of students' families or church groups to come along. The more people you have, the easier the clean-up is going to be.

4. Hold a class discussion about the plans for the event, such as how you will organise the tasks and address any safety issues. It is important that students know what is happening, as the students will need to direct and organise the community members who are helping on the day.

5. Use the event to raise community awareness. Invite the local media to report on the day or make your own posters advertising the event. Students could also write a school newsletter about it. This is a great way to promote your activities, your school and caring for the environment to the wider community.

6. On the clean up day, people will need to be organised into groups. Have groups of four or five community members work with a group of two or three students. Spread the groups out so that each has its own area to collect litter in.

7. Each group should be given a bag or a box to collect the waste. Many community stores have cardboard boxes or cartons that could be used, or you could use old rice sacks or large plastic garbage bags. Volunteers can be encouraged to bring along other collection equipment, such as buckets, rakes, shovels and gloves.

8. Collect the litter, separate what can be ***recycled*** or reused, and dispose of the remaining waste in a responsible way. If you are in an ***urban*** area with a rubbish collection service, put it out for collection. If you are in a rural area, you will need to dig a deep hole and bury the rubbish in an unused area away from creeks or drinking water supplies. Do not leave the hole open, as animals and the wind will carry the rubbish back out and you will have another litter problem to clean up!

Only separate out the recyclables if you can do something with them in your local area. Items that are potentially recyclable include:

- glass
- plastic
- paper and cardboard
- aluminium and steel cans
- metal
- car tyres, batteries and engine oil.

9. After the clean up day, thank the community by giving appropriate gifts from your area or holding a picnic lunch at the school.
10. Now that your community has been 'cleaned up', develop a waste reduction plan with your students to identify ways they can reduce, reuse or recycle waste and put these ideas into action so that you can maintain your clean community. Make a commitment to conduct regular clean up days.

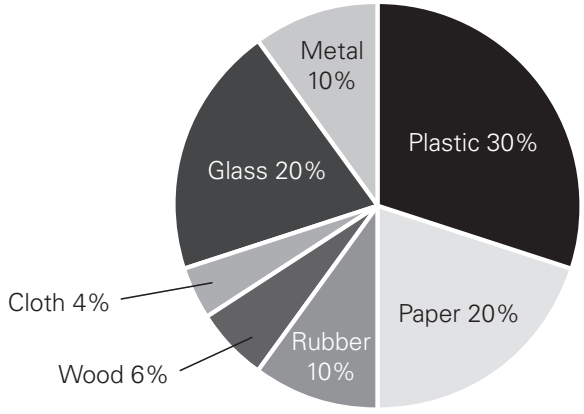
Assessment ideas:

There is no direct assessment for this activity.

Extension:

If you would like to include a Maths focused learning session in this activity, ask your students to record the types of rubbish that have been collected. This can be done by each individual group at the end of the clean-up day.

1. Students can sort the rubbish (or a representative sample of the rubbish) that their clean-up group collected into the following categories:
   - plastic
   - glass
   - metal
   - rubber
   - paper
   - wood
   - cloth
   - green waste (food and garden scraps)
   - other (anything collected that does not fit into another category).
2. Students can either weigh the rubbish from each category or count the number of items in each category.
3. Record the numbers on a data sheet.
4. Once the information has been recorded, dispose of the rubbish in a responsible way (see details on Page 60).
5. Back in the classroom, have each group of students summarise their results using graphs such as pie graphs, line graphs and or bar graphs.



6. Have each group share their results in a presentation with the class.
7. After the presentations, discuss the following with the students:
   - How can the information they collected be used to reduce marine pollution?
   - Where is the rubbish coming from? Do certain items indicate specific sources of rubbish? (For example, packaging of food from a local store).
   - Which items of rubbish are the most dangerous to marine wildlife?
   - How does it make them feel to see the rubbish along the beach?
   - How does it make them feel to see the beach clean after their work?
   - What can each of us do to minimise the problem of ocean pollution?

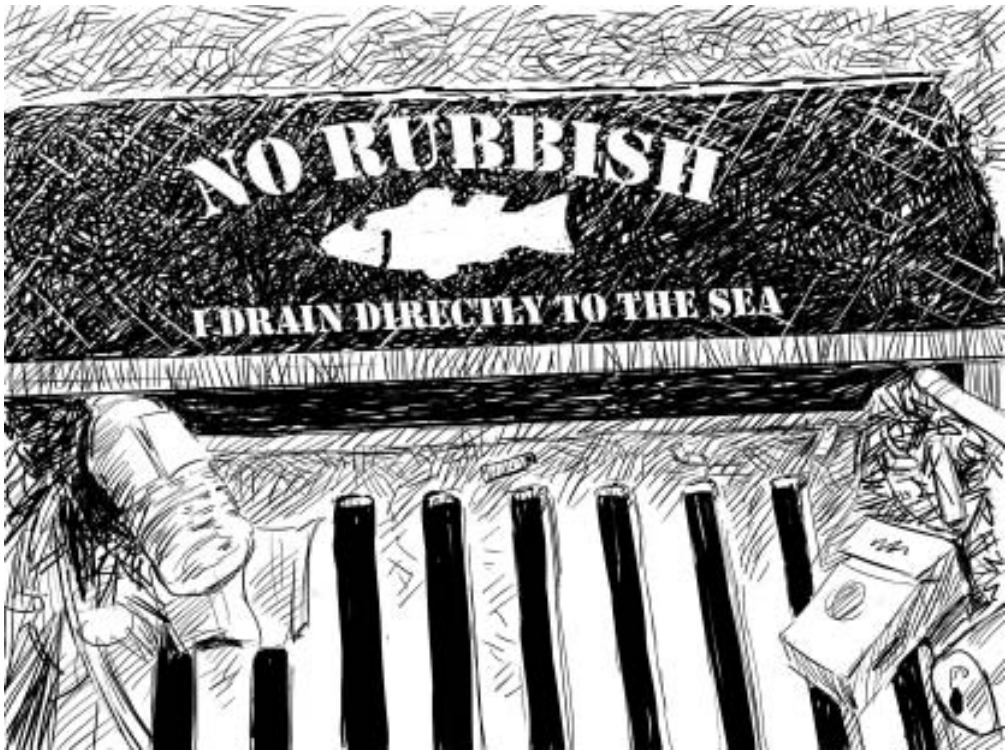
Alternatively, students could respond to the questions in their exercise books.

Assessment ideas:

The graphs produced by students to summarise their results could be used as a means of assessment.

The students' ability to respond to the questions posed either verbally or in writing could be used as a means of assessment.

- unsatisfactory – the student cannot adequately answer the questions
- satisfactory – the student is able to address each question on a satisfactory level
- excellent – the student is able to fully address the questions and provide in-depth answers.



Water in urban drains eventually empties into the sea, carrying rubbish with it.

Trying solutions

(Option 2): Litter education

When it rains, the water flows along the streets and down drains. But where does it go next? Many people in ***urban*** communities are not aware that the water in the drains travels underground in pipes and eventually empties into the ocean. This is a major problem when litter and other rubbish is dropped in the streets or just left lying around. The rain carries the litter into drains, and it ends up in the ocean.

People in rural areas also have problems with litter. Many people leave wrappers or plastic bags on the ground. Wind and rain carry the litter away. But where does it go? Our litter does not just disappear; it gets blown or washed into our rivers and the ocean.

All people, urban and rural, need to be educated about littering and the effect that it can have on our marine environment. On the following pages are two projects you can do. Choose the one that is most suitable to your area.

Alternative 1:

Drain Stencilling

Subject areas:

Language Studies, Health, Science, Social Science, Art

Glossary words:

pollution

Materials:

- poster paper/thin cardboard
- razor blades or a craft knife (take care when using a sharp instrument)
- masking tape
- sheets of newspaper
- spray paint or concrete paint
- paint brushes.

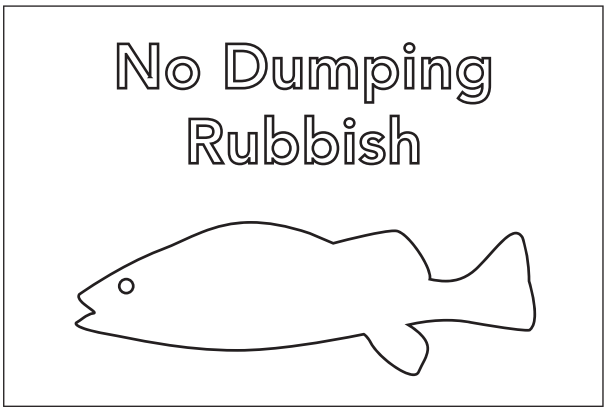
Activity summary:

Students stencil messages on concrete drain covers reminding people about the dangers of throwing their rubbish on the ground. Drain stencilling can be a very good way of educating people as they walk around the town or community. Contact your local council to ask permission to carry out drain stenciling.

Outcomes:

Students will be able to:

- understand that storm drains are connected to water systems and can be a significant source of marine ***pollution***
- plan and participate in an activity to teach others in their community about the connection between storm drains and ocean pollution.



Procedure:

1. First you need to identify a number of drains that you will paint a stencil on. Try to choose drains that are close to your school, easy to access and familiar to your students. You may need to gain permission from your local council before you paint any drains.
2. As a class, think of some short, catchy messages that tell people not to throw rubbish on the ground because it will wash into the drain and, from there, be carried into the sea. Make the slogans in your local language or pidgin so they are can be read by people whose English is not very good. Try to think of a simple picture or symbol, too.
3. Draw your slogan onto the cardboard in thick lettering, for example:

   ALL DRAINS LEAD TO THE SEA

4. Help students cut around the letters to create a stencil. Cut out symbols, such as a fish shape or a drink bottle. Be careful when using the blade or knife.
5. Once your stencils are ready, take your class out to the drains you have chosen. Encourage students as they are walking through the school yard or community to look around for any materials that could cause problems if they made it into the drains, or any behaviours that may cause a problem, such as cars being washed in the street or people rinsing out paint brushes into the gutters.
6. Firstly, brush or wipe the surface of the drain covers clean. This will help the stencil to lie flat and for the paint to stay even.
7. Lay each stencil very flat on the drain cover. You may need to hold it down with some rocks or use masking tape. Position the stencil on the drain where the message will be most visible. Make sure the stencil is not upside down.

8. Very evenly and smoothly, spray paint over the stencil. Be careful not to go over the edges of the cardboard. If you think this may be difficult, surround the stencil with sheets of newspaper. When you have applied the paint, remove the stencil carefully so you can use it again on another drain.
9. Alternatively, you could paint the stencil using a brush. Rather than brushing, try to dab the paint on; this will prevent you from using too much paint and will ensure the stencil stays clear. The stencil will need to be left in place until the paint has dried.
10. When you are back in the classroom, ask students to share anything that they saw while out (behaviour or materials) that could cause a problem for the drains. Make a list on the blackboard.
11. Lead a discussion with students about the things they saw and ways that these behaviours or problem materials can be reduced in your community.
12. You might like to extend this activity by having students talk to members of the community about the drain stencilling activities they have undertaken and how the community can help to prevent pollution reaching rivers or oceans.

Assessment ideas:

There is no direct assessment for this activity.

Drain stenciling is an effective way of educating people as they walk around a town.

Alternative 2:

Wall mural

Subject areas:

Language Studies, Health, Science, Social Science, Art

Glossary words:

urban

Materials:

- exterior paints in various colours
- chalk
- spray can of clear sealer (if available).

Activity summary:

Students create a mural to deliver a message about protecting marine environments.

Background information:

A mural is an artwork painted on a permanent surface, such as a wall, a fence, or even a structure, such as a rainwater tank. Murals are usually painted in a prominent position where they can be viewed by the public. Murals are big and colourful – the bigger and the more colourful the better.

Murals can be made in urban or rural areas. Rural areas do not have concrete drains to use as a place to display our message, but there may be other places that can be used to inform your community about the problems of littering. This task creates a mural on a wall in a prominent position in your community. First, you will need to get permission from the owner of the wall.

Procedure:

1. Decide on a mural theme. This will take a lot of discussion and sharing of ideas. Students should discuss ideas for the mural picture as well as the message they would like to communicate. Students can work as a whole class or in small groups. Themes could include a healthy coral reef, scene showing drains or rivers running into the sea, good or bad actions in relation to causing pollution, students cleaning up a beach.

2. Think of a short, catchy message about littering to include in your mural design. Write the slogan in your local language or pidgin so it is easily read even by people whose English is not very good.

3. On a large piece of paper, design a relevant picture to go with your slogan.

4. Draw an even grid over your design. Draw another grid, with the same number of squares, onto your mural wall. This will help you to copy the picture onto the wall surface at a larger size.

5. Draw the mural on the wall in pencil or chalk first. This outline can now be painted and filled in like images in a giant colouring book.

6. The painting will run more smoothly if you organise your students into small groups or set up a painting schedule. Divide the mural into small sections and give students specific directions.

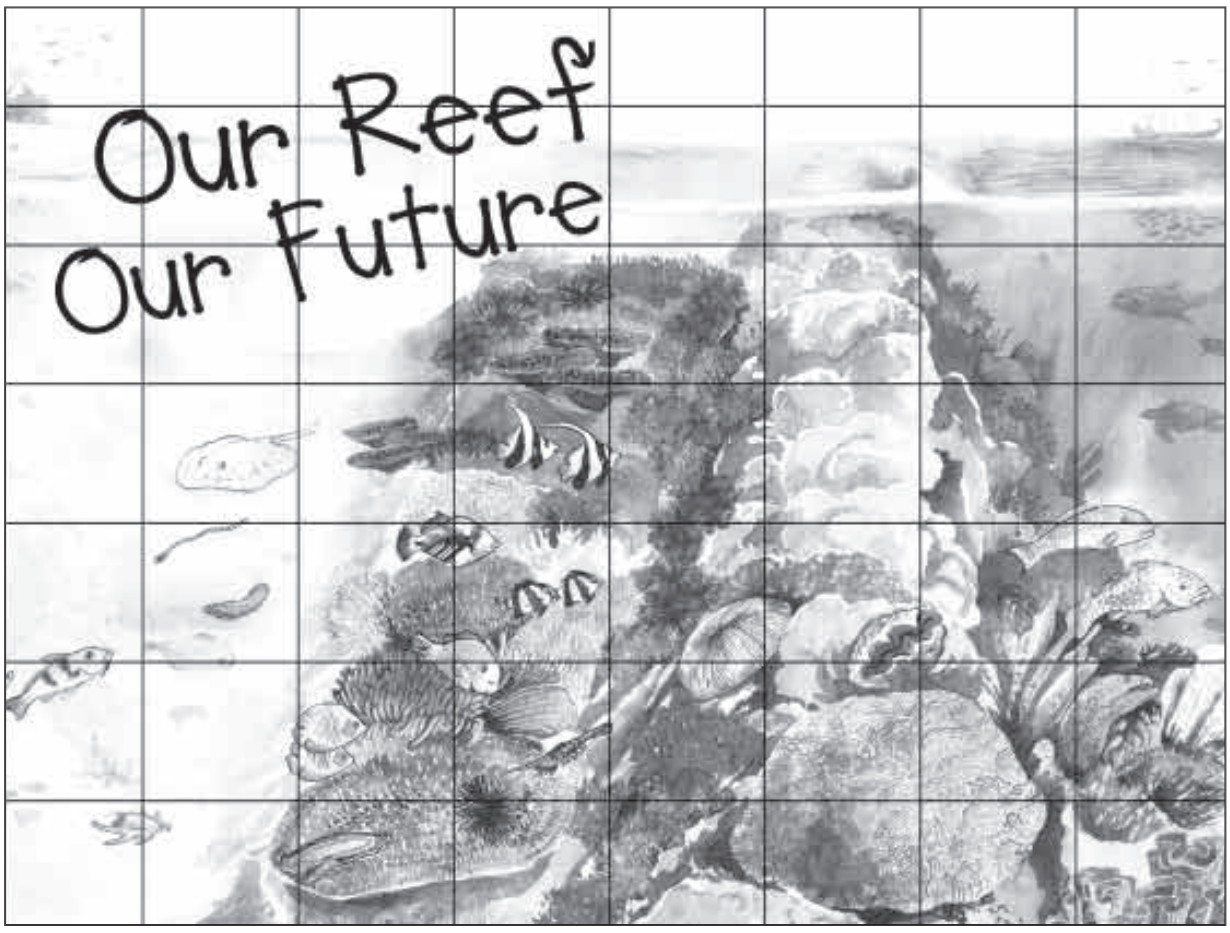
7. Paint your mural and slogan neatly and clearly on the wall. Encourage students to paint in smooth, even strokes. If the paint is too thick or lumpy it can cause peeling later on. To keep paint from mixing, avoid painting one section until the section next to it is properly dry.

8. If available, spray the finished mural with clear sealer once the paint is dry. This will help protect the picture from fading and peeling in the weather.

