Discovering Biodiversity

An Educator's Guide to Exploring Nature's Variety

LIVE&LEARN
Environmental Education

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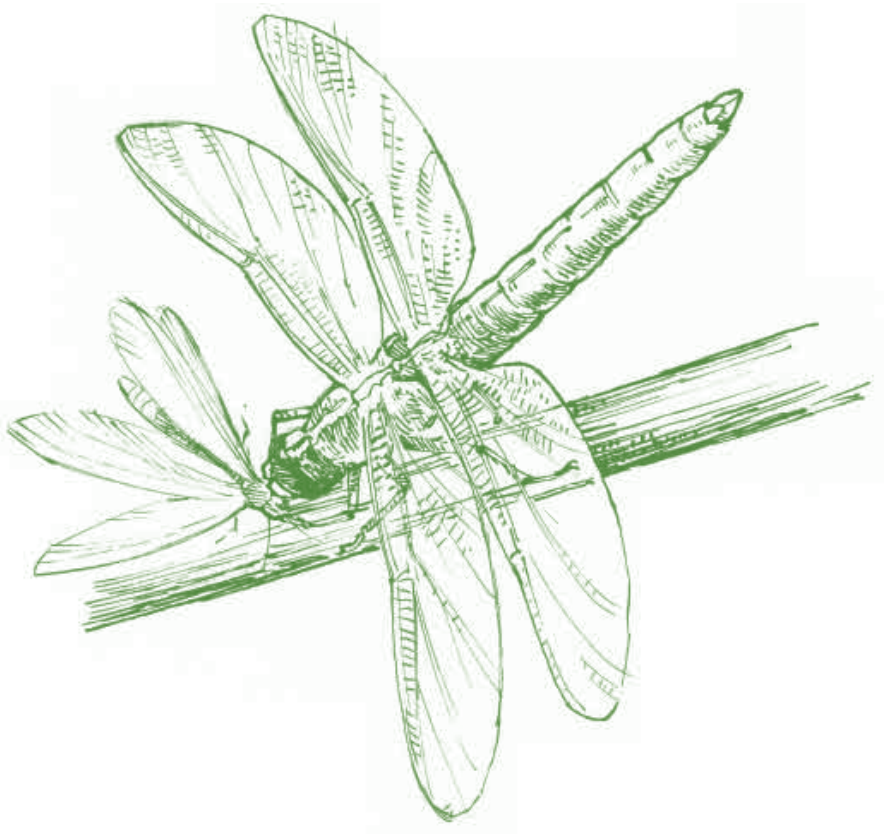

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Welcome

Discovering Biodiversity*: An Educator's Guide to Exploring Nature's Variety* provides teachers and students with an opportunity to learn about, investigate and take action to conserve the amazing variety of life in the Pacific. Biodiversity is the term that explains the natural variety on the planet, the variety of living organisms and the ecological systems in which they occur.

Biodiversity is essential to our survival and for maintaining the delicate balance of our climate ecosystems. The biggest threats to Earth's biodiversity are from climate change, invasive species and widespread habitat loss. 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 diversity of life around them and helps them to gain the skills, knowledge and confidence they need to rise to the challenge of maintaining biodiversity.

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 four Pacific countries, Cambodia 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.

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Introduction

Purpose

The purpose of the modules and activities in this guide are to provide teachers in the Pacific with a resource to help improve the quality of biodiversity education for students in the region. The goal of the resource is not to teach students what to think about biodiversity, but to introduce them to ideas, themes and concepts about biodiversity and encourage the development of values, attitudes and skills to help them to make better decisions that affect biodiversity conservation.

Overview

Discovering Biodiversity*: An Educator's Guide to Exploring Nature's Variety* is a teaching and learning resource that has been designed specifically for use by teachers and educators in the Pacific. The resources' six modules, topics and activities have been designed to support the teaching of key learning outcomes specified in school curriculum and have been developed with extensive input from teachers and educators across the region. It is packed full of ideas and information to explore the scientific, social, cultural and economic aspects of biodiversity with your students.

As you read through this resource you may be surprised by the topics it covers – everything from food chains to population growth and economics. The topics covered in the resource are so widespread because that is the nature of biodiversity itself: it links with almost every aspect of our lives.

In the resource you will find comprehensive information about biodiversity within the teacher's background reading sections and 34 teaching activities that can be used in and outside the classroom. The resource also includes some ideas, resources and techniques to enrich your teaching.

What is biodiversity?

Biodiversity is short for biological diversity, which means the variety of living organisms, the genes they contain and the ecological systems in which they occur. Biodiversity can be described at three levels: genetic, species and ecosystem.

Genetic diversity refers to the variety of genetic information contained in all of the individual plants, animals and micro-organisms.

Species diversity refers to the variety of living species.

Ecosystem diversity relates to the variety of habitats, communities and ecological processes, as well as the amazing diversity that exists within them.

Healthy ecosystems with many varieties of plants and animals, including micro-organisms and the genetics they contain, are the basis of our survival because they supply us with oxygen, clean water, soil and many other resources.

This resource introduces and explores the concepts that support education for sustainability and the conservation of biodiversity to help teachers and students create a more positive vision for the future.

Who is the resource for?

This resource is designed to help teachers present the concepts of sustainability and biodiversity, and its conservation, to students from 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.

Biodiversity

"The variety of all life forms – the different plants, animals, micro-organisms, the genes they contain, and the ecosystems of which they form a part."

The concepts are presented in two stages. The first consists of background reading which is aimed at clarifying concepts for teachers. The second stage contains activities that the teacher can do with the class, and is aimed at developing students' knowledge, skills, attitudes and behaviours necessary to help conserve biodiversity.

How to use the resource

The teaching components of this resource are divided into modules. Each module deals with major biodiversity themes. These modules are:

Module 1: Discovering Biodiversity - The concepts within this module provide students with essential knowledge and understanding of biodiversity. These concepts also help students understand the characteristics of living systems and the fact that the environment is made up of many connected systems.

Module 2: The Value of Biodiversity – The concepts within this module can help students to investigate how biodiversity affects their lives and supports life on Earth. Being able to recognise the importance of biodiversity increases students awareness of why and how people's actions affect biodiversity and why it's important to maintain and, where necessary, restore biodiversity.

Module 3: Biodiversity: Understanding the Threats – The concepts in this module can help students understand the status of biodiversity and why biodiversity is declining around the world. By learning about the causes and consequences of biodiversity loss, students will be able to participate in maintaining biodiversity in the future.

Module 4: Taking Action for Biodiversity – The concepts in this section help students identify ways to ensure that biodiversity will be conserved for future generations. An understanding of these concepts can help students to learn that although issues surrounding biodiversity loss are complex, individuals, organisations and governments all have a role to play in resolving them.

Module 5: Biodiversity in Culture – The concepts in this module help students to identify the connections between biodiversity and human culture. Students can learn that human cultures interact with, understand and value biodiversity in many different ways by exploring personal heritage and traditions that are connected to the natural environment.

Module 6: Biodiversity, Resources and Economics –The concepts in this module provide students with knowledge and understanding of the connections between resources, society and economics related to biodiversity and explore the influence that personal and economic values have on making decisions about biodiversity.

The modules are designed to be used by teachers during relevant teaching sessions. It is not intended that the biodiversity modules be taught as a separate subject. We acknowledge that school curriculums are already overcrowded. The intent of the modules is for them to be infused into the existing curriculums, aiming to maximise opportunities for biodiversity education.

Each module contains learning outcomes which will match closely to learning outcomes in existing curriculum and could be used to help teachers in choosing the activities that could be carried out when conducting lessons.

The six modules work together to form a holistic biodiversity unit but can stand alone as individual themes of study. You can pick up any of these modules and present biodiversity to your students. We know that no one can create better units of studies for your students than you, so 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.

Background reading

The background reading is a short text for teachers that introduces the concept in detail and can be used as preparation for the learning activity. In development of this resource it has been assumed that schools currently have little access to written information on biodiversity, hence an effort has been made to provide all the basic information required to conduct the activities and provide the students with learning experiences. 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.