9. Hold an 'unveiling' or 'opening' event for the mural and invite the local community, community leaders and media. You could launch the mural with speeches about littering, perform a play or conduct a clean-up of the local area.

Assessment ideas:

There is no direct assessment for this activity.



Draw a grid over your rough illustration on paper. This will help you copy the image onto the wall in the correct proportions.

Reduce your rubbish at home and at school by recycling paper, glass, cans and some plastic containers.

Student reflection

What can I do?

Suggested timing:
45 minutes

Subject areas:
Language Studies, Science, Social Science

Glossary words:
contaminate, emissions, pollutants, pollution, recycle

Materials:
- paper or exercise book
- pen or pencil
- blackboard.

Activity summary:

Through a short writing activity, students are encouraged to consider the role they play in creating marine ***pollution*** and the actions they can take to help prevent it from occurring.

Outcomes:

Students will be able to:

- consider the role they play in creating marine pollution
- propose solutions to marine pollution in their community
- set up an action project that will help solve the problem of marine pollution.

Procedure:

1. Write the following question on the blackboard:

'What role do I play in creating marine pollution?'

2. Give your students time to consider the question. Allow them to discuss their response with other students in small groups.

3. Ask your students to then write a response to the question in their exercise books. Invite students to share their responses with the rest of the class. Now write the following question on the blackboard:

'What can I do as an individual to stop or reduce some of the pollution I see around me?'

4. Again, give your students time to consider and discuss their thoughts about this question. Once they are ready, ask them to write a response in their exercise books. Invite students to share their ideas with the rest of the class. You could make a list of different ideas on the blackboard.

Ideas could include:

- Reduce your rubbish at home and at school by recycling paper, glass, cans and some plastic containers. You could also compost food scraps and find other ways to reuse some of your rubbish.
- Always put your rubbish into bins. Do not drop litter in the street or throw it from the windows of cars or buses.
- Make sure your rubbish bin is securely closed so that nothing can be blown out by the wind or spilled out by animals.
- Never put oil or chemicals down the drain, as these will not only ***contaminate*** the drain but will make their way down rivers and into the sea.
- Do not wash your cars on the road or on driveways, as the soap and waste from the water flow straight into the stormwater drain. Wash your car in your yard instead.
- If you are fishing or travelling by boat bring all of your waste back with you and dispose of it thoughtfully on land.
- Be careful when fishing, as all lines, plastic and packaging materials can be dangerous to wildlife.

- Regularly service boats to avoid excessive ***pollutants***, ***emissions*** and oil leaks.
- Take your waste items home from the beach with you.
- If you live on the coast, get involved in a beach clean up.

These ideas could be the inspiration for you to design a further action project for your class. Here are some ideas.

Test your local water

Water testing can be the first step towards discovering local water problems and helping to solve them. For more information about this activity contact the Live & Learn Environmental Education Office in your country.

Do a school/home waste audit

Finding out what sort of waste your school or home throws away can help you to develop a plan to reduce and recycle waste.

Design and sell reusable shopping bags

If you bring your own bag when you go shopping you will reduce the amount of waste you produce. Encourage the use of reusable bags by designing and selling them to parents, neighbours and other members of the community.

Participate in a coastal clean up

Students can take part in a beach clean up and learn first-hand about the coastal environment and how people affect it. See activity 'Trying solutions: Clean up day' on page 59 for details.

Start a compost system

This is an easy way to turn certain wastes into products that are useful for gardening.

Assessment ideas:

Use this activity as a summary activity. No separate assessment is needed, although student responses to the questions posed in this activity can be assessed.

Getting community members involved in making reusable shopping bags will encourage more people to use them.

3 Climate change

The marine environment is already showing the signs of the impacts of climate change. The increase in global temperature over the last two hundred years is disrupting life in the oceans, from the tropics to the poles.

Global sea level rise will have a a serious impact on marine ecosystems and coastal environments.

Module introduction

This module introduces the topic ***climate change***. In order to understand this term, we need to understand how ***climate*** is different to weather, how Earth naturally controls its climate and why Earth's climate is changing. Earth is the only planet in our solar system with air to breathe, liquid water to drink and temperatures that are just right for life as we know it. Our existence depends on our planet and its climate, so we need to understand how our actions affect Earth.

Climate versus weather

The term 'weather' refers to the daily changes in temperature, wind and rainfall of an area. The weather may be sunny today and rainy tomorrow. Climate refers to the average type of weather in a place over many years. While the weather can change in just a few hours, climate takes hundreds, thousands or even millions of years to change. Different regions of the world have different climatic conditions, or weather patterns. Tropical countries generally have a warm climate with a dry and a wet season.

How does Earth naturally control its climate?

Our planet is constantly changing, but Earth has a way of balancing and controlling the climate. Many different things help to control the climate of our planet. One of the most important is Earth's ***atmosphere***.

Earth's atmosphere is like a big blanket that is wrapped around the planet, keeping us warm. Without its atmosphere, Earth's temperature would be much colder and everything would freeze.

Earth's atmosphere traps energy in the same way that a greenhouse does. Greenhouses are made of glass and are designed to hold heat inside. Similarly, heat from the Sun is absorbed by a layer of gases in Earth's atmosphere, called ***greenhouse gases***. Greenhouse gases are made up of gases such as water vapour, methane, ozone, nitrous oxide and ***carbon dioxide (CO_2)***.

This system of absorbing heat is known as the greenhouse effect. The greenhouse effect warms the planet and allows humans, other animals and plants to live on Earth without freezing. Any change in the amount of greenhouse gases in the atmosphere will change the temperature on Earth.

Human activity and climate change

Throughout history, Earth's climate has changed many times. Earth has experienced very cold times, such as ice ages, and long warmer periods. These have all been caused by natural factors, such as volcanic eruptions that surround Earth in dust, which reflects the Sun's heat back into space. Most climate changes have occurred over hundreds, thousands or millions of years.

Natural causes, however, cannot explain all of the changes that have been observed over the last two hundred years. Human activities such as burning ***fossil fuels*** and clearing forests (***deforestation***) are releasing extra greenhouse gases, particularly carbon dioxide, methane and nitrous oxide, into the atmosphere. These gases increase Earth's natural greenhouse effect and make the world warmer. This problem is known as ***global warming***.

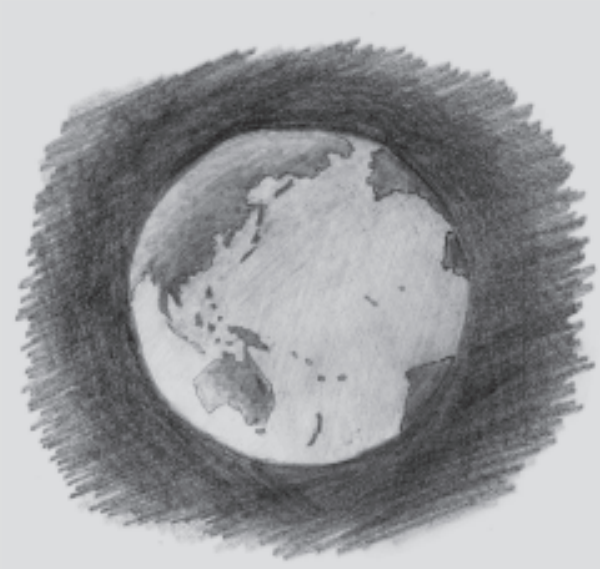
The impacts of climate change

The impacts of climate change are already being felt. The additional greenhouse gases being produced by human activities are resulting in warmer surface temperatures on Earth. These changes in surface temperature are causing climate change.

Across the world, scientists and communities are beginning to notice an increase in ocean temperatures, rising sea levels, extreme weather, such as cyclones, floods and bushfires, and changes in rainfall. It is believed that these impacts will continue and become worse in the future.

This module encourages students to use critical thinking skills to evaluate information and draw conclusions about the causes of climate change, the impacts it has on marine environments and actions that can be taken to help reduce climate change and learn to live with its impacts.

The module contains six activities and supporting information to assist the teacher:	
Tuning in:	Climate witness story
Searching for answers:	The greenhouse effect (Option 1) Collecting climate witness stories (Option 2) Beach watch (Option 3)
Trying solutions:	Carbon catchers
Student reflection:	Coral bleaching case study



Coral bleaching has been one of the most visually dramatic effects of climate change.

Tuning in

Climate witness story

Suggested timing:
45 minutes

Subject areas:
Language Studies, Health, Science, Social Science

Glossary words:
climate change, erosion

Materials:
- WWF climate witness story (see boxed text)
- paper or exercise book
- pen or Pencil
- blackboard.

Activity summary:

In this activity students read a climate witness story from Fiji (see boxed text). They are asked to think about the changes that Penina has noticed and the impacts these changes may have on people living in the Pacific in the future.

Outcomes:

Students will be able to:

- identify changes that are occurring in the Pacific due to ***climate change***.

Procedure:

1. Either make enough copies of the WWF climate witness story by Penina Moce for each pair of students to have a copy (see boxed text below), or read the story aloud to the whole class.

2. After reading Penina's story, ask students to answer the following questions:

   - Why do you think it is harder for Penina to find fish and shellfish than it was before?

- Why do you think the coral has changed from colourful to white? (*This is because the coral is suffering due to an increase in the water temperature. When corals are stressed or unhealthy they can lose their colour.*)
- What did Penina say was happening to the coastline?
- Have you noticed changes like this occurring in your own village or community?
- How do you think these changes could affect your life if they were happening in your community?

3. Ask the questions as a class discussion, or ask the students to write the answers in their exercise books and follow with a group discussion.

4. Encourage students to share their ideas with the rest of the class. Allow enough time so that everyone who wants to contribute has a chance to share their ideas.

5. Conclude this activity by explaining to students that the things that Penina Moce is seeing and has written about are very similar to what is happening in other Pacific Island countries. Many countries are noticing a reduction in the amount and size of fish and shellfish, loss of colour and other changes in the coral reefs surrounding their islands, and an increase in coastal ***erosion***. All of these impacts can be caused or increased by climate change. These changes will have a big impact on life in Pacific Islands in the future.

Assessment ideas:

This activity is intended to be used as an introductory activity. No separate assessment is needed, although student responses to the questions posed at step 2 of this activity can be assessed.

Case Study:

Climate Witness Story - Penina Moce, Fiji

Penina Moce, 43, is married and has five children. The family live in Udu on Kabara Island in Fiji. She was nominated as a WWF climate witness at a village meeting in October 2004.

We have begun to notice that the fish and shellfish we used to be able to gather so easily are getting harder to find.

There also used to be colourful, live coral from the edge of the beach out to the reef. But now everything has gone white.

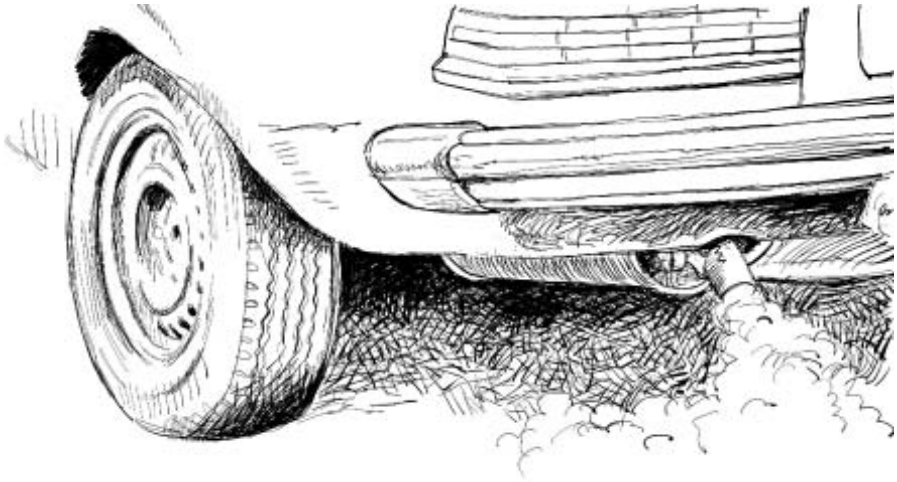
The sea is slowly eroding the coastline.

We used to catch enough fish in the shallows. But now we have to go further out, and the women are spending longer and longer in the seawater. Fish used to bite quickly – now we can spend more than an hour in the seawater before we get a single bite.

The fish are often tiny. Barely enough for a meal. One of our great delicacies, the gera shellfish, is now very difficult to find.

Another thing we've noticed is that the sea is slowly eroding our coastline and spreading the sand over our fishing grounds. The seagrass beds have also spread quickly, clogging up the natural flow of water within the fishing grounds and burying the coral.

http://www.panda.org/about_our_earth/aboutcc/problems/people_at_risk/personal_stories/witness_stories/?22344/Climate-Wtness-Penina-Moce-Fiji Climate Witness Story used with permission from WWF South Pacific. © April 2010 WWF (panda.org). Some rights reserved



When fossil fuels are burned as in a car engine they release their carbon back into the atmosphere.

Searching for answers

(Option 1): The greenhouse effect

Suggested timing:
90 minutes

Subject areas:
Language Studies, Science

Glossary words:
atmosphere, carbon dioxide (CO_2), climate change, emissions, fossil fuel, global warming, greenhouse effect, respiration

Materials:
- loose paper or pages in an exercise book
- pen or pencil
- copies of 'greenhouse effect' diagram (see below)
- coloured pencils (optional).

Activity summary:

Through a simple diagram and teacher-led explanation, students will learn about the ***greenhouse effect***, and how it contributes to ***global warming*** and ***climate change***. Students will then test their knowledge by answering short comprehension questions.

Outcomes:

Students will be able to:

- explain the greenhouse effect.
- explain how the greenhouse effect contributes to global warming and climate change.

Procedure:

1. Provide the students with copies of the 'greenhouse effect' diagram (see next page), or draw the diagram on the blackboard and ask the students to copy it into their exercise books.

2. Explain what is happening in the diagram, using the points below as a guide.

#1: Trees (or forests) are made up of plants that have 'woody' bodies. The wood is mostly made from carbon. When a tree breathes, it draws ***carbon dioxide (CO_2)*** into its leaves, and releases oxygen (O_2). The carbon dioxide is stored in the wood and underground in the roots. Each tree can store many tonnes of carbon dioxide, therefore a forest can store many thousands or millions of tonnes.

#2: Humans and animals breathe in oxygen (O_2), which is produced by plants, such as trees. When humans and animals breathe out, they release carbon dioxide (CO_2) into the air. The carbon dioxide is a by-product of our ***respiration***.

#3: In many Pacific Islands, vast areas of forests have been cut down. This happens because people want to sell the timber, or to clear the land to make way for agriculture or housing. When trees are cut down they release their carbon dioxide back into the air. This may happen slowly as the tree rots (decomposes), or rapidly if the trees are burned. When a forest is cut down the many thousands of tonnes of carbon dioxide that were stored in the trees are released back in to the air.

#4: Petrol-powered motors are used to drive trucks, cars and some boats. Petrol is made from oil, which is a ***fossil fuel***. Fossil fuels are actually the remains of forests that existed more than 300 million years ago, and were buried around the time of the dinosaurs. Like living trees, fossil fuels are made of carbon. When fossil fuels are burned, they release their carbon dioxide back into the air.

#5: Humans generate electricity by burning fossil fuels (coal, gas or oil) in power stations. Fossil fuels are burned to generate most of the electricity used in cities across the world. This process causes millions of tonnes of carbon dioxide to be released every day.

#6: Jet aircraft can fly at supersonic speeds at 10 kilometres above the ground. This takes a massive amount of power, which comes from jet fuel being burned by the aircraft's engines. This releases carbon dioxide high up in the ***atmosphere***.

#7: Earth has an atmosphere that covers it like a blanket. The Sun shines down onto the Earth. Some of the heat escapes, but some is trapped between the Earth and the atmosphere. The heat that is trapped is the right amount for people to live and plants to grow. Without Earth's atmosphere, all the heat would be lost and everything on Earth would freeze.

#8: The greenhouse gas ***emissions***, such as carbon dioxide, produced by the actions shown here (numbers 1–6) build up in the atmosphere and make the blanket thicker and thicker. This thick blanket stops heat from leaving Earth, causing it to become hotter and hotter. This is called global warming. The thick blanket of gases in the atmosphere is making Earth hotter. This is causing Earth's normal weather patterns to change.

These changes are called climate change.

3. Once you have completed this explanation, ask students to answer the comprehension questions (see page 80) in their exercise books to find out how much they understand about climate change. Give them enough time to think about their answers based on the information they have just heard. Alternatively, ask and answer the questions as a class. Write students' responses on the board and discuss their answers.

Greenhouse effect diagram

Comprehension questions:

- What is the layer of gases surrounding the Earth called?
- Without this layer of gases, what would most of Earth be like?
- What are fossil fuels? Give an example of how humans use fossil fuels.
- What are the two ways that trees release carbon dioxide back into the atmosphere when they are cut down?
- Recently, temperatures on Earth have been rising a lot faster than normal. Why is this?
- What is the name of the process of Earth getting hotter and hotter?

Assessment ideas:

The students' ability to respond to the comprehension questions either verbally or in writing should be used as a means of assessment.

- unsatisfactory – the student cannot adequately answer the questions
- satisfactory – the student is able to address each question on a satisfactory level
- excellent – the student is able to fully address the questions and provide in-depth answers.

Teacher's fact sheet:

Climate change cause and effect

Over the last 200 years, ***fossil fuels*** such as coal and oil have replaced fuels such as wood and steam as the main source of energy used in manufacturing, transport and agriculture. This massive increase in the use of fossil fuels and a rapid increase in human ***population*** has led to the development of many new and convienient technologies. However, it has also released enormous amounts of ***carbon dioxide (CO_2)*** and other ***greenhouse gases*** into the ***atmosphere***. Industrialised countries such as those in Western Europe, the United States of America, Canada, Australia and New Zealand are responsible for around 75% of the increase in greenhouse gases since the middle of the 1800s.

Clearing of forest, or ***deforestation***, also contributes to the release of carbon dioxide. Trees and plants are essential for a stable ***climate***. They help remove heat-trapping carbon dioxide from the air by storing it in their leaves, wood, roots and soil. But when trees and plants are disturbed, cleared or burnt, this stored carbon dioxide is released into the atmosphere, where it contributes to ***climate change***. In fact, deforestation and changes in land uses such as agriculture, open-cut mining and building of cities is thought to contribute between 15–20% of global carbon dioxide ***emissions***.

Deforestation is a problem in a number of Pacific nations, where many trees have been and continue to be cut down. The main reasons for deforestation in the Pacific are industrial logging to export timber and land clearing by local people to make room for gardens or houses.

Millions of tonnes of carbon dioxide to be released every day across the world when fossil fuels are burned to produce energy.

Sea Level rise will have a major impact on our lives in the Pacific.

According to the World Wide Fund for Nature South Pacific Programme, climate change will have the following impacts on our lives in the Pacific:

- Rising sea levels will cause flooding of coastal plains, leaving less land for us to use. Low lying atolls are especially at risk.
- There will be less fresh water available for our use due to an increase in the number of extreme weather events such as floods, droughts and cyclones, which threaten fresh water supplies.
- Agriculture will be affected. Coastal plains, where most of our agriculture is based, can become salty due to ***sea level rise*** and become less productive. An increase in cyclones, storm surges and land slides will damage crops and a warmer, wetter climate will encourage the breeding of pests.
- Marine environments will be affected. Increased ocean temperatures damage coral reefs and cause ***coral bleaching***. Coral bleaching is when the coral loses its colour and becomes white, and eventually dies. The colour in coral is caused by microscopic plants (algae) that live inside the bodies of the coral. These algae allow the coral to convert the Sun's energy into food. When the water becomes warmer the algae leave the coral host, turning it white and causing it to starve.
- Coral reefs are also threatened by ocean acidification, which means that sea water is becoming more acidic. Around 25 % of the extra carbon dioxide released by human activities is absorbed by the world's oceans. It then reacts with seawater to form carbonic acid. The extra carbonic acid reacts with coral, and stops the coral organisms from building a reef.
- Some migratory ***species***, such as tuna, may move to new areas where ocean conditions are more suited to their survival.
- There may be an increase in disease. Warmer, wetter conditions encourage the breeding of disease-carrying insects such as mosquitoes (which spread dengue fever and malaria) and water borne infections such as giardia.
- Tourism will be affected by the increase in natural disasters, loss of plant and animal species and increased occurrence of disease.

The island nations of the Pacific are among the lowest producers of greenhouse gases (less than 1% of global ***emissions***), but are amongst the most vulnerable to the problems caused by climate change and sea level rise. Many Pacific Islands are already experiencing climate-change-related impacts.

Why are Pacific Islands so vulnerable?

Climate change affects humans, plants and animals. The Pacific Islands have small, scattered land masses with relatively few ***resources*** such as coal, oil and precious minerals. They are mostly highly populated along the coasts.

For low-lying Pacific Islands and atolls, climate change is a major concern. As the sea level rises, people living along the coast have to ***adapt*** to be able to survive. Many communities along the coasts in countries such as Kiribati and Tuvalu have started building seawalls and setting up barriers to slow down the ***erosion*** of coastlines.

Rising sea levels also cause salt water to spread into fresh water resources and food gardens. This means that Pacific Island authorities must find alternative farming methods and water supplies for those people affected by sea level rise. These threats to farming may lead to issues with food supply for people in affected areas. Many fruit trees further inland are now flowering and bearing fruit later or earlier than usual, which also effects production of food.

Another issue for Pacific Island countries is the loss of ***biodiversity*** (native plants and animals). Plants and animals are adapted to certain and predictable climatic conditions. If these conditions rapidly change, many species will no longer survive.

For communities that are badly affected by sea level rise, relocation to other islands or to higher ground also means a loss of traditional ways of living and, to an extent, a loss of identity.

Read the following case studies collected by Live & Learn Environmental Education from the Solomon Islands to find out more about the impact climate change is having on people's lives in the Pacific.

Case Study:

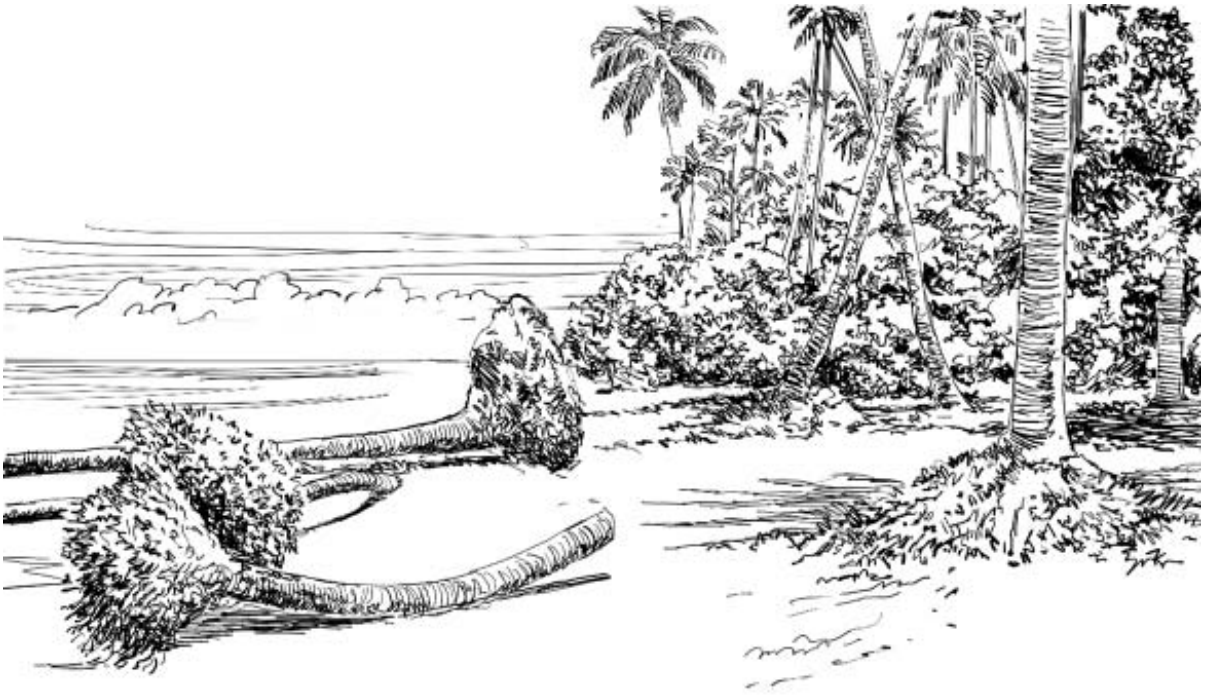
Mathias Sake – Maravagi Resort, Central Province

I come from Olevuga village, Sandfly Island, but I have been living and working at Maravagi for seven years. I am the manager of the Maravagi Resort. Over the last five years we have seen very high tides and erosion. During this time we had to build a sea wall to protect the huts from the rising sea. The creek beside the resort floods with sea water during the king tides, which then washes muddy water back into the ocean. We have been planting more trees to try to slow down the erosion.

Case Study:

Obed Mono – Kaonasugu Village, Makira

In the last 20 years my village in Makira has experienced environmental changes. In the last 10 years we have started to realise that our weather conditions seem unpredictable. Now we get abnormal rainfall throughout the year, and it gets unusually dry and hot during the dry season. During the dry season our streams go dry and it is difficult to collect water for drinking and washing. The changes in weather conditions have impacted the normal seasons for planting and harvesting our yam and pana, and have produced low yield crops. The sea tides are not normal. The high tide goes into the village, which causes coastal erosion that destroyed our sea foods such as shells as well as plants, animals and our coconut plantations. My community does not know what has caused these changes and have no committee to plan and address it. The coastal people started to move inland to their registered block of land, which was allocated for each family by the chief in the past.



Rising sea levels, stronger tropical storms and heavier rain result in an increase in beach erosion.

Searching for answers

(Option 2): Collecting climate witness stories

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science, Science

Glossary words:
climate, climate change, Marine Protected Area (MPA)

Materials:

- loose paper or pages in an exercise book
- pen or pencil
- copies of Climate Witness interview questions
- clipboards, or something solid for students to rest their paper against while they are collecting information.

Activity summary:

Climate Witness is a program run by WWF (World Wide Fund for Nature) which connects people around the world and provides them with an opportunity to share stories about how ***climate change*** impacts their lives. This activity provides an opportunity for students to collect their own Climate Witness story. Each student will interview a local person about the changes they have noticed in their community as a result of climate change and the impact these changes have had on their lives.

Outcomes:

Students will be able to:

- describe the impacts of climate change to the local environment
- enhance speaking and listening skills by conducting an informal interview.

Procedure:

1. Start the activity by telling students that many people around the world have started to notice changes in the ***climate*** which are impacting on the local environment and community. They suspect these changes might be linked to climate change.

2. If you have carried out the 'Tuning in' activity in this module your students should be familiar with Penina Moce's Climate Witness story. Tell your students that they are going to interview members of the local community to collect their own Climate Witness stories.

3. Divide your class so that students can work in pairs. When conducting an interview, one student should have the role of asking the questions and the other student can record the responses.

4. Either make enough copies of the WWF Climate Witness interview ideas (see boxed text on page 85) for each pair of students to have a copy or write the questions on the blackboard for students to copy down.

5. Choose a wide variety of people in the community for the students to interview. Each pair should only interview one person. If each pair interviews a different person, then the class will have a lot of information to share. The following are suggestions of the type of people you can collect Climate Witness stories from:
   - farmer
   - fisherman
   - villager/elder (choose an older person over 50 years)
   - a community leader (Mayor, Chief, church leader)
   - women working in gardens
   - someone working in tourism
   - someone involved in a ***Marine Protected Area (MPA)***
   - medical person (doctor, nurse, health worker)
   - government officer (working in Environment, Water Supply, Public Works)
   - someone from an environmental NGO (Non-Government Organisation)
   - international volunteer (Peace Corps, AYAD, AVI, VIDA, VSA).

6. Either allocate students someone to interview or ask students to select someone from the list above.

7. Hand out copies or write up on the board 'Tips for Interviewing' (see 'Teacher's fact sheet: Techniques for gathering local knowledge' in Module 1 on pages 21-22). Carefully explain each tip. You might like to give your students some practice conducting interviews. Have each pair role-play the interview with one another.

8. Once students become confident in conducting an interview have them organise and conduct their interview with one student asking the questions and one recording the responses. After completing the interview, have your students rewrite the questions and answers received on a fresh piece of paper so they can be easily read.

9. Give your students time to take the information they have collected in their interview and write it into a narrative/story format similar to Penina Moce's Climate Witness story.

10. Conclude the activity by having each of the pairs share their Climate Witness story with the rest of the class.

Climate Witness interview ideas

- Start by asking the person to tell you a little about themselves, such as their name, family background, where they are from.
- How long have you lived and worked in this area?
- Tell us how you observe or experience climate? e.g. I take notice of seasonal changes to plant my crops.
- Tell us the changes that you are noticing? What is happening in your local area?

Changes that they may have noticed in their area:

- coral bleaching
- more or less algae or seaweeds
- changes in numbers or behaviour of sea birds or mammals
- changes in fish populations
- new plants or animals appearing (pests and weeds)
- changes in coastal wetlands
- storm surge (flood heights)
- coastal erosion or ***sea level rise***
- changes in seasonal patterns (more or less rain, hotter than usual)
- changes in where animals or plants can be found

Tell us the consequences of these changes.
What is the result? How does it affect you?
i.e. livelihood, personal property, health

What solutions would you like to see from leaders (local or national) or what do you plan to do locally about the problem?

Extension

Have your students illustrate their Climate Witness stories. You can compile all stories from your class into a class book which can be displayed in the classroom, used for future climate change learning, sent home for other family members to read or sent to the school library, town library or another school's library.

If you believe any of the Climate Witness stories your class have collected are appropriate and of high enough quality, you could submit them to WWF to be used in their Climate Witness Program.

Stories can be sent to:

WWF Climate Witness Program,
GPO Box 528 Sydney NSW Australia 2001
or faxed to: +61 (0)2 92811060

Assessment ideas:

Collect the students' interview notes. Compare the information gathered in the interview with the information included in the narrative and/or the presentation to the class.

- unsatisfactory – answers to interview questions were incomplete and the narrative/presentation did not reflect the interview
- satisfactory – answers to interview questions were accurately recorded. The narrative/presentation content is clear from the interview notes
- excellent – notes from the interview were well documented. The narrative/presentation accurately reflects information from the interview.

Seawalls are designed to protect land and buildings from the impact of waves.

Searching for answers

(Option 3): Beach watch

Suggested timing:
3 hours (this can be done in one day or can be carried out over 3 days, with one session held on each day).

Subject areas:
Language Studies, Social Science, Science, Maths

Glossary words:
climate change, erosion, glaciers, habitats, polar ice caps, predictions, sea level rise

Materials:

- loose paper or pages in an exercise book
- pen or pencil
- flip chart paper (large pieces of paper if available)
- marker pens
- tape measure
- sea level rise data (optional).

Activity summary:

This activity provides an opportunity for students to visit and create a map of a local beach or other coastal area to investigate how it has changed over time. Students then make ***predictions*** about the future using information about ***sea level rise*** that has been forecast by scientists.

Outcomes:

Students will be able to:

- describe the impacts of ***climate change*** on the local environment.

Procedure:

Part 1 – Sketch a map of the beach

1. Start the activity by telling students that one result of climate change that will have particular impact on Pacific nations is sea level rise. As the global temperature increases, water in the world's oceans will expand, and this change, combined with the melting of the ***polar ice caps*** and ***glaciers***, will result in a rise in sea level. Rising sea levels result in increased beach ***erosion***, reducing the area of beaches and impacting coastal ***habitats***. Students may have already noticed changes in the local coastal environment.

2. Tell the students that they are going to make a map of a local beach or other coastal environment. Remind them that maps are views of an area from above – like what you would see from an aeroplane or if you were a bird.

3. Set a time during the cooler hours of the day to visit the area you are going to map. Once you arrive at the site, divide the group into pairs or teams of three or four students and make sure each group has a notebook and pen.

4. Have the students walk the length of the coastline, writing down everything they see. If the coastline is very varied, the student groups may be given different items to look for. One group might record buildings and roads, another group vegetation and trees, and a third group might record the type of activities that they see people doing, and so on.

5. As the purpose of this activity is to make a map, the students should write down or draw the various items and where on the coastline they are located. Ask students to record the following things;

   - tide mark (high water mark)
   - beach materials (sand, stones, rock outcrops, timber, rubbish/litter, oil)
   - buildings on or behind the beach, access points, seawalls
   - drainage ditches, outfall pipes
   - waves, wind direction, plants and animals, turtle nesting areas
   - vegetation behind and on the beach
   - the number of people and what are they doing
   - fishers, fish pots, nets, engines.

6. When all of the groups have finished, bring the teams together. Spend some time comparing students' observations.

7. Back in the classroom combine all groups' beach observations into one comprehensive class sketch map of the beach.

Adapted from SANDWATCH MANUAL Adapting to Climate Changes and Educating for Sustainable Development, 2009 G. Cambers and P. Diamond

http://www.sandwatch.ca/New%20Sandwatch%20Manual/Manual.pdf

Assessment ideas:

The beach sketch map, beach history timeline and students' predicted sea level measurements produced during this activity could be assessed.

- unsatisfactory – the student is unable to complete the three components of the assessment
- satisfactory – the student is able to complete the three components of the assessment
- excellent – the student is able to complete all three components of the assessment and can demonstrate a clear understanding of the effects of climate change on the local environment.