Background reading is not designed to be written onto the blackboard for students to copy down, however you will find that much of the information will be relevant to pass on to the students. A number of words and phrases are ***italicised and bolded*** throughout the background reading. These are identified as 'Glossary Words', which are new words that you and your students may not be familiar with. These words will be important for you to understand the readings and run the activity. Definitions for these can be found in the Glossary.

Activities

These suggested activities are designed as step-by-step guides on how to teach the key concepts and learning outcomes in each section to students. Where appropriate, activities are constructed using an example of an 'Experiential Learning Model' approach, which is explained in further detail on p. 13. Each activity follows the format described in the sample below.

Activity summary

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

Suggested timing

This gives an idea of how much time it might take for the teacher to prepare for and deliver the activity based on piloting and teacher comments. This is only a suggested time that teachers can use to deliver the lesson. Time taken to deliver the activity could be more or less depending on what the teacher plans for.

Subject areas

This is a suggestion of where in the curriculum this 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.

Outcomes

Outcomes used in this resource match closely to learning outcomes in existing curriculums and describe what students should be able to do after taking part in the activity. One activity may be able to achieve more than one identified learning outcome. Each learning outcome that the activity is designed to achieve will be stated here.

Biodiversity

Is the variety of life on Earth. It's everything from the tiniest microbe to the tallest trees, from creatures that spend their entire lives deep in the oceans to those that soar high above the Earth's surface.

Glossary words

This highlights important words used in the activity that students may not already know but are essential to understanding the concepts in the activity. These words will be defined in the glossary. They 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 have gathered 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 materials needed for the activities can be found easily by schools in the Pacific region.

Process

The process contains suggestions on how to implement the activity including:

Tuning in – introduces student to a topic by providing an experience, idea, question, or scenario that generates their interest, and challenges them to find out more.

Developing understanding - activities and experiences designed to assist students to understand the concept and answer questions raised during tuning in.

Use concept/Practise skills – provides opportunities to practise the skills or used the concepts they have learned.

Application/Reflection – allows students to identify ways they can use or apply what they have learnt to other situations or provides opportunities to apply or discuss what they have learnt with others.

Teachers' notes

These extra notes to help the teacher present the activity may include general teaching tips, and may provide additional activities for continued investigation into the concepts addressed in the activity or suggestions for references providing additional background information.

Teaching approaches

Education should challenge students to think critically and creatively about their world, to question how and why we do things and 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 build effective personal knowledge, skills and commitments, which enable them to participate effectively in society, and develop an understanding of their rights and responsibilities.

The resource is built on a set of underlying principles about education, which develop the concepts mentioned above. As you work through the modules and the supporting activities, you will notice many familiar educational strategies and approaches. We have included here some important approaches used in best practice environmental education that may enhance your teaching. These include education in, about and for the environment, critical thinking, considering different learning styles and encouraging experiential learning.

Enriching Your Teaching

Education for sustainability

Most of the activities in the ***Discovering Biodiversity*** 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 to take action for conserving biodiversity. 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 don't occur in isolation from economic, social and political factors. For example, a development that brings money into a community may have provided positive benefits by allowing people to pay school fees and access better healthcare. But if the development also destroys the forest, then the financial benefits may be short-lived. The loss of forest biodiversity may cause the water supply to be contaminated, and prevent access to building materials, medicines, foods and customs that benefit the community. Recognising this, ***Discovering Biodiversity*** is broad and tries to draw connections between the factors that link humans, our quality of life and biodiversity 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 practising important life skills.

Education 'in, about and for' the environment

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

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

Education *about* the environment is about providing students with an understanding or increased knowledge of the environment. It focuses on the development of understanding of facts, concepts and theories, by learning about 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.

Education *in* the environment provides students with opportunities to gain hands-on experience in the environment. It aims to provide students with increased awareness and appreciation of the environment through direct contact with plants, animals and natural areas and is used to provide reality, relevance and practical learning for the student. It focuses on the development of skills for collecting information, such as mapping, doing surveys, conducting interviews and sketching, as well as cooperation and group working skills. Education in the environment also allows students to have 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.

Biodiversity

It's also the wealth of habitats that house all life forms and the interconnections that tie us together. All of Earth's ecosystems and living things that have developed within them – including the fantastic range and expression of human culture – are all part of our planet's biodiversity.

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 feelings of concern and responsibility for the environment and promote the motivation and skills needed for students to participate in actions to improve the environment. It encourages student's willingness and ability to make lifestyle choices that have positive impacts on the environment.

Although education *in* and *about* the environment help students develop appropriate knowledge, attitudes, values and skills in relation to environmental problems, this is generally not considered sufficient to lead students to take positive actions and make choices that protect the environment. It is necessary for students to participate in education *for* the environment, so that they also have the motivation and ability to be involved in practical action and can make choices that play a part in solutions to environmental problems. Activities in this resource acknowledge the importance of linking knowledge to changes in behaviours and use all three approaches to help deepen students' understanding of environmental problems and 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 make a decision about the best action to take in the given situation. Having critical thinking skills allows 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 enable us to make decisions based on our own values and perceptions, rather than being influenced by others.

Critical thinking can be taught or developed through situations where students are allowed 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 provide real-life situations and guide students to discover their own knowledge. Rather then just transmitting knowledge, teachers should be facilitators of knowledge. Teachers can do this by good questioning techniques that encourage higher level thinking and problem solving. Teachers need to encourage more 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. There are a number of activities in this resource that provide opportunities for students to develop and practise critical thinking skills.

Learning styles and multiple intelligences

As teachers, most of us will know that not all students learn in the same way. One of the goals of developing this resource was to make biodiversity come alive to all students, 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. For example, conducting family culture and nature

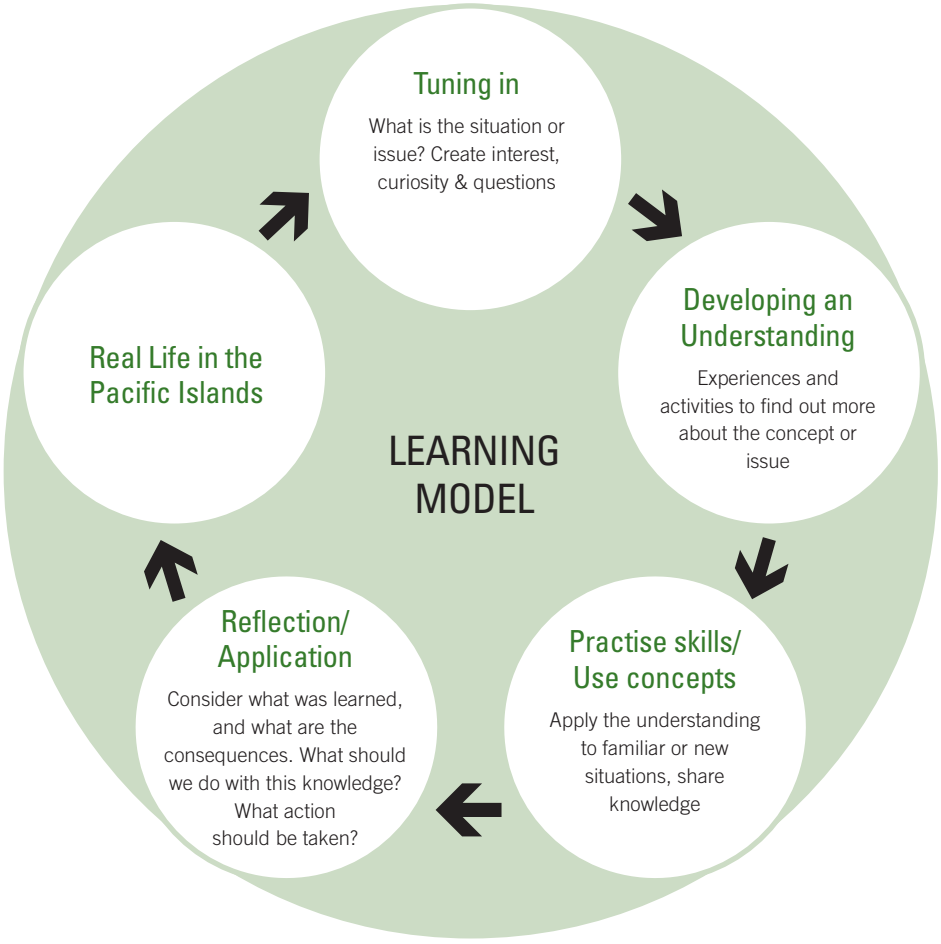
surveys in Module 5 is likely to appeal most to active learners who like to interact with others. The creation of a 'Resources and Management Mobile' in Module 4 will probably be of most interest to imaginative learners who thrive on creative expression. In addition to recognising different learning styles, the activities have also been developed to emphasise strategies that promote the variety of strengths your students already have and help them to develop new strengths.