Part 2 – Developing a beach history

1. Select a community member to come and talk to the students about the history of the area, particularly about local coastal environments. You might like to consider inviting a number of members of the community to the school and holding a meeting to discuss how the coastline used to look. If possible, try to encourage the community elders to attend this meeting.
2. On the day of the meeting or talk, place the final version of the beach sketch map in a position where everyone can see it. Introduce the guest speaker or community members to your class. Encourage your students to ask questions to help them to gather information about what the beach was like in the past.
3. Record the observations and use this information to make a timeline of the beach. A timeline may look something like the one below.
4. Use the timeline and the beach sketch map as the basis of a discussion about how the beach has changed over time.

Sample timeline
Before 1980: There used to be a seawall made of coral at the back of the beach.
1980s: Two houses behind this beach were washed away; families moved to another location.
1990: Beach was wide enough for two trucks to drive side-by-side along the beach.
1996: Harbour was built and sand from this beach was used in the construction. Many bags and truck loads of sand removed.
1997: Many palm trees were undermined and fell into the sea.
2001: Island Committee requested help with the erosion from the government.
2005: Sand removal from the beach continues after severe storm.

Part 3 – Predicting sea level rise

1. Find out from your national climate change focal point or meteorological office whether measurements of sea level are conducted in your country, and whether national data relating to sea level rise is available.
2. If no data is available, use the uppermost figure of predicted sea level rise, which is thought to be:

   0.59 metres over 100 years = 0.0059 metres/year (or 0.59 centimetres/year).
   (Source IPCC, 2007)
3. Using this figure, calculate the retreat of the high water mark over the next 10 years:

   0.0059 m/yr x 10 years = .059 metres/year (if you want to convert this to centimetres it needs to by multiplied by 100, so .059 X 100 = 5.9 cm

   Repeat the calculation for the next 20 years and next 30 years:

   0.0059 m/yr x 20 years = 0.118 metres/year (or 11.8 centimetres/year).

   0.0059 m/yr x 30 years = 0.177 metres/year (or 17.7 centimetres/year).

4. Record these calculations as you will use them whilst at the beach.
5. Return to the beach with your students.
6. Using these figures, let the students determine where the high water mark is today, then using a tape measure, measure .059 m landward of that point and make a line in the sand. Repeat for the 20 year and 30 year distances. If you don't have a tape measure you can estimate (one adult human stride = approximately one metre).
7. Explain to your students that the measurements show the average position of the high water mark in 10, 20 and 30 years' time, and they indicate how the sea will reach further into the land than it does today.
8. Back in the classroom, conclude this activity by asking your students to make some predictions about what the beach and surrounding coastal areas will be like in the future. Have them consider information from their own observations, the beach history timeline and their predicted sea level measurements when forming their predictions. They can do this as a short writing exercise or by using a different colour and marking the predicted future changes on the beach sketch map.

Students measuring the high water mark to help predict the extent of future sea level.

Teacher's fact sheet:

Learning to live with climate change

In the Pacific, the natural environment provides food, medicine, materials for building homes and our cash income. This environment and our livelihoods are now being threatened by the negative impacts of ***climate change***. It is time to take action to ensure we can ***adapt*** to a changing ***climate***. There are a number of things that we can do.

Protecting the natural environment

Where the natural environment is healthy, the best approach to ensuring we can live with a changing climate is to protect the natural environment. One example of this is to protect ***mangroves*** and coastal vegetation so that our coastlines are less vulnerable to ***erosion*** and sea level rise. By protecting mangroves, fish and crab ***habitats*** are also protected. This can in turn help support local coastal communities who depend on these ***resources*** for food and income. Another example is to protect our creeks and rivers, which provide clean water for drinking, cooking and bathing. If fresh water becomes scarce, it is all the more important to make sure that the water we have is protected.

Coral reefs and coastal marine habitats will come under increased pressure because of climate change. People can help to reduce this impact by taking care not to damage corals or overharvest fish.

New ways of producing food

New agricultural practices are needed in order to adapt to climate change and rising sea levels. Some coastal communities are being affected by rising salt water which is damaging their crops and making it hard for them to grow gardens. In places like these, simple technologies such as planting vegetables on raised garden beds and trialling plants that can grow in salty conditions can be applied. Improved techniques for storing food, or increasing supplies of foods such as wild yam can provide food security after a cyclone or if the wet season comes late.

Some communities are building raised garden beds to help combat the effect of rising salt water.

Climate change is expected to damage coral reefs, which currently provide a high proportion of the protein in our diets. Communities may have to learn new ways to produce protein, such as through aquaculture (fish farming) or more intensive pig farming.

Seawalls

In some coastal communities where sea level rise is an issue, people are now building seawalls to protect their homes from the rising seas or storm surges. A variety of materials are used, ranging from coconut trunks and husks, bags of sand and stones to concrete seawalls.

Protecting and planting trees

Many areas in the Pacific have had their forests depleted by logging or clearing for new gardens. Replanting trees should be encouraged. Trees provide timber for building and habitat for useful plants and animals. They also provide protection for vital fresh water supplies, because coastal forests and mangroves protect villages from cyclones, storm surges and flooding. The more trees there are, the higher the capacity of our forests to store ***carbon dioxide*** and contribute to reducing the amount of carbon dioxide in the ***atmosphere***. We can lead by example, and other countries may do the same. Reduced ***deforestation*** may also lead to opportunities for earning money through carbon trading.

Talking about climate change

Raising public awareness of climate change and the different ways we can learn to live with it can greatly improve the future for Pacific communities. Many communities are facing the effects of climate change but do not know how to adapt to these changes. If we are on the lookout for changes in climate and our environment, and observe changes over time, we can plan our response to these changes. Communities can be encouraged to make plans about how they want to use their land, making sure that these plans acknowledge and respond to changes to the environment.

Planting trees will not only help to reduce the amount of carbon dioxide in the atmosphere, they can also help combat some of the effects of climate change.

By protecting or replanting mangroves, fish and crab habitats are also protected and restored.

Trying solutions

Carbon catchers

Suggested timing:
Varies

Subject areas:
Social Science, Science, Making a Living

Glossary words:
adapted, atmosphere, carbon dioxide (CO_2), carbon sinks, climate, climate change, fertiliser, habitat, mangroves, sea level rise

Materials:

- seedlings or cuttings of native plants (see information in activity)
- a selection of containers, e.g. old ice cream, butter or egg containers, yoghurt containers, disposable cups, empty plastic bottles, milk cartons
- pen or pencil
- soil and sand.

Activity summary:

In this lesson, students will explore the role trees can play in addressing ***climate change***. Students will then carry out a tree planting effort in their school or community.

Outcomes:

Students will be able to:

- explain the benefits trees provide in reducing the impacts of climate change
- implement a tree planting to address the impacts of climate change.

Background information;

Trees act as ***carbon sinks*** by absorbing ***carbon dioxide (CO_2)*** and converting it into plant material. Trees store this carbon in roots, trunks, stems and leaves while they grow, and in wood products after they are harvested.

That means that planting trees can help reduce carbon dioxide in the ***atmosphere***. Less carbon dioxide in the atmosphere means we have a better change of avoiding the worst impacts of climate change, such as ***sea level rise***.

Forests are the world's second largest carbon sinks, after oceans. Unlike oceans, however, we can grow new forests. One acre of forest will be able to capture and store between 150 and 200 tonnes of carbon dioxide in its first 40 years.

Planting trees will not only help to reduce the amount of carbon dioxide in the atmosphere, Trees can also help combat some of the effects of climate change being felt by Pacific Islands now. Many coastal areas have suffered from loss of trees, such as when ***mangroves*** are cleared. When the coastal region has been cleared, the bare ground has no protection against increasing tropical storms or cyclones, and will wash away. Planting trees in these areas will help reduce this impact.

Procedure:

Before you begin

1. You will need to have seedlings or cuttings of native plants and trees to plant. When you are re-planting in your local environment, it is very important that you choose local or native plants, rather then flowers or garden plants. See the information box 'Why Local Plants' on page 95 for details.
2. The class may need to start a plant nursery or collect cuttings for a long time prior to the planting day. See 'Tips for growing local seeds' below. A good source of native plant seedlings could be your local forestry department. The time required for this will vary depending on the seeds you have put in and how fast they grow.
3. It is important that the site you choose for planting is protected. Consider what or who might ruin your planting. People walking or driving over them easily kill small trees and shrubs. Seek an appropriate agreement with your community if others access your planting area.
4. Also consider roaming domestic animals and whether or not they are likely to eat your young plants. Your re-planting could be on your school grounds or nearby, such as a coastal area.
5. Select and prepare your site. Many sites will be infested with weeds. These will need to be cleared and monitored so they do not take over the area, ensuring that your plants have space and light to grow. Do not clear back to bare ground if possible, and be selective about what you remove – don't take out any native plants, only the weeds. Prepare the area no more than one week before your planting day.

On the planting day

1. Get support and help if possible from your local community.
2. Start the day by holding a discussion with the students and any community members that are assisting with the planting about the role that planting trees plays in reducing the impacts of climate change. Use the information provided in the background information section and Teacher's fact sheet as a basis for the discussion.
3. Once you are confident that the group has an understanding about the link between climate change and planting trees, begin the tree planting effort.
4. Plant the seedlings and cuttings with enough space between them so that they can grow (consider how they grow in the wild).

5. When planting, remember to give some water to each plant. Your plants may also need to be watered occasionally in the first few months.

   Have students monitor how dry the soil is, and water accordingly.

6. If necessary, rope or fence off the area and stake the plants.

Follow up

1. Check the plants regularly and give them water when needed.

2. When the planting has been successful and you can see significant growth, invite the community members who helped you to a picnic near the area to say thank you and to celebrate your re-planting area.

Tips for growing local seeds

Before you start your re-planting project, you might like to spend some time collecting seeds.

Your surrounding local bushland is a good source of seeds. These local plants have ***adapted*** to the local conditions (soil, ***climate*** etc.) and therefore will require less maintenance and have more chance of survival. They also provide ***habitat*** and food for local animals.

In the months or weeks leading up to your re-planting project, keep a lookout for plants that are producing seeds. Try to make sure the seeds are mature before you pick them, and when you are storing them, try to keep them dry. An old envelope is a good way to store seeds; you can easily write the name of the plant and the date you collected the seeds on the envelope. If you are unsure of which plants are local to your area, ask an older community member who knows which plants grow naturally in the bush.

Once you have the seeds you want, you are ready to start growing them!

Sowing (planting) the seeds

- Put a few small holes in the bottom of seed containers for drainage (old ice cream, butter or egg containers work well). Fill seed containers with a light mix of soil and sand. Push down the soil mix firmly and gently. The mix should be about 1 centimetre from the top of the container. Water the mix.
- Sow the seed. For fine seeds, mix the seeds with fine sand and lightly sprinkle evenly over the mix. Medium and large seeds can be sown by hand, spreading evenly and pressing seeds down into the mix.
- Cover the seed with a thin layer of soil mix. Try to spread the soil evenly. A good guide is to cover the seeds with a layer of soil mix two to three times as deep as the size of the seed.
- Water with a fine spray.
- Write labels for each container, with plant name (common and local language) and sowing date.
- Place seed containers in a sheltered, warm, well-ventilated area and water regularly, especially on hot days.

Transplanting (pricking out)

When seedlings have developed four leaves (two pairs of leaves), they are generally ready to be transplanted into small individual pots. For this you will need a pencil-sized stick to help remove the seedlings from the tray.

- Fill the new pots (yoghurt containers, paper or plastic disposable cups, and cut-off plastic bottles, drink cans or milk cartons will all work well) almost to the top with fresh soil mix. Make sure you put a few small holes in the bottom of the containers so that water can drain out.
- Make a hole in the mix large enough for the seedling root system.
- Gently remove the seedling from the tray with the stick, holding onto the leaves, not the stem. Try to disturb the roots as little as possible.

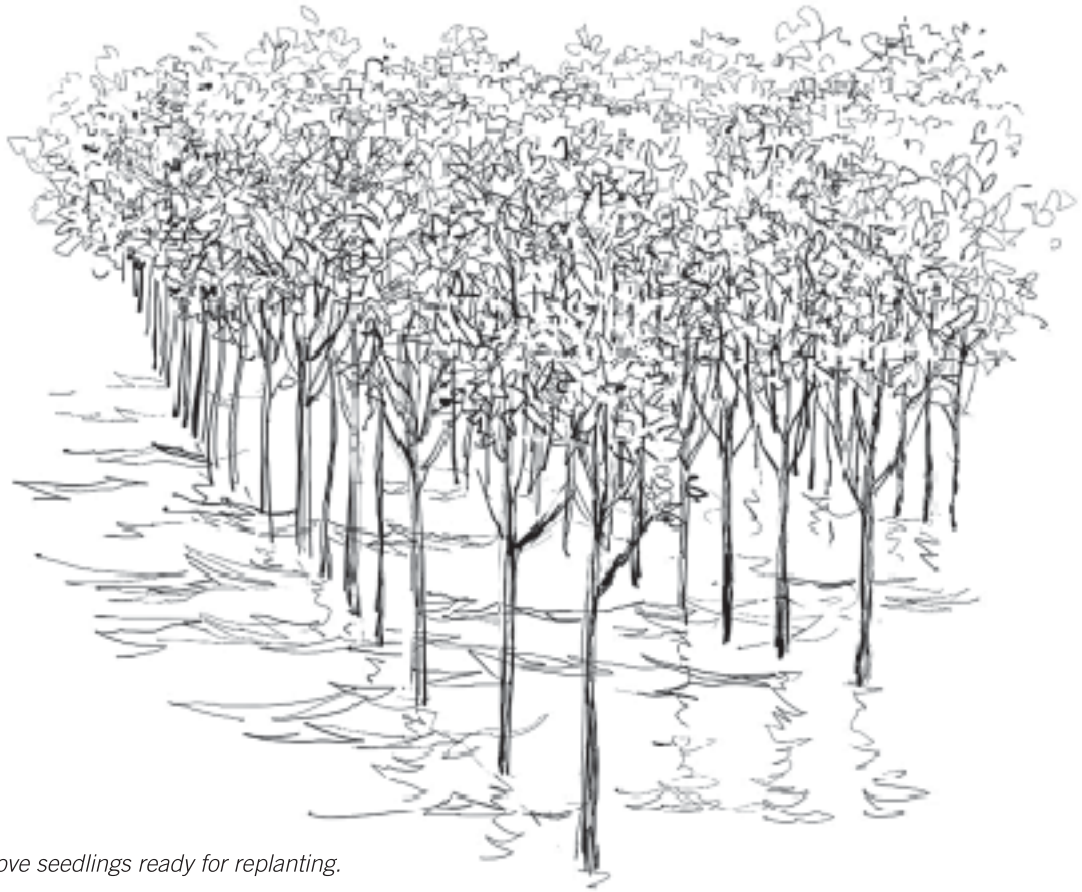
- Place into the new pot, keeping the roots straight with your stick.
- Push the mix around the plant firmly and water thoroughly.
- Label the plant with its common name and local language name if you know it, and the date of planting.
- Place in a partly shaded, sheltered spot and water regularly.
- After a few weeks, move the plants gradually into a more exposed spot where they get some sun and rain.
- After a few months, the plants will be ready to transplant into the ground.

Why local plants?

Local plants refers to the trees, shrubs and other plants that grow in the natural bush or coastal area where you live or used to grow in your community before areas were cleared for gardens and houses. Most plants grown in cultivation are brought in from elsewhere and are not local plants. Local plants are especially valuable in helping us to learn about our natural environment, since they reflect the local conditions.

Local plants are also useful in telling us what is happening in the environment. Before modern human settlement, these plants thrived. Today, some of them are struggling. By thinking about why this is, we can better understand some of the ways in which human beings have, directly or indirectly, affected the environment.

As local plants are the plants with which our animals evolved, local plants are extremely important for ***conservation***. They are food for the larvae of many different insects, which in turn are food for many other animals, such as lizards, birds and bats. They are also important because they don't need any extra ***fertiliser*** or watering, because they are adapted to the local environment.



Mangrove seedlings ready for replanting.

Would you like to do more to combat climate change?

Establish a Youth Climate Action Group

If your class or school is particularly interested in taking action to help address the impacts of climate change on your community or marine environment, there are a lot of actions that can be taken at a local level.

Establishing a Youth Climate Action Group can be time-consuming and will require a lot of effort and commitment from you as well as your students, however, a Youth Climate Action Group is a means by which young people can organise themselves to learn about climate change issues and gain the skills necessary to take action.

For more information about establishing a Youth Climate Action Group see 'Guide to Establishing a Youth Climate Action Group' at the end of this module.

Assessment ideas:

There is no direct assessment for this activity.

Mangroves are important for helping to protect communities from storms and big waves.

Coral reefs are made up of millions of very small animals called coral polyps.

Student reflection

Coral bleaching

Suggested timing:
45 minutes

Subject areas:
Language Studies, Science, Social Science

Glossary words:
calcium carbonate, climate change, coral bleaching, global warming

Materials:
- paper or exercise book
- pen or pencil
- blackboard
- coloured pencils or markers (optional).

Activity summary:

After reading a case study about ***coral bleaching*** students reflect on the threats of ***climate change*** by writing a journal piece or doing a series of drawings.

Outcomes:

Students will be able to:

- consider the impact of climate change on marine environments.

Procedure:

1. Ask your students to imagine the impacts on their lives if the coral reefs found on their coasts were to disappear because of ***global warming***.

2. Either hand out a copy of the coral bleaching case study (see page 98) for students to read through or read it out loud to the whole class.

Case Study:
Coral bleaching

Coral reefs are very important to the Pacific Islands. They provide food for many of our communities, attract tourists and protect our coasts from storms that come from the ocean. They also provide homes for many animals and plants.

Changes in ocean temperature create big problems for coral. Coral reefs are made up of millions of very small animals called coral polyps which are related to, and look like, miniature jellyfish. These polyps live in huge colonies and produce a hard substance known as ***calcium carbonate***, which is the building block of the reef. Each coral polyp has microscopic algae living inside it, which helps the coral create sugars (food) using energy from the Sun. When the sea temperature rises, the corals are forced to spit out the algae. This turns the corals white in a process known as 'coral bleaching'. The coral that have turned white cannot survive for very long without their algae, and will slowly starve to death.

3. After the students have had time to read through and think about the case study, ask them to respond to the following questions by either contributing to a class discussion or writing in their exercise books.

   - Why are coral reefs important?
   - How do you feel about the threat to coral reefs?
   - What would change in your community if you didn't have coral reefs?
   - What changes could your community make so that it could survive without coral reefs?
   - What do you and your family do that may contribute to the climate change problem?
   - What could you or your community do to help fight climate change? (Aim to list 5 to 10 things you can do.)

Assessment ideas:

Use this activity as a summary activity. No separate assessment is needed, although student responses (either verbal or written) to the questions posed in this activity can be assessed.

Guide to establishing a Youth Climate Action Group

The following is a guide to assist you (the teacher) in establishing a Youth Climate Action (YCA) Group in your school or community. Young people, both in and out of school, are concerned about issues affecting them either directly or indirectly as a result of climate change. A Youth Climate Action Group offers young people an opportunity to learn about ***climate change*** issues and develop the skills necessary to take action.

Background

Young people have an important role in the fight against climate change. The decisions and actions we take over the next few years will shape the world we live in for the rest of our lives, and the lives of future generations.

Young people around the world are standing up to decision makers and polluters and taking their future into their own hands. They will be the leaders of tomorrow, so must be given the confidence and skills required to take on this important role. We can help them by encouraging them to start leading today.

Action against climate change falls in to two categories, ***mitigation*** and ***adaptation***.

Mitigation

Climate change is caused by the release of greenhouse gases such as ***carbon dioxide***. Fortunately, this leads to a very simple solution: reduce the release of greenhouse gas! This approach is known as climate change mitigation. While we are not completely removing the problem (some change will still occur), we are making it less severe and more manageable.

Adaptation

Even if the release of greenhouse gases stopped worldwide, scientists believe that we would still experience some ***global warming***. This means that, regardless of the choices we make to mitigate climate change, some warming will still occur. We will have to find ways to ***adapt*** to the effects it causes. This area of climate change is known as adaptation and focuses on how to minimise the potential damage from or to cope with the consequences of climate change

It's clear that when we are tackling climate change mitigation and adaptation are both needed. Young people have a very important role to play in both of these approaches to tackling climate change.

Who can start a YCA Group?

Any group of young people, teachers, parent committees or other interested members of your community, both male and female, can start a YCA Group.

Goals and objectives

YCA Groups aim to educate young people about climate change issues and to help them promote action in their school, home or community. This can be achieved through improving young people's knowledge, awareness and skills through training from experts and through peer learning groups.

The main *objectives* of a YCA Group include:

- To promote effective learning.
- To allow young people to participate in decisions that affect the future of their community.
- To increase self-esteem and self-confidence among young people by creating positive values and developing their abilities.
- To empower young people as ambassadors and role models to their peers.
- To raise awareness in the community about the effects of climate change and the human activities that cause it.
- To take part in projects in schools, homes and communities that will lessen the future impacts of climate change.
- To encourage young people to develop their leadership abilities.
- To encourage young people to develop their leadership abilities.
- To encourage young people to become aware of political processes so that they can participate in the future.

You may have other specific goals for your own group that you could add to this list.

Establish some guidelines

For effective management and steering of YCA Groups, it is useful to have guidelines to help the group achieve its goals. Guidelines are essential in helping to run the group effectively. School management, communities and administrative authorities will readily accept a group if it is led by guidelines that define its mission, role and responsibilities.

YCA Group guidelines should be flexible enough to avoid imposing procedures that are too difficult for young people. However, once the guidelines are approved, they become a binding document that directs the actions of the group's leadership and its members.

Getting your YCA Group started

Get permission

If you are setting up your YCA Group in a school, get permission from the school's administration to start the group. Your YCA Group could also be established as part of a community or church youth club. In that case, you will need to get permission from the appropriate group leader or coordinator.

Hold a planning meeting

Look for interested young people in your school or community by advertising through school newsletters, noticeboards or by word of mouth to other staff. You might also like to contact existing youth groups in your community. Once you have enough interest, call a planning meeting of 20–30 people. This meeting may result in a core of interested people who will continue with the development and management of the group.

Set a structure

You can elect representative members such as coordinator/chairperson, secretary and treasurer. Or you may choose to keep it less formal by having a steering committee of parents, teachers and/or potential volunteers. This group could be responsible for establishing the guidelines mentioned above and could assist in planning the YCA Group.

Recruit members

The next step is to recruit members to the group. These can either come from a specific ***target group*** within your school (e.g. all of Grade 5, a boy and girl from each class, a call for volunteers) or membership can also come from the community.

Too many members will be difficult to manage and too few will not be able to achieve the group's objectives. When deciding on your group size, consider the number of adults that will be able to regularly attend the meetings to supervise and help out.

Select a meeting venue

The YCA Group should choose a location where they will regularly meet. The venue can be in a suitable classroom at your school or another suitable building in your community. The venue needs to be clean and safe for members, be big enough to hold the group comfortably and be easy for members to access. Once activities begin they can be held either inside or outside depending on the type of activity.

Clear goals, visions, and targets of the group

The YCA Group should have clear goals, visions and targets to achieve. All members, position holders, parents of members and steering committee representatives should be aware of and contribute to the YCA Group's goals, visions and targets.

Keep the community informed

After the YCA Group has been formed and is functioning, members can let the community know about the group's activities and events. You might like to involve members of the community as instructors, resource people who can provide equipment, materials, ideas or information and in governance roles, such as raising money, providing special skills such as in management or finance and acting as ambassadors to the community. Having members of the community involved helps to ensure the program is anchored in the community.

Once your group is established

Hold planning meetings

A good group is well organised and benefits from a strong committee. Whether you have a voluntary steering committee or a more formal board, you should have regular planning meetings to keep the momentum going. These do not have to be overly formal, or long and tedious, but they should provide a way to keep everyone informed, plan for future activities and reflect on how the group is going.

Try to have planning meetings that help to set out a program of activities in advance. This will mean that you as the organiser, the steering committee and the members all know in advance what will be happening.

Run activities

To keep up interest in the YCA Group and to help achieve its objectives you need to hold regular activities for members to attend. Tell members about activities as far in advance as possible.

Get your members involved in the planning, development and running of activities. This will encourage ownership of the group and its activities and will boost members' confidence and self-esteem.

YCA Group activities should aim to increase awareness and understanding of climate change. Activities should also encourage critical thinking and problem-solving skills.

Tips for organising a climate action project

Source: Adapted from TakingITGlobal Climate Change Youth Guide to Action www.climate.takingitglobal.org

Climate action projects can make a big difference – not only to the environment but also to members of your YCA Group. By taking action on climate change and contributing to a school or community project, young people can feel a sense of achievement and satisfaction. There are many climate action projects that your YCA Group can get involved in. Here are some simple tips for organising a climate action project.

Be inspired

Discover what inspires your YCA Group to take action on climate change. Reflect on what climate change means for you and how you can be a part of the solution.

Learn more about the issue

Hopefully this module has taught you more about how Earth's climate works, why it has been changing, the human activities that affect it and how young people can have an impact. Being informed about these issues will mean you are better prepared to make a real difference. The YCA Group can get more information about climate change issues by collecting information from newspapers or other media, interviewing community members or contacting organisations and government agencies that focus on climate change. You can also ask your students to explore their community and identify the problems first hand.

Choose a topic for your project to focus on

As a group, list all the ideas you have for potential climate action projects. Come up with your own ideas and ask others for help and advice. You could even research what others have done and adapt their concept to your circumstances. Discuss the project ideas and, considering what it is you want to achieve, decide on the top three. Hold a group vote or have a group discussion and try to reach a consensus. See suggestions for possible climate change action projects on page 104.

Encourage members

When planning the climate action project, encourage members to take ownership and initiative. The more members that are involved in planning the project, the more they will get out of it. It is important to help members appreciate the value of their work. The YCA Group members need to know that their project, no matter how small, is valuable.

Set some goals

Have a clear goal for the project and a strategy to accomplish this goal. What would you like to see change as a result of this project? Set goals that are achievable. Do not take on projects that are beyond the available resources and time.

Think about timing

What is the timeline for the project? Set an approximate start date and end date. Can it fit into your school term or school year? Does it fit in with other plans?

Map it out and delegate tasks

Before getting started, think about the specific steps or tasks that need to be completed to meet the objectives of this project. Assign tasks to members of your team based on individual strengths and areas of interest. Breaking your project down into manageable tasks will help to ensure its success. Use a table such as the following to help create an action plan for your project.

Action plan				
Project step	***Tasks needed to achieve our goal***	***How will we do this?***	***What help will we need?***	***How will we know when it has been successful?***
Step 1				

What do you need?

Who needs to be involved? What supplies or equipment are needed for the project? Try to identify individuals or organisations that might be able to provide useful information, specific skills or expertise or other help. Also identify sources of funding or other materials if required.

Tell others

Think of ways to promote and generate support for your project, from within your school or the wider community. You can make school announcements or put up promotional notices on the school noticeboards, as well as in the community. If the project is going to be carried out in the community, it is a good idea to talk to parents or community leaders before students take on a project. This will help to avoid any misunderstandings and will generate support for the project. Fundraisers could also be used to raise money for your YCA Group project.

Be flexible

As you carry out your project, you may find that you need to adapt your plans due to unexpected circumstances. Remember to keep an open mind and try new approaches.

Celebrate your achievements

Any project can be a lot of work, so it's important to monitor your progress along the way, and celebrate your successes. Keep yourself (and your group) energised and positive. For example, when a group member experiences success, no matter how small, acknowledge it and, as a group, offer congratulations. When you achieve a major milestone in your project, consider having a party to celebrate. Include people outside of your YCA Group who have helped you – let them share in your success.

Evaluate

At the end of your project, you will want to know how much of a difference you have made, to see if you achieved your objectives. This process is called evaluation. Taking time to evaluate projects helps to understand what the group has accomplished and allows the group to recognise how their project has assisted their personal growth. Don't just evaluate at the end of the project – you should also check in at different stages of your project to monitor your progress along the way.

Possible indicators of success:

- the number of people who said, in an evaluation form, that they learnt something from your project
- the amount of waste being composted instead of placed in ***landfill***
- the number of people involved with your project (group members and participants)
- how many projects have been inspired by your work.

Some ideas for climate action projects

Develop and perform a play for the community

A play about a climate change issue can educate others and serve as a fundraiser for other action projects. Work with local drama teachers or theatre groups to help get your play started.

Develop a newspaper or newsletter

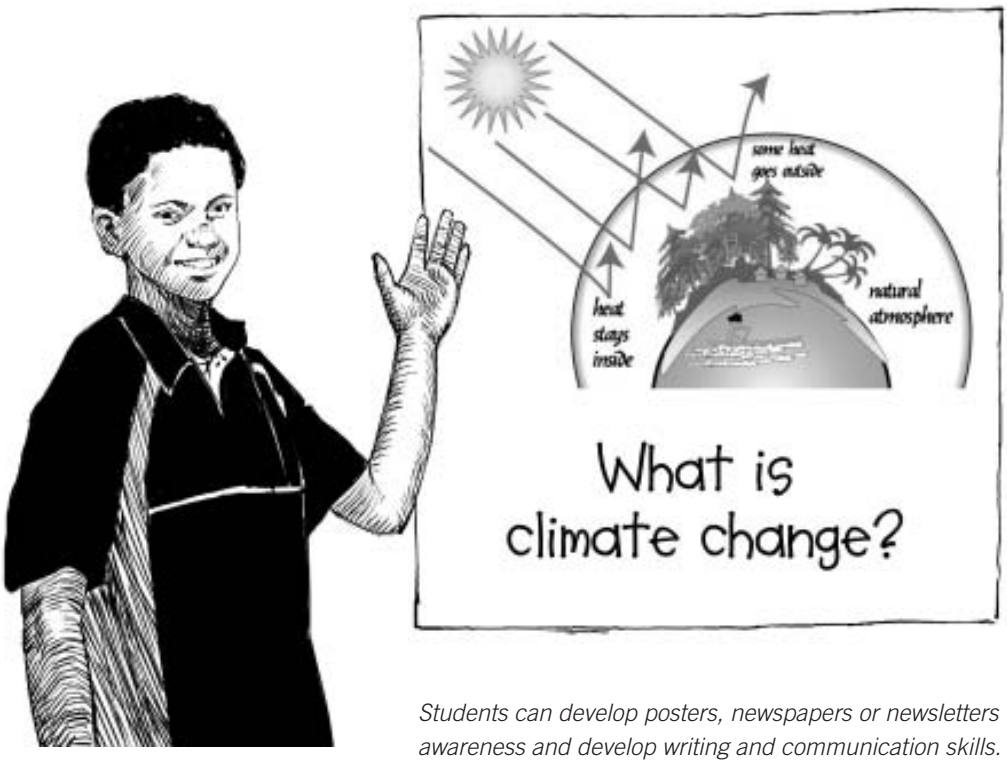
Creating a newspaper or newsletter about climate change issues can help students to fine-tune their writing skills and explore and share their thoughts. Students might like to distribute the newspaper or newsletter beyond their school to raise the profile of the issue in the community. Alternatively, you could write an article or letter to the editor for your local newspaper about a climate change issue.

Organise a 'Climate Change Awareness Day'

Organising a community event focused on climate change can help raise awareness about local, national and global issues. Team your school up with an environmental organisation and others to help coordinate a Climate Change Awareness Day.

Survey the community about climate change

Students can find out how community members feel about climate change by conducting a survey of individual thoughts and points of view. The survey could also lay the groundwork for future action projects by identifying the issues that people are most concerned about.



Students can develop posters, newspapers or newsletters to raise awareness and develop writing and communication skills.

Start a school or home energy patrol

Saving energy reduces ***greenhouse gas emissions***. Students can save energy at school by turning off lights and turning off fans when they're not in use. An energy patrol can remind students and teachers to save energy.

Write songs and lyrics

You can use an original song about climate change as an energiser for your group, at events and to get public attention. Try taking a well-known nursery rhyme or pop song and re-writing the lyrics to deliver a message about climate change.

Hold a skill share workshop

Hold a community workshop designed to teach others a skill that will help combat climate change. For example, a bicycle maintenance and repair workshop may encourage more people to ride to work or school, rather than drive. Ask skilled people in your community to help with workshops.

Contact decision makers

Contact decision makers at a local, national or international level. Tell them you have an ***opinion*** to share on climate change and that you want this issue on their agenda. Ask them to recognise, develop and put into practice actions that aim to address both current and future effects of climate change. Your group could write a letter, make a phone call, arrange a face-to-face meeting, organise a petition or join a committee.