The learning model

This resource uses the teaching and learning techniques mentioned above and incorporates them into an activity structure that follows an experiential learning model. As educators, we know that students learn better when they are actively engaged in their learning and have a chance to take part in varied experiences. Experiential learning models are a way of organising lessons to provide opportunities for students to do this. Several experiential 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, Developing an Understanding, Practise skills/Use concepts* and *Application/Reflection*.

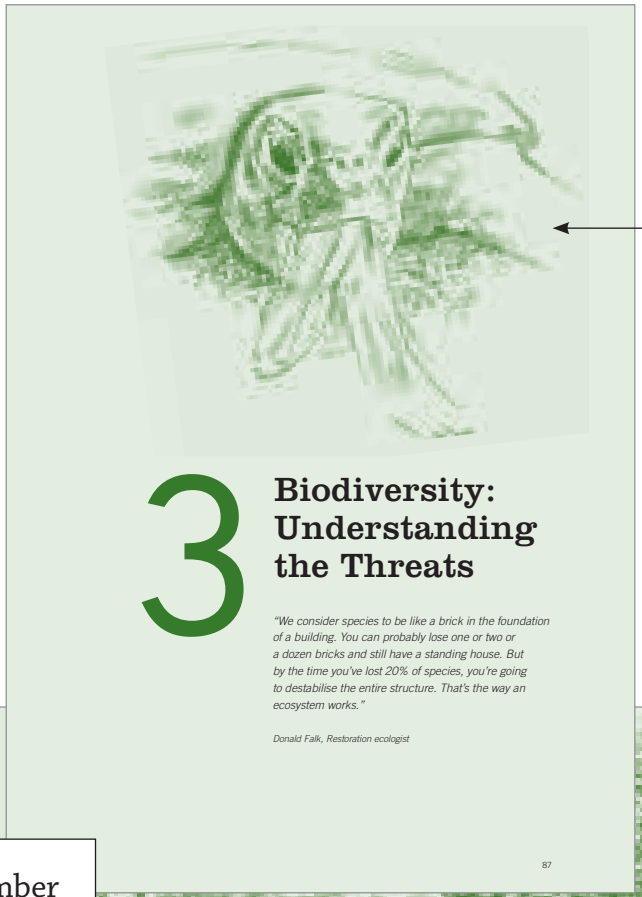
- **Tuning in:** An introduction that engages students with a situation or issue, raising students' curiosity and motivation to learn
- **Developing an Understanding:** A chance to take part in an experience or activity that helps them to gain knowledge or a better understanding of the topic
- **Practise skills/Use concepts:** An opportunity for students to apply what they have learned to familiar or new situations, and practise new skills
- **Reflection/Application:** A chance to reflect and generalise on what has been learned, how this can be applied to other situations, and to consider what action should be taken.

The diagram below summarises the learning model presented above.



At a Glance

Welcome to the activity part of the resource. Below is a visual overview of the structure of the resource and its individual activities to help you navigate your way through.



3

Biodiversity: Understanding the Threats

"We consider species to be like a brick in the foundation of a building. You can probably lose one or two or a dozen bricks and still have a standing house. But by the time you've lost 20% of species, you're going to destabilise the entire structure. That's the way an ecosystem works."

Donald Falk, Restoration ecologist

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Module opening page

Module Introduction

This page provides teachers with a 'snapshot' or a summary of what they will find inside the module.

Module number

activities are not as gentle on the Earth as they may have been a long time ago. When population growth is also considered, this highlights the big challenges we face today. If we can minimise our impact, we will do much to save our biodiversity and keep the planet and ourselves healthy.

This module has seven Topics that cover:

1. Loss and Degradation of Habitats
2. Human Population Growth
3. Endangered Species
4. Trade in Endangered Species
5. Waste and Pollution
6. Invasive and Introduced Species
7. Climate Change.

The topics not only define these issues and allow students to understand them in their own context, but they allow students to investigate and critically look at how and why they have an impact on the Earth's biodiversity.

MODULE 3

MODULE 3

Module Introduction

Biodiversity: Understanding the Threats

Threats to our incredible and unique biodiversity in the Pacific are numerous; we are losing our biodiversity faster than the Earth has ever seen before. This loss, called extinction, is forever; the species will never be seen again. Sadly, more and more species are at risk of extinction every day because of our activities. To make things worse, it is happening at a time where we are only just starting to understand how and why biodiversity is so important to our world and to us. Biodiversity not only keeps the world healthy, but keeps us healthy as well.

This module looks at various ways in which our biodiversity is threatened. The threats range from habitat loss to wildlife trade to climate change. The module aims to provide students with an insight into these and other issues. It is important for students to understand how we, as individuals and communities, threaten biodiversity locally and globally. Activities that seem harmless, such as driving a car or burning plastics and other rubbish, are having a much bigger impact than many of us realise.

Today we are seeing a trend toward ever increasing growth in the use of many of the world's resources, including land, food, minerals, water and fuels such as oil and timber. The Earth's resources are already being used up at a rate never known before. The world is faced with a problem because the supply of resources is limited, which means there are limits to how much we can take.

Another big issue affecting our communities and the planet as a whole is that of population growth. The world's population of people recently reached 6.7 billion people, and is predicted to reach 9 billion by 2050. If each person alive today was to hold hands with another and stand in a line, this line could wrap around the Earth 160 times!

Much of the human use of Earth's resources has happened with little thought about how this will impact us and our world in the future. Human

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Activity summary table

This provides a summary of the activity's aim, outcome, relevant subject area and suggested timing.

Topic Background reading

Before each activity, you will find a short text that introduces the activity concept and can be used as preparation for the learning activity.

MODULE 1

Activity Details Summary: Module 1, Discovering Biodiversity

Topic	Activity Name	Activity summary	Outcome	Subject Areas	Timing
Biodiversity in your local area	Activity 1 – Recognising and Naming animals	During this activity students become familiar with several local plants and animals and describe their local environment.	Recognise and name common animals and plants from local habitats and investigate how they live.	Science, Language Studies, Art	Teacher preparation time: 60 minutes Lesson time: 90 minutes, plus a small homework task
Identifying adaptive features of living things (Made for the job)	Activity 2 – Finding Features	In this activity students will draw an imaginary animal with adaptations that will help them survive in a particular environment. Students will then recognise that certain features help animals to survive in the habitats where they are found.	Investigate similarity and diversity of characteristics within and between groups of living things in order to group things by common features. Link observable features to their functions in living things. Explain how an adaptive feature of animal assists it to live and function in a particular habitat.	Science, Art	Teacher preparation time: 30 minutes Lesson time: 90 minutes
Ecosystem diversity, genetic diversity and species diversity (Types of biodiversity)	Activity 3 – Biodiversity at 3 levels	This activity will enable students to recognise the 3 different levels of biodiversity, list examples of each different biodiversity correctly and identify examples from their local environment.	Explain that the diversity of living things is considered at three levels; ecosystem diversity, genetic diversity and species diversity. Give examples of each.	Science, Language Studies	Teacher preparation time: 45 minutes Lesson time: 90 minutes
Connections between living things	Activity 4 – Natural Connections	This activity will enable students to discover the many ways in which plants, animals and other living things are connected with each other and depend on each other for survival. They will be involved in a scavenger hunt, and will Practise skills in observation, drawing, writing and sharing ideas.	Observe and explain some ways in which living things are interdependent with reference to a small number of simple, familiar examples.	Science, Language Studies	Teacher preparation time: 60 minutes Lesson time: 90 minutes
Exploring habitats	Activity 5 – Habitats and Homes	This activity uses our own communities as an example to introduce the concept of habitats. Students will undertake an active investigation of habitats in their school grounds to become familiar with features of habitats in their local environment.	Explore the needs of a plant or animal in a particular habitat and recognise that they depend on specific aspects of their environment for survival. Identify various types of habitat in your local area	Science, Language Studies	Teacher preparation time: 30 minutes Lesson time: 90 minutes

MODULE 1

Bracket fungi

Topic

1

Biodiversity in Your Local Area

Background Reading

Biodiversity is not only found deep in the forest, beneath the ocean or in a coral reef. Biodiversity also includes the many different varieties of living things that make their homes in our villages, gardens, streams, local bush, shoreline and even within the school grounds.

An investigation of the living things found in or around the local environment is an excellent way to introduce students to the topic of biodiversity. You may be surprised how much life can be discovered only a short distance from the classroom door. A focus on locally found plants and animals is important because they are more relevant to students' lives and everyday experiences. Knowledge gained about local plants and animals can be applied by students making it more interesting. It also allows students to share what they already know about their plants and animals and prov... knowled...

have a surprising amount of knowledge about the natural world, as they spend a lot of time playing outside!

If we want students to grow up to become adults who care, respect and take action to look after their local environment, it is important that they understand and value their local biodiversity. This is the reason why it is important to get to know the biodiversity in the place where you live.

Looking for wildlife

Taking your students outside provides opportunities for many different learning experiences. Students will be able to discover and experience biodiversity for themselves. Students will find hands-on activities a lot of fun and therefore will be more interested in learning.

Biodiversity in the school grounds includes all of the plants and animals, both large and small; some

Teachers' notes:

At the beginning of most activities, these notes give tips to assist you to present the activity.

Case studies provide practical examples for students.

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 all the 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.

MODULE 3

Activity 5
Story of a River

Suggested Timing
Teacher preparation time: 30 minutes
Lesson time: 45–90 minutes

Subject Areas
Language Studies, Arts, Health, Science, Social Science

Glossary Words
Pollution, POPs, non-biodegradable, biodegradable, domesticated, urban, organism, molecule, predator, toxic, sediment, ecosystem

Materials
- 4 empty bottles
- A transparent container or big bowl (more then 2 litre capacity)
- 1 bottle of cola (full) or cold black coffee
- 1 bottle of milk and coffee or tea
- 1 bottle of green cordial
- 1 bottle of yellow cordial
- Soap

Four cards with the following titles:
- (1) Mr Watson, the Logger
- (2) Ms Gina, the Farmer
- (3) Ms Siwa, the Villager
- (4) Mr Fremie, the Factory Manager

Teachers' notes:

If you do not live near a river or your island has no rivers you can still use the 'Story of a River' in this book as a guide to write your own story. The story could be about the mangroves or the landscape and how pollution builds up.

When you are doing the 'Story of a River' simulation with your class, make sure they understand that the substances you are tipping into the river are only representations of the pollution, not the real stuff. At the end of the simulation make sure you dispose of the water responsibly, e.g. pour it onto a garden bed. Make sure the students are aware that you are disposing of it properly.

Activity summary

Students will investigate sources of waste and pollution in their area and be able to understand its effect on the food chain and its impact on biodiversity. They will then be able to develop a storybook that illustrates their understanding of the issues, and suggest actions that could be done locally to address the problems with pollution.

Outcomes

Students will be able to:

- Identify ways in which humans pollute the environment and explain the effects of pollutants on biodiversity.

Tuning in

1. Show students the picture of a dead fish floating next to rubbish and pollution (see p. 126). Ask the students what they think has happened to the fish. Conduct a discussion to develop a definition of 'pollution'. Ask the students: Where does pollution come from? (What are the sources of pollution?). Make a list of sources on the blackboard.

MODULE 3

At the beginning of each activity, there is a list of practical information to assist you with planning. This contains suggested timing, subject areas, Glossary words (which links to words in the Glossary at the back of the book) and materials required.

1 Discovering Biodiversity

"When you have seen one ant, one bird, one tree, you have not seen them all. Each species is a masterpiece, a creation assembled with extreme care and genius."

Edward O. Wilson

Module Introduction

Discovering Biodiversity

We don't have to travel to the deepest darkest rainforests or coral reefs in our region to discover biodiversity. By just walking outside we can discover the amazing diversity of life in our own school grounds, backyards, roadsides, villages and communities.

Biodiversity is the variety of living organisms on Earth and the ecological systems in which they occur. It includes everything from the tiniest micro-organism to the tallest trees, from animals that spend their entire lives deep in the oceans to those that fly high above the Earth's surface. Biodiversity is also the amazing number of habitats and ecosystems in which all life forms live.

Biodiversity is the variety of life around us, but it is also much more. It's everything that living things do, and the interactions of living things with other living things and within their environment. These interactions can be as simple as a moth's dependence on one species of plant for food and the

plant's dependence on the moth for pollination. The moth and the plant are also dependent on all of the other elements that make up their ecosystem.

Biodiversity is not limited to the number and kinds of living things or the Earth's ecosystems, it also includes genetic diversity, which refers to the variety of genes within a species. All three levels of biodiversity are critical to understanding the interconnections that support all life on the planet.

This module explores what we mean by biodiversity and what we consider to be part of biodiversity. The activities are designed to provide students with a fundamental knowledge and appreciation of biodiversity.

There are five Topics that cover:

1. Biodiversity in your Local Area
2. Identifying Adaptive Features of Living Things (Made for the Job)
3. Ecosystem Diversity, Genetic Diversity and Species Diversity (Types of Biodiversity)
4. Connections Between Living Things
5. Exploring Habitats.

The complex nature of biodiversity and the millions of plants, animals, ecosystems and relationships that are part of biodiversity can be overwhelming. By discovering what biodiversity is, through exploring their local environment and reflecting on themselves as part of biodiversity, students begin to understand why biodiversity is so important to protect and conserve. Protection and conservation is addressed in later modules.

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Topic

1

Bracket fungi

Biodiversity in Your Local Area

Background Reading

Biodiversity is not only found deep in the forest, beneath the ocean or in a coral reef. Biodiversity also includes the many different varieties of living things that make their homes in our villages, gardens, streams, local bush, shoreline and even within the school grounds.

An investigation of the living things found in or around the local environment is an excellent way to introduce students to the topic of biodiversity. You may be surprised how much life can be discovered only a short distance from the classroom door. A focus on locally found plants and animals is important because they are more relevant to students' lives and everyday experiences. Knowledge gained about local plants and animals can be applied by students making it more interesting. It also allows students to share what they already know about their plants and animals and provides an opportunity to tap into local knowledge in their community. Children often have a surprising amount of knowledge about the natural world, as they spend a lot of time playing outside!

If we want students to grow up to become adults who care, respect and take action to look after their local environment, it is important that they understand and value their local biodiversity. This is the reason why it is important to get to know the biodiversity in the place where you live.

Looking for wildlife

Taking your students outside provides opportunities for many different learning experiences. Students will be able to discover and experience biodiversity for themselves. Students will find hands-on activities a lot of fun and therefore will be more interested in learning.

Biodiversity in the school grounds includes all of the plants and animals, both large and small; some so small they are difficult to find. Smaller living things include insects, spiders, crabs and other

forms of life such as ***fungi*** and ***lichens***. It is a good idea to have a look around the school grounds before you involve the students.

Through simple investigations and observations, students will become familiar with varieties of plants and animals and experience their ***habitats*** first hand. This personal experience helps students to make connections between their own lives and biodiversity.

Where do I look? What might I find?