Build a seawall

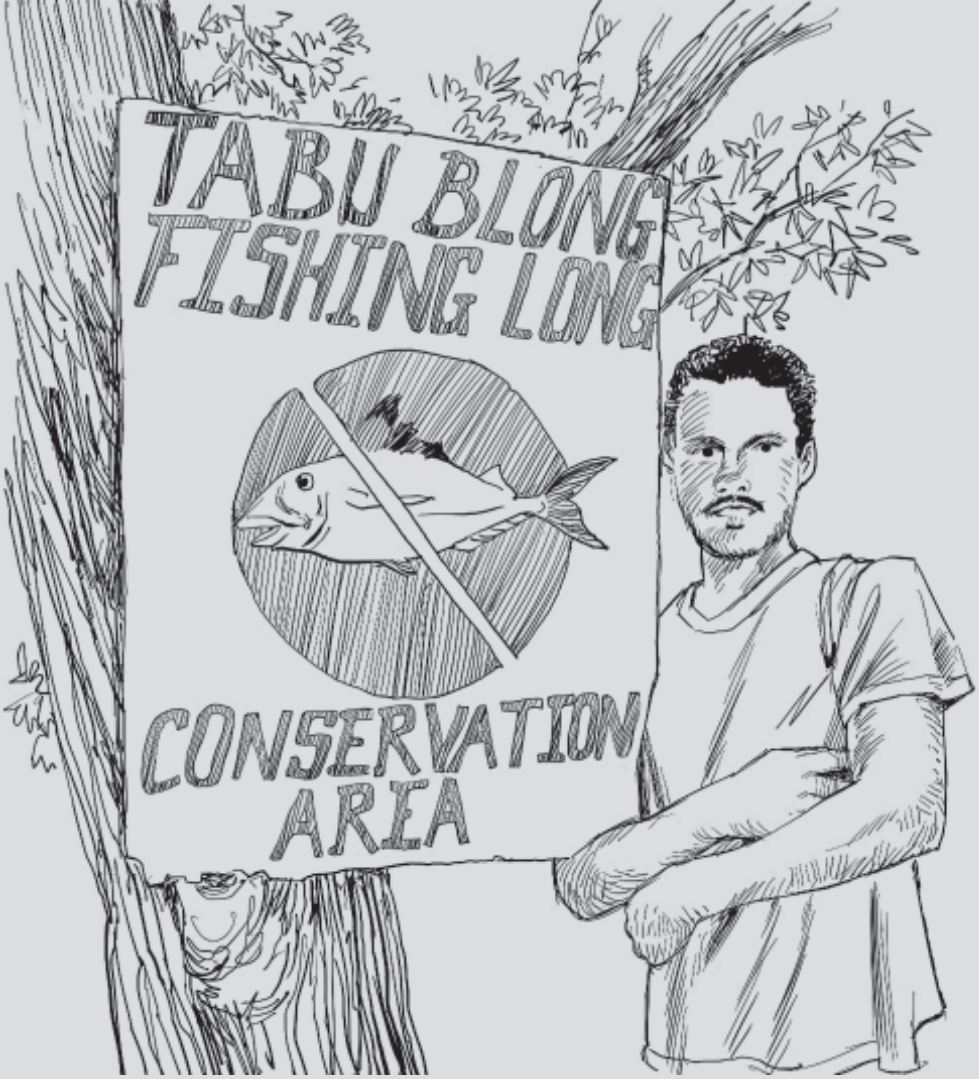
Seawalls are structures made of logs, steel, rock or concrete. They are designed to protect land and buildings from the impact of waves. Seawalls need to have strong foundations to stand up to the scouring and undercutting caused by waves breaking against them. If you are planning on building a seawall you need to remember that the sea water will wash around the wall. Think about where the seawater will go, and speak to neighbours and other community members before building the wall.

Restore mangroves

Mangroves are important for helping to protect communities from storms and big waves. They work like a natural seawall. The roots of mangroves hold soil together to stop it being eroded by big waves and heavy rain. By protecting mangroves or by replanting mangroves, you are strengthening this barrier between sea and land, protecting vulnerable coastal communities. Contact your local government or environmental group for assistance.

Building raised garden beds

Some communities who live near the sea are building raised garden beds to protect their plants against rising salt water. There are many ways to make a raised garden bed. Why not look around for old building materials that you can use, such as bricks, or ***recycle*** things like old drums, tyres or even old canoes.



4 Discovering Marine Protected Areas

Marine Protected Areas offer a range of benefits for fisheries, people and the Marine environment. MPA's can help restore the balance in the use of our oceans by protecting valuable fish stocks and important habitats while also providing local people with a stable income.

Module introduction

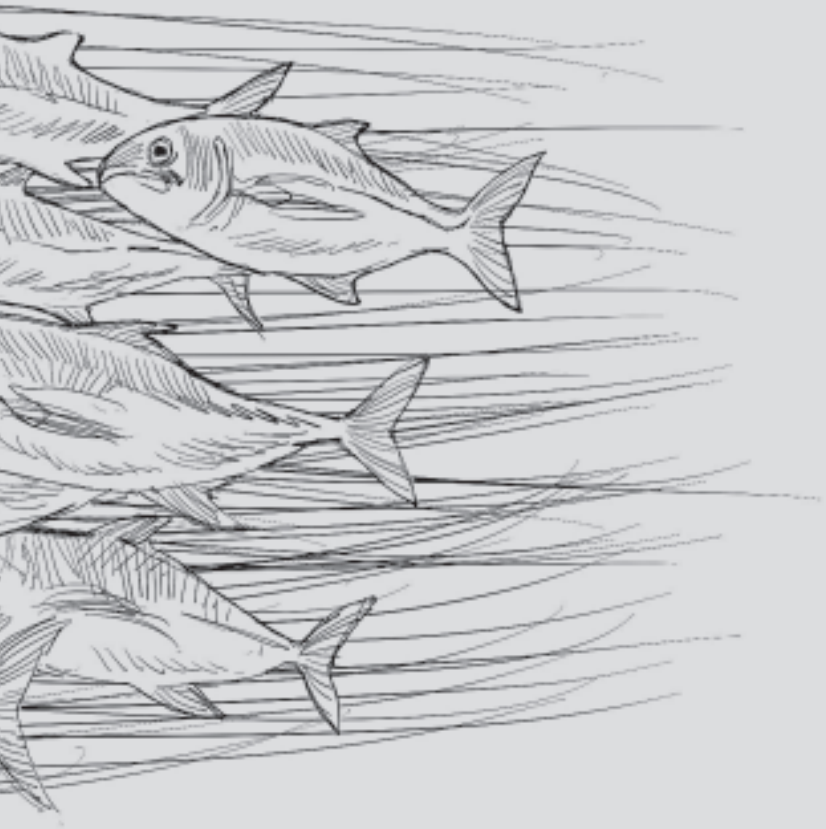
MODULE 4

Coastal and marine environments are facing threats from overfishing, destructive fishing practices, ***pollution***, ***habitat*** degradation and the increasing impacts of ***climate change***. ***Marine Protected Areas (MPAs)*** are an important tool for the ***conservation*** of the marine environment and the ***resources*** it provides.

A Marine Protected Area is an area of the marine environment that is actively managed to protect some or all of the life that exists within it. The term MPA is often used to cover a wide range of marine areas, all of which have some level of restriction to protect the animals, plants, historical and cultural features within them.

Marine Protected Areas (MPAs) offer a range of benefits for ***fisheries***, people and the marine environment. They work by providing safe havens for fish to breed and ***populations*** to recover. They also support local communities who depend on the sea and its resources by offering increased food security and new opportunities to gain income.

MPAs can restore the balance in the use of our oceans by protecting valuable fish stocks and important habitats while also providing long-term sources of food and income for local communities.



This module introduces Marine Protected Areas as a potential solution to a number of conservation issues affecting marine environments in the Pacific. It encourages students to investigate the benefits of Marine Protected Areas and examines the ways in which establishing a local protected area would affect their community.

The module contains four activities and supporting information to assist the teacher:	
Tuning in:	What is a Marine Protected Area?
Searching for answers:	MPA Map Makers
Trying solutions:	Creating a Marine Protected Area
Student reflection:	Stand in someone else's shoes

Teacher's fact sheet:

What is a Marine Protected Area?

What is a Marine Protected Area?

A ***Marine Protected Area (MPA***) is a coastal or offshore area especially set aside for the protection of marine ***ecosystems***, processes, ***habitats*** and ***species***. MPAs can be protected by a government body or by local landowners using national or customary laws.

MPAs have been used for many years to protect marine ecosystems and ***resources*** and to control the ways that these resources can be used.

The term Marine Protected Area applies to many different types of marine parks and reserves. MPAs can have different levels of protection, and a wide range of activities may be allowed or prohibited within their boundaries. Types of MPAs include marine reserves, fully protected marine areas, ***no-take zones***, marine sanctuaries, ocean sanctuaries, marine parks and ***locally managed marine areas (LMMAs)***, to name a few.

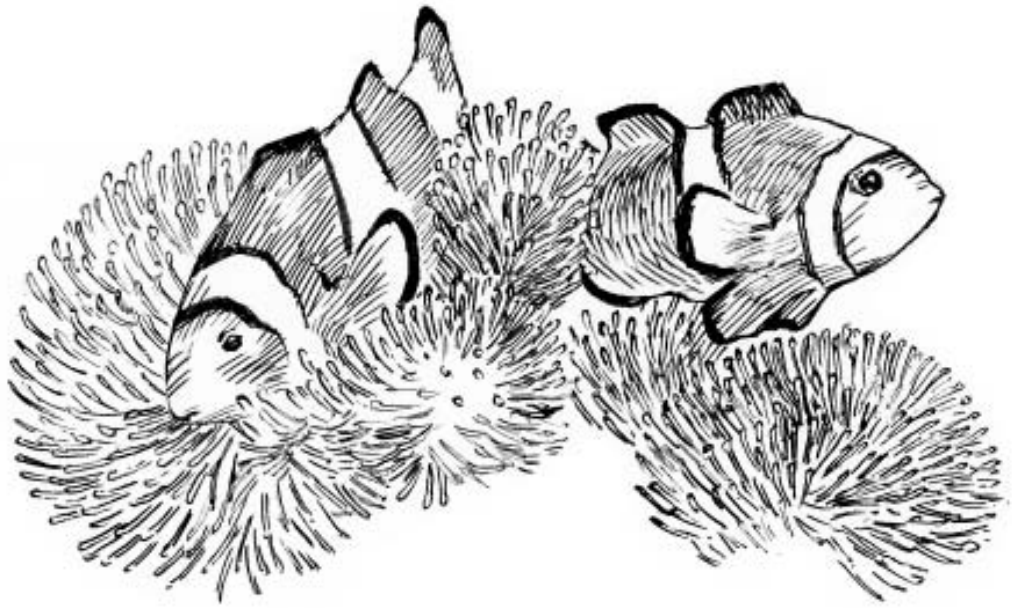
In many parts of the world there is a growing awareness of the need for more MPAs and for better management generally of coastal and marine environments.

Why have Marine Protected Areas?

Marine Protected Areas offer a range of benefits for ***fisheries***, people and the marine environment. For example, MPAs:

- protect important breeding, nursery and feeding habitats and provide safe havens for depleted fish ***populations*** to recover
- benefit local people by creating new opportunities to earn an income through tourism and ***sustainable*** fishing
- increase fish catches (both size and quantity of fish) in surrounding fishing grounds because fish breed in the protected area and then move out into surrounding fishing grounds
- protect important habitats from destructive fishing practices and other human activities, and allow damaged areas to recover
- offer examples of undisturbed, natural ecosystems, which can be used to measure the effects of ***fisheries*** in other areas and help to improve fisheries management
- develop a marine environment's ability to recover from damaging external impacts, such as ***climate change***
- help to maintain local cultures, economies and livelihoods which are closely linked to the marine environment.

Marine Protected Areas can help restore the balance in the use of our oceans. MPAs protect valuable fish stocks and important habitats while also providing local people with a stable income and still maintaining a healthy marine environment.



MPA's help to maintain biodiversity by providing places where species are safe from being caught.

Tuning in

What is a Marine Protected Area?

Suggested timing:

45 minutes

Subject areas:

Language Studies, Art, Science, Social Science

Glossary words:

biodiversity, climate change, conservation, habitats, Marine Protected Area (MPA), species, toxic

Materials:

- paper or exercise book
- pen or pencil
- blackboard
- coloured pencils.

Activity summary:

Students are introduced to the concept of a Marine Protected Area (MPA) by considering the need for rules that govern behaviour, the roles MPAs play in protecting marine environments and the benefits they provide.

Outcomes:

Students will be able to:

- define Marine Protected Area
- identify the benefits of having Marine Protected Areas.

Procedure:

1. Read the 'Poison rope fishing' example provided below to the class. Alternatively, choose information or a case study provided in any of the earlier modules in this resource that demonstrates a marine ***conservation*** problem.
2. Ask the students if anyone has heard of the term 'Marine Protected Area' or if they know of any that exist in your area.
3. Tell the students the definition of a Marine Protected Area and give them some examples (see information below).

   A good definition of a Marine Protected Area is: 'Any area of the marine environment that has been reserved by a government body or local land owners using national or customary laws to provide lasting protection to the area.'

   Some examples of Marine Protected Areas include national marine sanctuaries, community protected areas, no take zones, marine conservation areas and tabu/tambu areas protected through customary laws.
4. Tell the students that Marine Protected Areas are often used as a solution to a number of marine conservation issues, such as the one you introduced at the beginning of the activity.
5. Then, explain that while all Marine Protected Areas fit the overall definition, they may each have different rules that apply to use of those areas.
6. As a class, create a list of games that students know, such as noughts and crosses, snakes and ladders, or an outside game such as soccer, rugby or hopscotch. In pairs, ask your students to record the rules for one of the games.
7. Now ask each pair of students to draw a picture of what might happen if one of the rules is not followed.

Poison rope fishing

A local resident described a developing problem in our community. The resident, who didn't want to be identified, said:

'We all like to live in a beautiful area where there are clean beaches, healthy coral reefs and lots of fish and shellfish to eat. But in this beauty there are some serious problems. Some fishermen are using destructive fishing methods like poison rope fishing. Poison rope fishing uses a highly toxic substance that is collected from various local plants. This kills all the fish and other marine creatures that come into contact with it, and also affects corals, destroying parts of the fragile reef.

Something needs to be done!'

8. Ask students to write captions for their drawings that explain the possible reasons for games having rules. Answers will vary but may include such responses as:
   - so it is fair for everyone.
   - so that everyone has fun.
   - so that nobody gets hurt.
9. Then, explain to the students that they are going to apply their understanding of why rules exist to Marine Protected Areas.
10. Ask the students why Marine Protected Areas need rules. Answers will vary but may include such responses as:
    - so fish can be protected
    - so fisherman know where they can and can't fish
    - so more fish can breed
    - to protect the coral
    - because people often catch too many fish
    - so that small fish have a chance to grow into bigger fish.
11. To conclude the activity, lead a class discussion that summarises the benefits offered by Marine Protected Areas. These include:
    - maintaining ***biodiversity*** and providing places where ***species*** of fish are safe from being caught
    - protecting ***habitats*** from destructive fishing practices and other human activities, and allowing damaged areas to recover
    - providing areas where fish are able to breed and grow to their adult size
    - increasing fish catches (both size and quantity of fish) in surrounding fishing grounds
    - to help make sure there are fish to catch if the area is affected by a cyclone or ***climate change***
    - helping to maintain local cultures, economies and livelihoods linked to the marine environment.

Assessment ideas:

This activity is intended to be used as an introductory activity. No separate assessment is needed, although students' understanding of the need for rules in Marine Protected Areas can be assessed.

Teacher's fact sheet:

Establishing effective Marine Protected Areas

The ***Locally-Managed Marine Area (LMMA)*** Network works to improve the way marine environments are protected as well as the well-being of coastal people across the Pacific Islands. Members of the LMMA have valuable information and experience to share with others about creating and managing ***Marine Protected Areas*** at a local level with community involvement.

Below is information from the LMMA about establishing effective marine protected areas:

Traditional versus modern management techniques

Throughout the Pacific Islands, communities have long practiced traditional techniques to preserve their marine ***resources***. These techniques include seasonal bans or no-take areas, either temporarily or permanently. For example, in Fiji, the traditional use of tabu (no-take) areas was used to make an area of the reef a temporary no-fishing zone when a chief or special community member died.

Besides being considered a sign of respect, declaring the tabu also had a practical effect, ensuring there were plenty of fish to feed visitors when the mourning period ended many months later. This customary practice was a good way of making sure that there was plenty to eat from the sea.

On many Pacific Islands, particular reef areas were considered sacred according to the pre-Christian belief system. These areas were permanently closed to fishing as tabu areas. Over time, the traditional practice of establishing tabu areas has mostly been abandoned. However, in many areas today, island chiefs have begun to reintroduce no-take areas, to try and increase the number of fish.

While falling back on traditional management practices alone may work well in some places, adding other options or blending traditional with modern techniques may make managing MPAs more effective.

When establishing and managing a MPA it is important to consider the following:

Variety of habitat

Many ***species*** that live on coral reefs as adults grow up in seagrasses, seaweeds and ***mangrove*** areas. Therefore, it is important to have these ***habitats*** as part of the MPA. Sandy and rocky shorelines are also important nursery areas for particular types of sea cucumbers, so these areas also need protection from human activities.