Discovering biodiversity for yourself is a good way to learn more about it. The following tips may help you to get to know biodiversity in your school grounds:

Tip 1: It is a good idea to start your search for biodiversity in different habitats in the school grounds. Habitats may include a patch of grass, decaying leaf litter, soil, under a pile of rocks, a rotting log, under the bark of trees, a pond of water or a patch of flowering plants. Explore all of these places to find a variety of living things.

Tip 2: Think small! Many of the animals that live in the school grounds will be small, such as insects, spiders, millipedes and even crabs. Web-spinning spiders can usually be found between branches of trees and shrubs; these spiders are usually trying to catch flying insects that are visiting flowers. Look out for the different types of flies, bees, wasps, beetles and butterflies that may be searching for flowers. Crabs and some insects and spiders inhabit burrows in the ground, and a close inspection of the grass will reveal that there are many different types of ants – all actively going about their business.

Tip 3: Get your hands dirty! Many animals shelter during the day to avoid the attentions of things that might want to eat them (***predators***). Carefully turn over rocks or logs or peel back bark to reveal many animals that are otherwise hidden. Students may need to be encouraged to get their hands dirty and may need to be shown how to look. Remember to respect the animals and return rocks and logs to how you found them when you've finished looking.

Tip 4: Don't forget the plants! Plants are an important part of biodiversity. They come in many different shapes and sizes, and the great thing is they can't run away! Encourage students to look at the variety of plants in and around the school. Don't forget lichen and fungi, and remember that plants provide the food and shelter that support animals.

St Andrews cross spider

Activity 1
Looking for Locals

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 90 minutes, plus a small homework task

Subject Areas

Science, Language Studies, Art

Glossary Words

Biodiversity, lichen, fungi, vertebrate, invertebrate, predator, mammal, reptile, amphibians, metamorphosing, aquatic, native, introduced, exoskeleton, scat

Materials

- Coloured pencils
- Paper
- Exercise book
- Optional - crayons and butchers paper

Teachers' notes:

Leaf rubbing is a great way to make a picture or an impression of a leaf or another part of a plant, such as bark. Students start by placing a blank piece of paper over a leaf. The back of the leaf needs to be supported with a hard surface, e.g. place an exercise book under the leaf, creating a sandwich with a book at the back, leaf in the middle and the paper on top.

Students then use a lead or coloured pencil, chalk or crayon and colour the paper over the surface of the leaf. If you are making a bark rubbing, you do not need to worry about having the support behind it, just place the paper over the bark and colour. Students will soon see the image of the leaf appearing on the paper. This technique is a great way to observe and record details of the leaf, such as the shape or leaf veins. You can use this technique on other natural objects, such as shells, or to get details of other surfaces, such as paving or brick work. Why not try this in an art class?

Activity summary

During this activity students will become familiar with several local plants and animals and describe their local environment.

Outcomes

Students will be able to:

- Recognise and name common animals and plants from local habitats and investigate how they live.

Tuning in

Ask the students to suggest the types of animals and plants they are likely to see in their local environment. Encourage students to think about all animals; don't forget the small creatures such as insects and don't just focus on the big ones. Also make sure that students consider all the different types of plants such as palms, flowering trees, grasses etc. Create a class list of the students' answers.

When conducting this 'brainstorm' you may get a lot of suggestions of domestic animals such as dogs, cats, and cows. Try to get your class to think about the types of animals that are ***native*** to your country rather than animals that have been ***introduced*** to your country.

Set the students a homework task: ask them to choose a living thing from the list and interview an older family member or community elder about it. They should try to find out what the local language name for the plant or animal is, what the animal eats and where you can usually find the plant or animal. Encourage students to find out as much about the plant or animal as they can from family members.

As part of this homework task, if the student has chosen a plant ask them to collect a leaf from the plant to do a leaf rubbing (see teacher's notes), or ask them to draw a picture of the plant or animal. They can add this to the information they have gathered.

The next day at school, students should be encouraged to share the information they have found and their drawing or sample with the other members of the class.

Developing understanding

The next step of this activity is to sort the information that the students have collected into groups of animals or plants. This will be helpful when it comes to undertaking the investigation in the school ground. All animals have certain characteristics that make it easy for them to be placed into groups. All animals that have a backbone are called ***vertebrates***. All animals that don't have a backbone are called ***invertebrates***. The vertebrate group can be split into a variety of categories.

There are many varieties, categories and classifications of plants – so many, it would be difficult to name them all. You might like to create your own groups for the different plants you find. Suggestions include: grasses, trees (different types such as palms and pines), shrubs, vines and lichens. A simple way to categorise plants is by growth form. By comparing the physical form of different plants students can put them into groups. Ask them to think about vines, grasses, trees, shrubs and lichens as different ways plants grow.

Go through these groups with your class and discuss the different characteristics of each group.

Now, as a class (or you can get your students to work in small groups), try to sort the animals and plants they have been investigating into these categories. This will get students thinking about all the different types of animals and plants that are in their local area and helps set the scene for the survey that will be conducted outside the classroom. If there are any other common living things they can think of during the exercise, the students can discuss these and put these into the categories.

Practise skills

For this part of the activity you will need to prepare large posters or an area on the blackboard for students to record information. On each of the posters write one of the categories that animals can be split into and on the blackboard create a column for each category. You may not have a chance to investigate fish in your school ground so you could leave this category out. You might also like to have one poster for each of the plant categories you come up with.

Now prepare your students to go outside of the classroom to carry out an active search for plants and animals. Use the information from the background reading 'Where do I look? What might I find?' section to help guide the students' investigation. It will work better if students work in pairs or in threes. This will make it less likely

Group / Class of Animal	Characteristics
Mammals	Warm-blooded, usually furry, young feed on milk from the mother.
Birds	Warm-blooded, covered in feathers, have wings, young develop in eggs.
Reptiles	Cold-blooded, usually covered in scales, young usually develop in eggs.
Amphibians	Usually lay eggs in water, young usually go through a ***larval*** or tadpole stage, later ***metamorphosing*** (changing) into lung-breathing adults. In the Pacific, these would be toads or frogs.
Fish	Usually cold-blooded, completely ***aquatic***, breathe oxygen from water with gills, usually covered in scales.
Invertebrates	Animals that do not have a backbone. Most invertebrates have an external skeleton (***exoskeleton***) or none at all. Animals that can be called invertebrates include insects, spiders, ticks, crustaceans (e.g. slaters and crabs), snails, slugs and worms. They are common on land, sea and freshwater.

that animals will be scared away. Most large animals will disappear when students approach. It might be best to conduct this lesson over a number of days with students recording their results as they actually observe the animals. Tell students that they can also record evidence of the presence of animals in the school ground such as scats, tracks, nests, skin, fur and feathers.

Ask your students to record the animals and plants they see as they are carrying out their survey. Encourage them to also record information about what the animal was doing when they saw it, e.g. where was it? When recording information about plants, ask students to record information such as whether it had fruit, seeds, flowers etc. If you have time, additional surveys could be conducted at the students' homes or in a local area of bush, providing a broader picture of biodiversity in the local area.

Once back in the classroom give the students time to review and identify what they found. When they are ready have them add the names of the animals or plants they observed to the appropriate category or group on the survey posters.

Reflection

Conclude this activity by having the groups or pairs report on their observations and the process they used.

This could be done by holding a group discussion. Use the following questions to guide your discussion or, if you prefer, pose the questions to your students and ask them to write their answers in their books:

- How many different living things did your group find?
- Where did you find the different living things?
- Were living things spread out evenly across the schoolyard or did students find greater variety in particular areas?
- If so, where did they find the greatest biodiversity?
- Do you think the class found all the living things in the school ground?
- Do you think you would find the same things if you had been looking at night-time?
- Were you surprised by anything you found or did not find?

Finally, have each group or pair draw a map of the school ground or survey site and mark the different areas on it that they looked at, as well as including the particular plants or animals they observed in the different locations. These maps can be put up around the classroom and kept as a reference to keep track of changes in biodiversity from year to year by comparing new observations with those collected by other groups in the past.

Blue-tailed skink

The Pacific harrier has strong talons (toes) for catching prey

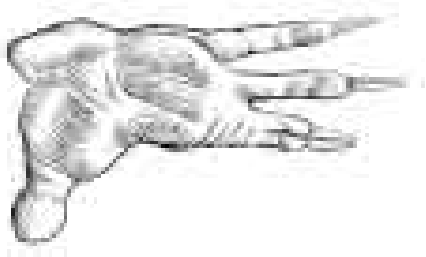
Topic

2

Made for the Job

Background Reading

Have you ever noticed that animals seem to be very well 'designed' for the way they live their lives? The possums and wallabies of Papua New Guinea are a good example. Possums and their close relatives the cuscuses live in the forests of Papua New Guinea and Australia. The Solomon Islands also has a cuscus which is often locally known as an 'opossum'. These animals spend almost all of their time high up in the forest trees. The possum therefore has very different feet from the wallaby, which lives on the ground. Possums have short and wide feet with long toes for grasping onto branches. The wallaby has hard narrow feet made for jumping and moving quickly across the ground.



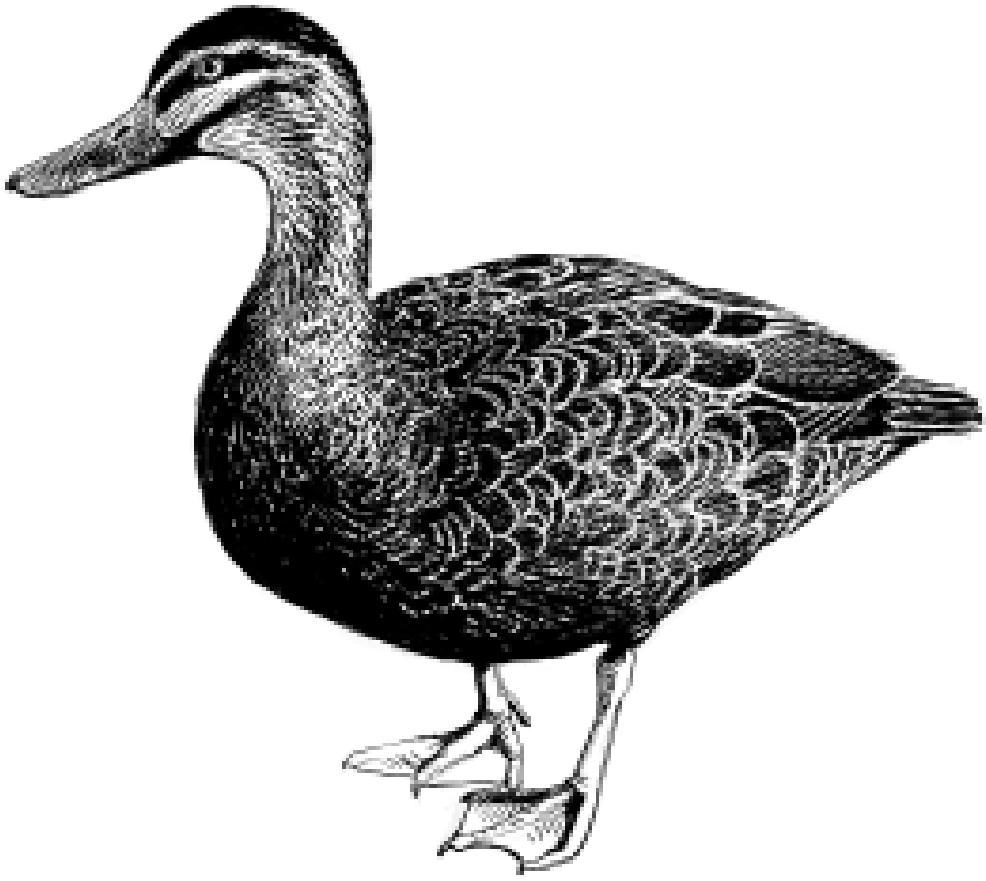
The top-left foot belongs to a ringtail possum, which needs a broad foot with long toes to help it grip and keep balance on the branches of trees. If it were to run on the ground, it would be easy prey for predators.

The bottom-left foot belongs to a wallaby (a very small kangaroo), which moves by hopping on the ground. The narrow surface gives it maximum power, so it can move very quickly to avoid ***predators****. If this animal tried to climb a tree it would probably fall and break its neck! Both of these animals are found in Papua New Guinea.*

Another good example can be observed in the feet of birds. The Pacific black duck has very different feet from a Pacific harrier. Ducks have webbed feet, which have long toes with skin that stretches between them, used for paddling through water. The Pacific harrier has strong talons, which are flexible toes with huge curved nails on the ends, that it uses to grasp and hold onto its prey.

The features of an animal or plant that help it to survive in its environment are called ***adaptations***. Features such as claws and teeth are adaptations, and behaviour such as aggression and hiding are also adaptations. These different adaptations are necessary for plants and animals to survive: for protection, to get food and water, and to find shelter and mates in their environment.

Every feature of an animal is an adaptation, but we do not always understand their uses. For instance, we may not be sure why some fish and parrots are brightly coloured or why some birds have a long beak while others don't. It can be fun to guess the purpose of different adaptations as they have a very important role to play in the survival of the animal or plant.



Ducks feet are well suited to swimming

Amazing adaptations of the barn owl!

The barn owl is another example of a common Pacific bird with amazing adaptations. The barn owl is found throughout Melanesia and Western Polynesia, but not on Tuvalu, Kiribati or Tokelau.

Adaptation: World's most sensitive ears

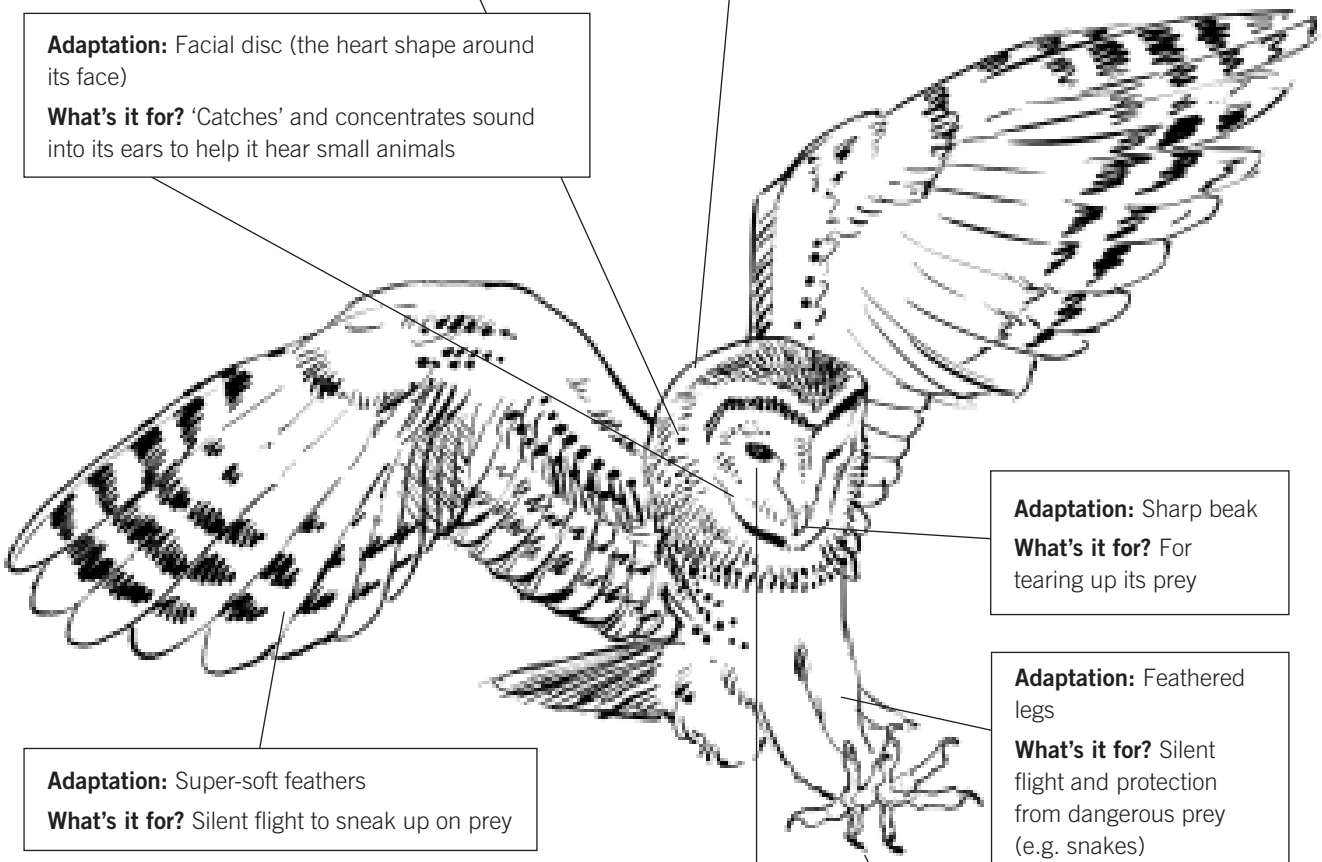
What's it for? Locating small animals that are crawling around at night; the owl can pinpoint the EXACT location of its prey in complete darkness!