Health of the reef

Communities often choose to protect unhealthy reef areas where there are few fish because they don't want to lose the better fishing areas, and because they want the sick reef to get healthy again. However, it is important to include healthy areas of reef that contain a variety of marine resources as part of the MPA. This will allow different kinds of fish and shellfish to reproduce and spread into other areas.

Patrolling and enforcement

As the MPA starts filling with fish, some people will be tempted to fish there. It is important to set up your MPA in areas where community members can see and stop anyone breaking the rules. An enforcement system and penalties should be clearly established during the planning stage.

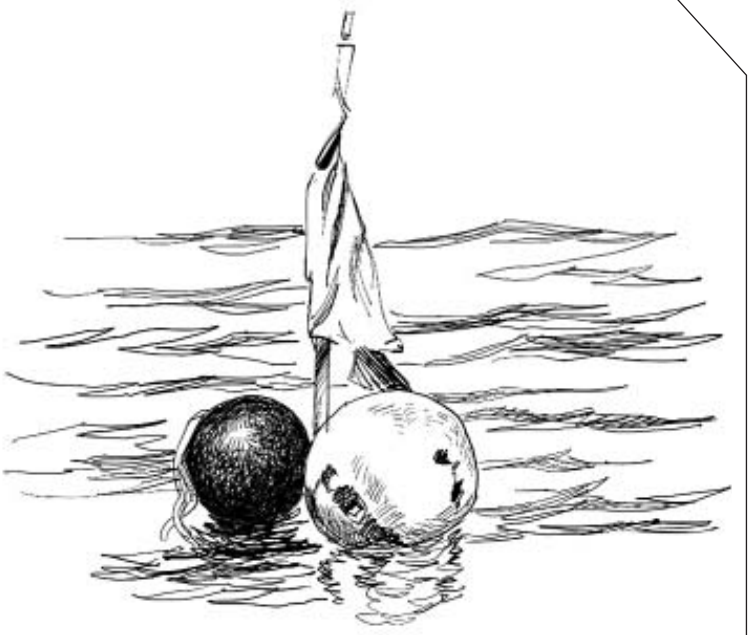
Period of time

The amount of time that a MPA is enforced will have an impact on how successful it is. For example, closing a reef for three to five years is necessary for significant recovery of fish, but if the reef is protected permanently, the results will be even greater. A temporary closure will result in an increase in the size and the number of fish in the open fishing grounds, but it may not do much to restore animals that have become very scarce.

After seeing an increase in fish and shellfish, communities may be tempted to lift the no-fishing ban. However, doing this will mean that most of the benefits are lost. The greatest benefits occur when the area becomes full of mature fish and acts as a breeding ground. This may take a number of years.

Size

For a single MPA to protect the ***ecosystems*** needed for all species in an area, it would have to be huge. But for ***fisheries*** to benefit, MPAs must be small enough to allow fish species to spill over into adjacent fishing grounds. To balance the needs of fishers and the marine environment, and to get the best benefit from protection, the best solution is often a number of MPAs of different sizes.



Using Bouys to mark boundaries will help to ensure everyone knows where the MPA is located.

Local participation

The participation of local communities is vital to the success of most MPAs. With local support, MPAs can be very successful in improving the health and the ***yield*** of the marine environment. Without community involvement, MPAs can be a waste of effort. Established MPAs show that the more the local community are involved in the decisions in the beginning, the fewer conflicts and management problems occur later.

Make it known

It is important to post the rules of the MPA and to display its boundaries so that all members of the community and neighbouring villages know about it. Using prominent sign boards, buoys, sticks or other markers to show the borders will help ensure that there is no confusion about where the MPA is located. In some cases it may be possible to legally register the area with the national government.

Monitoring

One problem that may occur in a MPA is that sometimes a species may become overabundant until the natural balance is restored. This can prevent the recovery of other species. For example, octopus may become overabundant in the months following no-take area establishment. The octopus could kill most of the remaining shellfish, leaving the no-take area with fewer shellfish than the open fishing areas. Octopus predators, such as black-tipped reef sharks and moray eels, may take many years to recover. Monitoring the MPA will identify any problems, and will determine if any action needs to be taken, such as introducing a regulated octopus harvest to offset this imbalance. Monitoring will also show which resources are returning and which are not, and where other actions may be necessary to return particular species to the reef.

Some ideas for setting up MPAs are given below. These are just guidelines; each community should set their own rules according to their particular circumstances.

- Pick an area that has variety, including shallow reef top, deep reef edge, sandy areas and mangroves and seagrasses if possible. The more diverse the area, the better the chance that the homes of different fish, shellfish and other marine creatures are protected.
- Choose a place that is easy to look after (for patrolling and enforcement), rather than reef areas that are far away and out of sight.

Monitoring the MPA will identify any problems, and will determine if any action needs to be taken.

- To make sure that everyone knows where the no-take area boundaries are, pick some obvious landmarks, such as a point of land, a cliff, a cave, or a river. This prevents people claiming that they were outside the reserve.
- Draw a map and have everyone who controls the fishing rights sign it to agree that this is the protected area.
- Have a village meeting to let everyone know where the MPA is and what the rules are. Be sure to also inform other communities that use the area for fishing, and anyone who may be absent from the village meeting.
- Do a monitoring ***survey*** when you first establish the MPA, so you can measure the recovery of the area over time. A simple way to see if fish and shellfish are returning is to have fishers (both men and women) start a fishing diary recording various information, such as how many fish, octopus, clams, etc. they catch every day, how long they are out fishing, where they fish, and what fishing methods they use.
- Set up long-term no-take areas in addition to shorter-term no-take areas within your MPA.
- Consider other measures to help fisheries resources recover faster in all areas, such as regulating net fishing, banning harmful fishing methods, and prohibiting commercial fishing in areas where people catch their daily food.
- If there are other serious problems affecting the reefs, such as pollution or mud and silt coming from human activities on land, your management action will need to address these. For example, reduce nutrient ***pollution*** by improving sewage systems and reducing other sources of nutrients, such as run-off from piggeries.

Source: Adapted from Information by The Locally-Managed Marine Area (LMMA) Network and WWF Global Marine Programme.

Below are some case studies about effective Marine Protected areas in the region.

Case Study:
Community-based management in Fiji

Parts of the vibrant coral reefs around Fiji's Ono Island have been damaged since many fishing communities have shifted from subsistence living to a cash economy.

Local commercial fishers frequently use diving equipment and spear guns, and until recently even poison, to catch fish and earn cash.

Towards the end of 1998, Ono islanders decided it was time to stop the decline of their marine environment. With WWF's help, the villagers have come together to create a community-based management system that makes the most of their customary ownership rights

WWF is working with the community to identify the best strategies for local resource owners to better manage their reef and increase their capacity to manage income- generating activities. Among the community's options is a return to the traditional practice of reserving a fishing ground to increase a fish population for a traditional ceremony. One village has declared two large lagoons off limits to fishing, diving and other damaging activities. Elders of the community who have watched the changes in fishing methods are already noticing an improvement.

Story used with permission from WWF South Pacific

Case Study:
Arnavon Islands' Marine Protected Area, Solomon Islands

The Arnavon Islands is a group of islands located between two different provinces, Isabel and Choisuel, in the Solomon Islands. The islands have diverse shoreline and coral reef habitats with different types of coral, fish, shells and other marine life.

The people of Choisuel and Isabel agreed to establish the islands as a Marine Protected Area (MPA). This meant that neither group could use the islands directly but all would benefit.

By establishing a Marine Protected Area, the people provided a safe place for the marine life in the area. The MPA is used as a breeding ground by the various living things in the marine environment so that overall numbers of fish and shells increase. Even though they are not able to fish or collect shells in the MPA, the people have more to gather in other areas because breeding and growth is occurring within the MPA and then the fish and shells spread out into the fishing areas.

Observations in the Arnavon Islands showed an increase in the number and type of marine and terrestrial living things. The islands' beaches became a nesting place for turtles, and many commercial species, such as bech-de-mer and trochus shells, are increasing not only within the MPA but also in the surrounding areas. The greater numbers of different marine resources is an obvious advantage, but there were other opportunities as well.

The greater number and variety of fish in the MPA became an attraction to tourists, who wished to snorkel and see the beauty of our Pacific marine life. This tourism brought income into the area. Also, monitoring and assessment of the MPA needed to take place so various people from the communities involved were given the opportunity to be trained and were provided with employment.

Students drawing a map representing the important features of the land and sea at a local site.

Searching for answers

MPA map makers

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science, Art

Glossary words:
habitats, mangroves, Marine Protected Area (MPA), resources

Materials:

- loose paper or pages in an exercise book
- pen or pencil
- copies of an outline map of a local site, or paper for students to create their own map
- clipboards or something solid for students to rest their paper against while they are creating maps
- coloured pencils (optional)
- marker pens (optional).

Activity summary:

This activity provides an opportunity for students to draw a map representing the important features of the land and sea at a local site that would benefit from being managed as a Marine Protected Area (MPA). A map of the features, as well as known activities and resources, can be used as a basis for designing a MPA in the next exercise.

Outcomes:

Students will be able to:

- identify features, activities and resources in the local marine environment and present this information on a map
- determine features, activities and resources in the local marine environment that need to be considered when establishing a MPA.

Procedure:

Before the lesson:

1. Choose a site in your local area that you believe would benefit from being managed as a MPA. Ensure it is easy for your students to access.

2. Draw a large outline map of the proposed area. Be sure to mark the position of a few important landmarks on the map. This will help students to understand the scale and help them to identify central features. You may like to include a map key. Use symbols to represent the features mentioned above, as well others the students might use.

3. If you are able, make enough copies so that when divided into small groups, each student in your class has access to a copy to work with. If you are unable to make copies, draw the map onto a blackboard for students to copy.

On the day of the lesson:

1. Tell students that they are going to make a map of a potential MPA site in your local area. Remind them that maps are views of an area from above, like what you would see from an aeroplane, or if you were a bird.

2. Divide the group into teams of three or four students (or larger if necessary). If you have made copies of the map, distribute one map to each group. If not, ask each group to copy the outline map you have drawn on the blackboard.

3. Take your students on a field trip to the site.

4. Familiarise the students with the study area by having them identify features on the map. Discuss the symbols used in the map key, so that all students use the same symbol if they want to mark any of these features.

5. Ask students to consider features, resources, activities and issues that occur at the site. Tell students to use symbols or colours to identify each of these things on the map, and to record what they mean in the map key.

   See checklist below for ideas.

   - infrastructure: homes, churches, schools, bridges, roads, paths, wharves, etc.
   - boundaries: government, tribal, language, etc.
   - commercial: hotels, resorts, markets, harbours, shops, etc.
   - geographic features: rivers, farming areas, forests, gardens,
   - marine ***habitats*** (***mangroves***, sea grasses, shallow reef top, deep reef edges, deep water etc.), location of important animals or plants, etc.
   - resource use: key resources and who harvests what, where, when and how. (E.g. places where men or women fish, places where commercial fishing happens)
   - other impacts, such as aquaculture, land clearing, mining, dredging, etc.
   - traditional uses or special features: sacred sites, tabus, fish traps, etc., or even things that people like or value
   - problems: things that are considered to be problems, such as conflict about how the site or a resource can be used, destructive fishing activities, commercial fishing, sources of pollution, damage being done to beach or reef etc.

6. When all of the groups have finished, bring the teams together. Lay out all of the maps. Spend some time comparing students' observations.

7. Back in the classroom, combine all of the group maps into one comprehensive class map of the site, showing all of the features, resources, activities and issues that occur at the site.

8. Conclude this activity with a class discussion, using the information on the map to identify the problems and issues affecting the site, the community and its resources.

Examples of the problems and issues students may identify include:

- run-off from land clearing, gardens or farms
- sand being removed for construction
- reef being damaged by boats entering at a particular point
- dumping rubbish in the sea
- people using large nets catching large quantities of fish
- mangroves being removed or damaged
- destructive fishing activities such as coral smashing or poison rope.

9. Make a list of these so they can be addressed when planning a local MPA in the next activity. Ensure the map is kept safe for future reference.

Assessment ideas:

Collect the maps produced by the students to use as the means of assessment. Review the students' maps for features, resources, activities and issues identified against the checklist provided at step 5.

- unsatisfactory – the students' map does not adequately incorporate the features, resources, activities and issues from the local marine environment
- satisfactory – the students' map incorporates features, resources, activities and issues in the local marine environment
- excellent – the students' map clearly incorporates features, resources and activities in the local area and demonstrates a clear understanding of issues that affect the local marine environment.

A sign that an area has been declared tabu.

Teacher's fact sheet:

Establishing management guidelines for your MPA

When deciding on the management actions to be taken when establishing a ***Marine Protected Area*** it is important that communities (or students, in the case of this exercise) consider their best options. The approach chosen should be trying to deal with the reason that ***fisheries*** are declining. For example, if the root cause of decline is believed to be the use of dynamite or poisons for fishing, then destructive fishing practices should be addressed in the plan to manage the area. As well as addressing these issues or activities, the creation of some sort of ***no-take zone*** should be considered to help ***species*** and ***habitat*** recover or continue to flourish.

The main reasons that MPAs are established are:

- to protect the natural environment (species, ***habitats***, ***ecosystems***)
- to protect the historical or cultural importance of the site (sacred sites, tabus, wrecks)
- to ensure the site's ***resources*** are used in a ***sustainable*** way.

The management guidelines regarding what can and cannot occur in the MPA will depend on the problems faced by the site, the root cause of these problems and the main reason the MPA is being established.

In establishing guidelines for your MPA, you should consider areas, times, activities and rules. Below are some examples.

Areas:

- Decide on the area that will be covered by the MPA.
- Clearly define the boundaries of MPA.
- Create permanent areas where you cannot fish or collect marine species (no-take zones).
- Create different zones for different uses (for example, banning commercial fishing where it competes with local fishing for food, or tourism, etc.).
- Create tabu/tambu areas.

Times:

- Establish a rotating or temporary no-take zone, to give the reef a resting period.
- Close fisheries during breeding season.
- Create tabu areas when a chief or special community member dies.
- Ban the harvest of egg-bearing female crayfish or crabs during breeding season.

Traditional fishing methods such as using fish traps and fish fences can replace some types of net fishing in MPA's.

Activities:

- Discourage destructive practices such as walking on corals, anchoring on corals (instead, make permanent moorings, or buy or make sand anchors) and harvesting corals (instead, introduce sustainable coral farming).
- Ban the disposal of rubbish into the sea, especially plastics, batteries and cans.
- Ban the use of poisons for fishing (both traditional and modern).
- Ban fishing that destroys habitat, such as ***dynamite fishing***, smashing corals to chase fish into nets, etc.
- Use fish traps and fish fences to replace some types of net fishing.

Other rules:

- Establish size limits for clams, lobsters, crabs, octopus and certain fish.
- Set bag limits, which restrict the number of a particular fish, shell or other animal that can be taken per person at one time.
- Ban the harvesting of rare or threatened species, such as marine turtles and giant clams.
- Limit the numbers of commercial fishers in a particular area.
- Re-establish traditional fishing methods that allow 'totem' species (species that are sacred to a particular clan) to be easily released.

Enforcing Marine Protected Area rules

As marine areas show signs of increased fish, shellfish and other marine resources, poaching (illegal fishing) often increases as well. Communities use different strategies to enforce their rules and maintain their marine protected areas.

Below are some suggestions from the Locally-Managed Marine Area (LMMA) Network for enforcing MPA rules.

- Ensure good communication and outreach within the community and in surrounding communities so that everyone knows the rules and the areas being protected.
- Suggest that surrounding communities set up their own Marine Protected Area to gain the benefits witnessed at other sites.
- Use traditional methods and chiefly systems when possible.
- Seek government support for community regulations. This can increase credibility and recognition of rules.

An important step in creating an MPA is to ensure that all community members are aware of and support the plan for the MPA.

Trying solutions

Create your own MPA

Suggested timing:
90 minutes

Subject areas:
Language Studies, Social Science, Science

Glossary words:
conservation, dynamite fishing, fisheries, habitat, Marine Protected Area (MPA), no-take zones, resources, species, stakeholders, sustainable

Materials:

- site map created in previous activity
- loose paper or pages in an exercise book
- pen or pencil
- coloured pencils (optional)
- marker pens (optional).

Activity summary:

In this activity students establish basic rules for a ***Marine Protected Area (MPA)*** within the area they mapped in the previous activity. These rules are intended to demonstrate students' understanding of the issues affecting a marine site and their ability to propose management solutions. The activity can be applied to a real or imaginary MPA and site.

Outcomes:

Students will be able to:

- identify issues affecting a marine site and propose solutions
- describe ways in which establishing a local protected area would affect their community.

Procedure:

1. Display the map created in the 'Searching for answers: MPA map makers' activity.

2. Recap on the problems and issues affecting the site, the community and its ***resources***.

3. Using the site map as a starting point, ask your students if they believe the area they mapped would be a good place for a Marine Protected Area (MPA)?