Adaptation: Swivel neck that can turn almost full circle

What's it for? Its eyes are so big that they can't turn in their sockets like ours can, so instead they have an extra-flexible neck!

Adaptation: Facial disc (the heart shape around its face)

What's it for? 'Catches' and concentrates sound into its ears to help it hear small animals



Adaptation: Sharp beak

What's it for? For tearing up its prey

Adaptation: Feathered legs

What's it for? Silent flight and protection from dangerous prey (e.g. snakes)

Adaptation: Super-soft feathers

What's it for? Silent flight to sneak up on prey

Adaptation: Large forward-facing eyes

What's it for? Seeing at night when it is searching for prey, and for judging distance

Adaptation: Razor-sharp talons

What's it for? Grabbing and killing its prey, such as mice, rats, insects and other birds

Activity 2
Finding Features

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 90 minutes

Subject Areas

Science, Art

Glossary Words

Adaptations, habitat, environment, predators

Materials

- Glass jars
- Hammer and nail (to put holes in the jar lids)

Activity summary

Students will be able to draw an imaginary animal with adaptations that will help them survive in a particular environment. Students will then recognise that certain features help animals to survive in the habitats where they are found.

Outcomes

Students will be able to:

- Investigate the similarity and diversity of characteristics within and between groups of living things in order to group things by common features.
- Link observable features to their functions in living things.
- Explain how an adaptive feature of animal assists it to live and function in a particular habitat.

Tuning in: What big eyes you have!

Use the diagram in the background reading to draw a large picture of the barn owl on the blackboard (just draw the bird, not the labels that go with it). If you don't feel confident with your ability to draw ask one of your students who is good at drawing to do this part for you.

Discuss the following questions with the class to increase students' curiosity about this bird:

- What do you think this bird eats?
- Why do you think this bird has such large eyes?
- Why does this bird have very sharp claws on its toes?
- Why does this bird have so many feathers around its head?
- When do you think this bird is active?

Developing understanding: Adaptations of the barn owl

Explain to the students that this is a barn owl that lives in many countries throughout the Pacific. Tell the students that all the features of the owl have special uses that allow it to survive in its environment. The features allow it to catch food, shelter, reproduce and avoid being eaten.

Draw a line to each part of the barn owl and ask the students to suggest what each part is used for. Use the background information to correct or assist the students where necessary.

When you have labelled the features of the owl (with help from the students) explain the term '***adaptation***' and relate this term to the features of the owl. Explain that all living things have features that are specially suited for the environment and type of life that they live.

Practise skills: Bug catcher

1. Ask students to bring empty glass jars to school. The jars must have lids. Prepare the jars by using a hammer and nail to put small holes in the lids. You will only need one jar between 2 to 4 students.

2. Students will now go on a bug hunt. Organise the students into small groups of 2 to 4, and then go to a place that you have pre-arranged to search for bugs. Instruct the students to collect one type of small animal for their jar. For example, they could collect a grasshopper, spider, cockroach beetle, fly or a hermit crab. They should also collect some material to provide the creature with some shelter, e.g. if they collect a grasshopper they should also provide it with some grass.

3. After students have successfully collected a bug they should take it back to the classroom to observe it. Ask each student to carefully draw a picture of the bug that they have collected.

4. Ask the students to label their picture with arrows pointing to its various features. For example, they should put an arrow pointing to the legs, feet, wings, eyes, mouth etc. The students should then look closely at the animal in their jar and try to work out what each feature is used for. Explain that because each feature has a design related to its use, you can often guess this use just by looking at it. For example, the shell carried by a hermit crab looks like it might give the crab protection from its enemies – and this is exactly what it is actually used for. It doesn't matter if students get this activity 'right' or 'wrong', it is more important that they are correctly using the concept of adaptation.

5. After making observations the students should write an explanation to go with the label for each feature, e.g. 'the wings are used to fly away from danger' or 'the fangs are used to kill other bugs'.

6. When the students are finished ask them to 'show and tell' to the rest of the class. They should show their bug, and then explain the adaptations that they have labelled in their diagram. Encourage other students to ask them questions or to also give their ideas about the creatures' adaptations.

7. After the activity is completed you may wish to keep the bugs to observe them for another day. If students keep the animals, make sure that students take responsibility for their care. The creatures should be released alive and well back in the place where they were first collected.

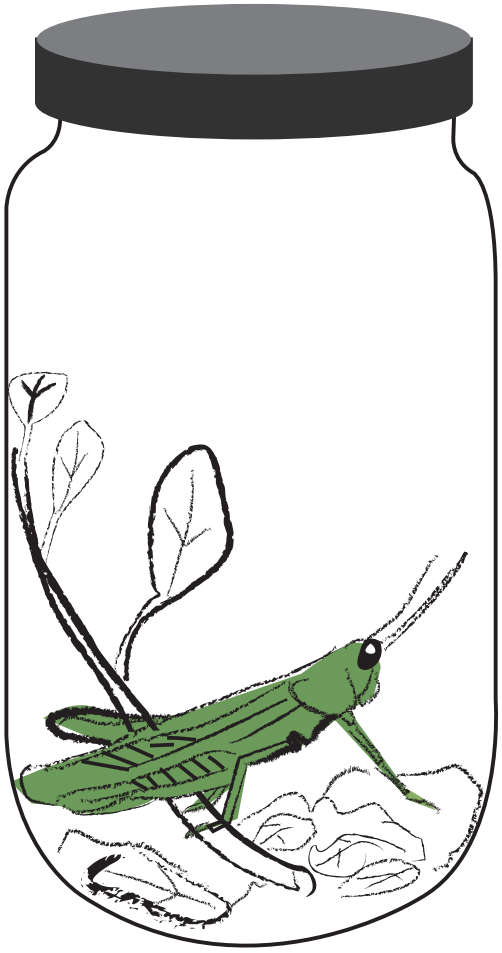
Application: Feature fantasy

Provide the students with an opportunity to be creative and design their own imaginary animals. First, each student needs to choose a particular ***habitat*** or ***environment*** where the creature will live. Ask them to think about all the different adaptations or features needed for the animal to survive in that particular environment. For example, if it is a cold ecosystem your animal might need fur; if it is a wet ecosystem your animal might need scales or skin, like a frog, and webbed feet; if it is dark your animal might need big eyes; if it is bright your animal might need big eyebrows to shade its eyes.

Ask each student to draw their fantasy animal. Tell them to make sure they include all the different adaptations or features the animal needs to survive in its environment. Get the students to label their drawing with an arrow to the different adaptations or features of the animal and a brief description of what each adaptation is used for. The students should also give their creature a fantastic name.