4. Through class discussion, determine the following:

   - What are the main problems and issues affecting this site? (See ideas from 'Searching for answers: MPA map makers'.)
   - What would be the main reason, or primary ***conservation*** goal for making this site a MPA? (e.g. to protect the natural environment, to protect the historical or cultural importance of the site, to ensure its resources are used in a ***sustainable*** way.)
   - What activities should be stopped or restricted in the MPA? e.g.
     - Discouraging destructive practices such as walking on corals, anchoring on corals (instead, make permanent moorings, or buy or make sand anchors), and harvesting corals (instead, replace with sustainable coral farming).
     - Ban the disposal of rubbish into the sea, especially plastics, batteries and cans.
     - Ban the use of poisons for fishing (both traditional and modern).
     - Ban fishing that destroys ***habitat*** (***dynamite fishing***, smashing corals to chase fish into nets, etc.).
   - What rules are needed to support the area being a MPA? e.g.
     - Create permanent areas where you cannot fish or collect marine ***species*** (***no-take zones***).
     - Create tabu areas or activities.
     - Temporary no-take zone (giving the reef a resting period)
     - Create different zones for different uses (for example, banning commercial fishing where it competes with subsistence fishing or tourism).
     - Set size limits (no fish under a certain size can be taken or no fish over a certain size).
     - Set bag limits, which restrict the number of a particular fish, shell or other animal that can be taken per person at one time.
     - Close ***fisheries*** during breeding season.
     - Limit the numbers of commercial fishers in a particular area.
   - Who are the people (***stakeholders***) that will be affected by the MPA?
   - How might the stakeholders feel about the area becoming a MPA?
   - How would you check this MPA over time to determine whether it is doing what it was set aside to do?

5. Record the students' answers and ideas on the blackboard so they can be referred to again.

   For the next part of the exercise, your students can work either as individuals, pairs or in small groups.

6. An important step in creating an MPA is to ensure that all community members and other stakeholders are aware of the plan for the MPA and understand their role in supporting the MPA. Using the answers and ideas determined above, ask your students to create a poster or report that informs the rest of the community about the new Marine Protected Area. The poster or report should include the following information:

   - What area is being set aside as a MPA? (include a map)
   - Why should it become a MPA?
   - What activities are restricted in the MPA?

- What are the rules of the MPA?
- How will the rules of the MPA be imposed? (e.g. what are the penalties for breaking the rules)
- Who will be involved with supporting the MPA once it is established?

7. Conclude this activity by having each student, pair or small group share their report or poster with the rest of the class. This can be done as an oral presentation, or less formally, by displaying all posters around the room for students to look at in their own time and making the reports available for quiet reading time. You may like to share the students' ideas with community leaders – who knows, they might prompt the creation of a real MPA!

Assessment ideas:

The poster or report about the new Marine Protected Area prepared by the students should serve as one means of assessment.

- unsatisfactory – student's poster/ report fails to demonstrate an understanding of issues affecting a marine site and does not propose management solutions
- satisfactory – student's poster/report demonstrates an understanding of issues affecting a marine site and proposes management solutions
- excellent – student's poster/ report clearly demonstrates an understanding of issues affecting a marine site and proposes sound management solutions.

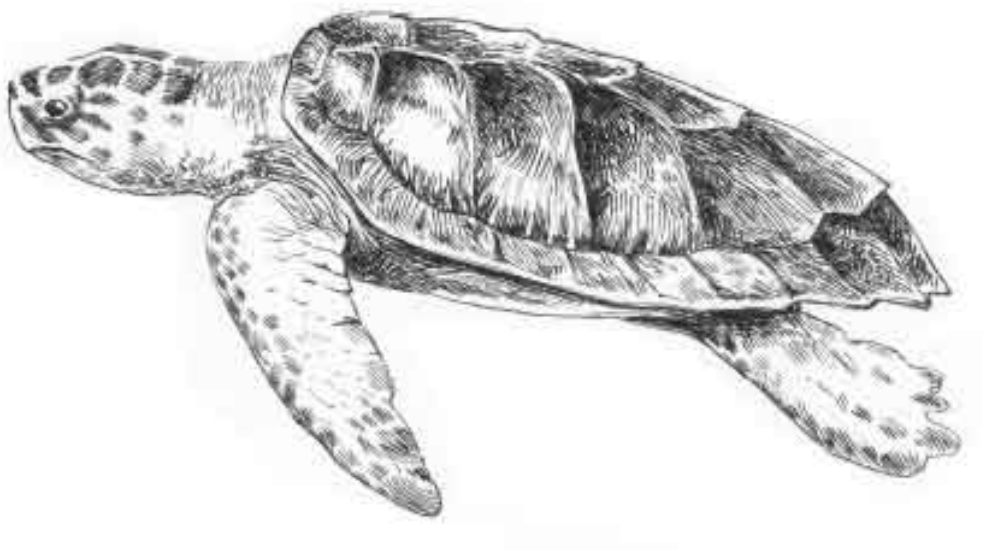
Optional activity:

MPA guest speaker/field visit

You may be fortunate to have a MPA or LMMA established close to your school or community. If this is the case, you can carry out the 'Searching for answers' and 'Trying solutions' activities for this module with a classroom visit from a guest speaker involved with the management of the site, or by taking the class on a field visit to the site. If you have enough time you can carry out both.

See names of some organisations involved with MPAs in the region which may be able to assist with a guest speaker or field trip.

- The Locally-Managed Marine Area (LMMA) Network www.LMMAnetwork.org (P): +679 3361122 (F): +679 3361184
- Foundation for the South Pacific International (FSPI) Coastal Programme www.fspi.org.fj, (P): +679 3312250 (F): +679 3312298
- Mahonia Na Dari – Guardian of the Sea Kimbe, West New Britain, Papua New Guinea http://www.mahonia.org/ (P): +675 983 5046, (P): +675 983 4241
- WWF South Pacific Programme, http://www.wwfpacific.org.fj/ WWF Solomon Islands (P): +677 60191 WWF Fiji (P): +679 3315533 WWF Papua New Guinea (P): +675 32 00 149
- The Nature Conservancy Solomon Island Field Office, (P): +677 20940
- The Nature Conservancy Kimbe Bay Project Office, (P): +675 9835808
- The World Fish Centre Solomon Islands (P): +677 25090 or (P): +677 25080.
- Wildlife Conservation Society Papua New Guinea Office (P): +675 532 3494



Marine creatures such as turtles can benefit from restrictions set in MPA's such as no take zones.

Student reflection

Stand in someone else's shoes

Suggested timing:
45 minutes

Subject areas:
Language Studies, Social Science

Glossary words:
fisheries, Marine Protected Area (MPA), resources, stakeholders

Materials:
- paper or exercise book
- blackboard
- pen or pencil
- coloured pencils (optional).

Activity summary:

In this activity students will consider who the ***stakeholders*** of a ***Marine Protected Area (MPA)*** are and how its establishment affects them.

Outcomes:

Students will be able to:

- identify the different people or groups affected by marine areas
- describe the impacts of establishing Marine Protected Areas from different points of view.

Procedure:

1. Remind students that MPAs have rules about how the site and its ***resources*** can be used. The enforcement of these rules can have an effect on various people or groups in the community.

2. Copy the stakeholder list (see below) onto the blackboard. Stakeholders are individual people or groups that are affected by an issue.

   Stakeholder list:

   - local women who catch fish for their family
   - tourists
   - marine biologists (scientists)
   - commercial fishermen
   - person who uses poison rope
   - Chief
   - children
   - fisheries officer
   - giant clam.

3. Ask each student to choose one stakeholder and write a short creative writing piece about how their chosen stakeholder has been affected by the establishment of the MPA. The experience of the stakeholder could be positive, negative or both (there is no right or wrong answer).

4. Encourage students to illustrate their creative writing piece.

5. Invite students to form groups with other students who have chosen the same stakeholder. Encourage students share their writing with the rest of their group.

6. Conclude this activity by discussing the following with each group:

   - How does your stakeholder feel about the MPA?
   - How do you personally feel about the issue?
   - Did you learn anything about the challenges involved when deciding to make a site a MPA?
   - What are some of the costs of creating an MPA?

Assessment ideas:

Use this activity as a summary activity. No separate assessment is needed, although the creative writing piece can be assessed.

One benefit of an MPA is an increase in fish stocks in surrounding fishing areas.

Glossary

A

adapt
Change to suit a new environment or conditions

adaptation
Making plans and taking action to reduce the vulnerability of natural and human systems to the effects of climate change, both actual and expected.

algal blooms
Sudden spurts of algal growth, often affecting water quality. Some algal blooms are the result of excess nutrients in water – higher concentrations of nutrients can cause increased algae growth.

atmosphere
The gases that surround the Earth. These gases include water vapour, greenhouses gases, oxygen and nitrogen.

B

biodiversity
The total diversity of living things and of the ecosystems they are a part of (including species, genetic and ecosystem diversity).

bottom trawling
A method of fishing where large nets are weighted and dragged behind a boat, often catching both target and non-target species, as well as causing significant physical disturbance to bottom habitats.

by-catch
Unwanted marine creatures that are caught in the nets while fishing for another species.

C

calcium carbonate
A mineral that hard corals secrete from sea water to create their limestone skeletons.

carbon dioxide (CO_2)
A naturally occurring gas that cannot be seen or smelt. It is formed by burning organic materials such as wood or fossil fuels. Carbon dioxide is the main gas effecting current global temperature increases.

carbon sinks
Ecosystems, such as oceans and forests, that absorb carbon from the atmosphere.

chronological
Presented or arranged in the order in which events occur or occurred.

climate
The weather in a certain location averaged over long period of time. This includes temperature, rainfall and wind.

climate change
A change in the world's climate due to human activities.

conservation
The protection, improvement and wise use of biodiversity to ensure its continued existence.

contaminated
To make something impure or unclean by contact or mixture.

coral bleaching
When coral loses its colour, becomes white and eventually dies. This happens when algae that live inside the coral and give it its colour are expelled by reef corals, causing the coral to look white or 'bleached'; generally a response to stress.

cyanide fishing
The process of using cyanide to poison and stun fish for capture on a coral reef; commonly used to catch live fish for restaurants or the aquarium trade.

D

deforestation
When forest-covered areas become non-forested areas, such as farms and cities, as a result of human activities.

dynamite fishing
The process of using dynamite or other explosions to capture fish from a coral reef or other marine environment.

E

ecosystems
Communities of plants and animals interacting with each other and with their non-living environments, such as coral reef ecosystems, sea grass ecosystems.

emissions
Gases or other substances that are released into the atmosphere.

erosion
The wearing away of land or soil by wind or water, intensified by land-clearing practices related to farming, residential or industrial development, road building or logging.

extinction
The complete disappearance of a species from Earth, forever.

F

fertilisers
Substances put onto or into soil to improve plant growth.

fishery/fisheries
The industry of catching, processing, and selling fish, shellfish, or other aquatic animals. The place where fish or other aquatic animals are caught.

fossil fuels
Fuels, such as coal, oil and natural gas that are formed in Earth's crust from the organic remains of prehistoric plants and animals.

G

glaciers
Slowly moving masses of ice.

global warming
The increase in the average temperature of Earth's atmosphere and oceans as a result of an increase of carbon dioxide and other gases in the atmosphere.

greenhouse gases
Various types of gases in Earth's atmosphere that contribute to the warming of the planet through the greenhouse effect.

H

habitat
The place where a plant or animal lives.

L

landfill
An area in which rubbish is buried between layers of earth.

Locally Marine Managed Areas (LMMAs)
A community designated and managed area that protects coral reefs and other marine resources.

M

mangroves
Shrubs and trees that live along the seashore in tropical and sub-tropical regions and have a high tolerance for saltwater.

Marine Protected Areas (MPAs)
An area of coastal land and water that is set aside to protect natural resources and ecosystems.

mitigation
Action to address a problem. For example, climate change mitigation aims to reduce the concentrations of greenhouse gases, either by reducing their sources or by increasing their natural storage.

N

non-point source pollution
Pollution whose origin is not easily identifiable, such as runoff from a road or pollution in a river generated from a variety of sources.

no-take zones
Areas where fishing and commercial extraction is not allowed.

O

objective
Something worked toward; a goal.

opinion
What one thinks; a point of view, judgement or belief.

organisms
Individual living systems, such as animals, plants or micro-organisms, that are capable of reproduction, growth and maintaining themselves.

overfishing
Fishing an area beyond the capacity for fish stocks to reproduce and remain sustainable over time.

P

photosynthesis
The chemical process used by plants to take energy from the sun and produce food (sugars).

point-source pollution
Pollution that enters the environment from an identifiable source, such as a sewer or pipeline.

polar ice caps
Areas at the north and south poles of Earth that are permanently covered in ice.

pollution/pollutants
Any substances in water, air or soil that reduce the natural quality of the environment.

populations
All the members of one species in a habitat.

predictions
To imagine or forecast what might happen in the future.

R

recycled
The process of making things that people have thrown out into useful things again. For example, glass can be recycled by being ground down into small fragments, heated and turned into any shape.

resources

Materials, money or skills that are available to be used.

respiration

The process in which an organism uses oxygen to breathe and gives off carbon dioxide.

replant

To plant again or anew. Can also mean the restoration of a forest that has been reduced by fire or cutting.

S

sea level rise

As global temperatures increase, water in the world's oceans will expand, and this change, combined with the melting of the polar ice caps and glaciers, will result in a rise in sea level.

sediments

Soil particles, usually sand, silt or clay

sedimentation

The process by which sediments are carried by flowing water and gather at the bottom, such as in a river or on a coral reef.

species

A group of closely-related organisms that are capable of interbreeding and breed only among themselves and not with others.

stakeholders

Individual people or groups that are affected by an issue.

survey

To look closely at something to try and find more out about it. One way of finding out information is by asking people questions (surveying).

sustainable

Meeting the needs of the present without compromising the ability of future generations to meet their needs. Sustainable resource use means the rate at which a resource is being used is balanced with the natural processes needed to replace the resource .

T

target audience/group

An individual or group that are intended to be influenced.

target species

The term used to describe the type of animal or plant that an action is focused on, e.g. the species that you want to catch or to protect.

toxic

Able to poison or harm an organism. Toxic substances are bad for the health of living things.

U

unsustainable

Taking or using too much of a resource, meaning it will not be available in the future.

urban

Urban describes areas in cities instead of on farms (rural)

Y

yield

An amount of a product produced, or the income arising from land or other property.

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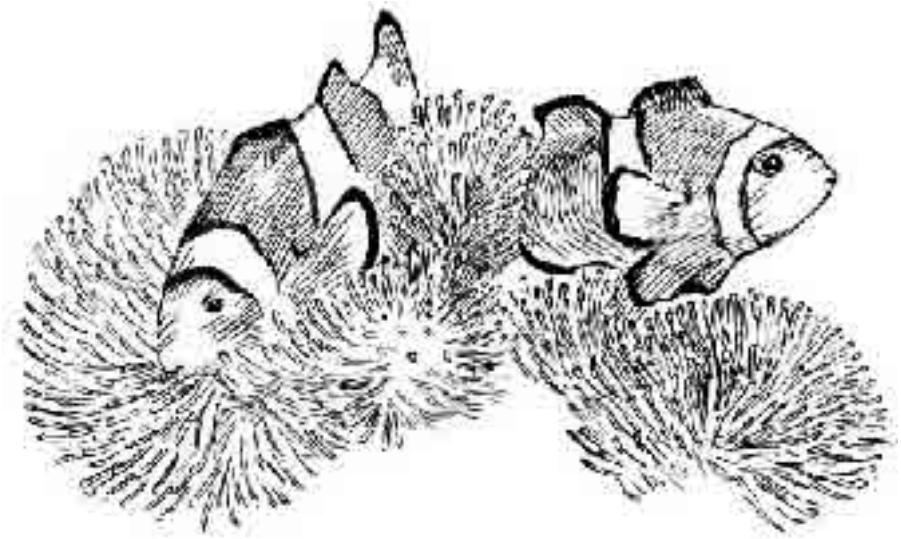

Scientists have only recently discovered a world whose astounding diversity of life holds the promise of new medicines to treat our ailments, a sustainable supply of delectable, healthful foods, and a wealth of understanding unlikely to be matched anytime soon in the sterile vastness of outer space. This new world is called the sea.

Elliot Norse,
President, Marine Conservation Biology Institute

Fisheries for our future

An educator's guide to marine conservation

Fisheries for our future: *An educators guide to marine conservation* is a teaching and learning resource that has been designed specifically for use by teachers and educators in the Pacific. The resource's four modules, fact sheets and activities aim to support education about marine conservation in the region. The goal is not to tell students what to think, but to introduce issues and encourage students to develop values, attitudes and skills to help them to understand how their decisions affect the marine environment and to inspire them to take action.

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