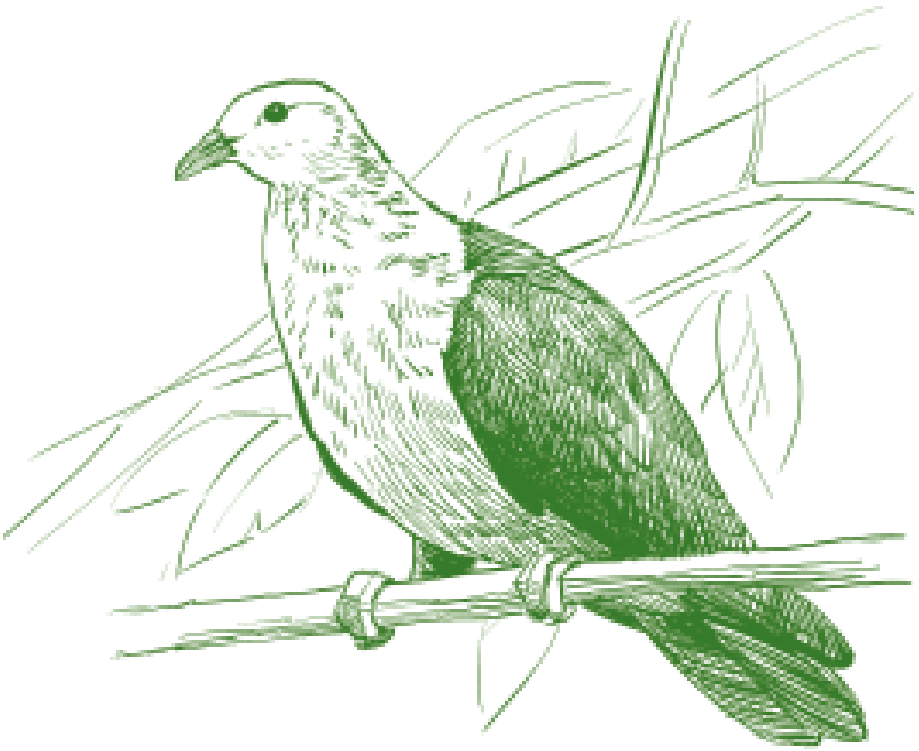
Tips for collecting and keeping bugs at school

- Find a good place to collect bugs before you take the students out looking. This could be somewhere with lots of leaf litter, compost, loose rocks or rotting logs, or the beach.
- Make sure students don't collect anything dangerous (such as a centipede or wasps).
- Ensure that students are respectful of the creatures that they collect. Demonstrate proper handling: jars should NEVER be shaken.
- Always provide some shelter (e.g. some grass, a leaf or some bark) in the jar with the bug. Don't put in rocks that can roll around and squash the bug.
- Never leave the jar sitting in the sun – this will quickly cook and kill your bug.
- Don't keep the bug for more than a few days.
- Remember that catching, respectfully handling and releasing a live and healthy bug is also a lesson in respect for nature and conservation.



Topic

3



Pacific pigeon

Types of Biodiversity

Background Reading

Biodiversity is short for 'biological diversity', which means the variety of living things on Earth. Our Pacific Islands have a very rich biodiversity; there are so many different types of living things in our region that it's impossible to count them all. The sheer variety of species on Earth is quite amazing. Species range from the smallest bacteria to the biggest animal to have ever lived, the massive 160-tonne blue whale. To fully appreciate and understand biodiversity, it needs to be divided up into three levels:

1. The variety of individual species (***species diversity***)
2. The variety of ecosystems, where species interact with each other and the environment (***ecosystem diversity***)
3. The variation between the individuals that belong to one species (***genetic diversity***)

Species diversity

A ***species*** is a distinct sort or kind of living thing (e.g. a plant or animal), whose members share a set of common features. Normally members of one species do not breed with members of another species. For example, a yellow-fin tuna is a species, and it cannot breed with a skip-jack tuna as they are different species. Species diversity is the variety of species within a habitat or a region. Some habitats, such as rainforests and coral reefs, have many species living within them. Others, such as salt flats or a polluted stream, have fewer species.

The term ***endemic*** is used to describe species that are found in a particular place and not found anywhere else. For example, the Pacific pigeon is endemic to the Pacific Islands because it is not found in any other region. However, although the Pacific pigeon is found in Fiji, it is not endemic to Fiji, because it is also found in the Cook Islands, Samoa and Tonga. The tooth billed pigeon also know as the Samoan pigeon or *Manumea*, is a

species endemic to the Pacific Islands *and* Samoa (it is not found in any other Pacific country).

The Pacific Islands have a high number of endemic species because the islands are separated from each other and the rest of the world by the Pacific Ocean. When populations of living things are isolated from other populations, they develop unique characteristics. Each species has features related to the particular environment on the island where they live, and all the islands in the Pacific are different. This has lead to many different species that are adapted to their island's unique environment.

It is impossible to put together a complete and current list of species living in the Pacific Islands, because many ***invertebrates***, ***micro-organisms*** and ***lower plants*** (the three most diverse life forms) have not yet been identified and named. However, the rich and unique biodiversity of the Pacific Islands can be demonstrated by looking at the diversity of birds.

The following table shows the number of land-based bird species found in a selection of Pacific Island countries. The endemic species are those found in that country and nowhere else.

	Papua New Guinea	Vanuatu	Fiji	Solomon Islands	Tonga	Palau
Total land-based bird species	578	57	67	163	21	32
Endemic land-based bird species	324	7	23	72	2	10
Percentage of land-based bird species that are endemic	56%	12.2%	34%	44%	9.5%	31%

Manumea or tooth-billed pigeon

Papua New Guinea's incredible biological diversity

Papua New Guinea is recognised as one of the four mega-diverse areas of the world. Papua New Guinea occupies only 0.3% of the Earth's land area but scientists believe that it supports 5–7% of the world's terrestrial (land) biodiversity.

Look at orchids, for example. Australia, with all its land, has about 1,000 species of orchids; North America, which is even bigger than Australia, has only 150 species. But Papua New Guinea beats both of them. Scientists believe that PNG is home to at least 3,000 species.

The Pacific Islands biodiversity is only part of the amazing variety of life that exists on Earth. The table on p. 35 shows the number of species in the world that have been identified by scientists. However, this table does not cover anything near all the species on the planet. There are several groups of organisms not included in the table, but more importantly many species have not been formally recognised or named yet. For example, the table includes the 950,000 species of insects that have been named. However, scientists estimate that there are over 10 million more insects that have not been 'discovered' yet!

Ecosystem diversity

An ***ecosystem*** refers to a community of living things that interact with each other and with the environment around them. Different types of ecosystems are recognised by the types of plants and animals present, their relationships to each other and by the nature of the physical environment. For example, the coral reef ecosystem is made up of a huge diversity of marine organisms, including fish, crustaceans (e.g. crabs), molluscs, star fish, algae etc., all linked through a complex food web. Corals are a major feature and provide the physical structure of the reef.

The physical environment consists of clear, shallow, warm water that receives a lot of sunlight and is poor in nutrients. Coral reef ecosystems only exist within a narrow range of environmental conditions. The following are more examples of ecosystems:

- Rainforest
- Dry woodland
- Grassland
- Fast-flowing river
- Swamp
- Mangroves

Ecosystem diversity relates to the variety of different ecosystems in a given place. Ecosystems can cover a large area, such as a whole forest, or a small area, such as a pond. Ecosystems are considered to be part of biodiversity because they form unique groups of living things that need each other for survival. This means that an ecosystem is more than just the variety of species that live within it. The interactions between the species and the environment are important, because each species could not survive without the others nor could they survive without the particular environmental conditions within the ecosystem.

Genetic diversity

A species is made up of individuals who share common features. However, within a species these individuals vary in appearance. For example, although individual Pacific pigeons are similar in many ways, they vary in size, colour and other subtle ways. The Pacific pigeons in the Cook Islands are the same species as those in Fiji, but they are slightly different in appearance.

Another very good example is the variety of kava plants found in the Pacific Islands. Many types of kava belong to the one species (*Piper methysticum),* but they differ in various ways, such as the shape of the leaf, and also in the taste and strength of the drink that they are used to make.

These differences are due to genetic diversity, which refers to the variety of ***genes*** within a species. Genes are the basic units of all life on Earth and are responsible for both the similarities and differences between living things. Each species is made up of individuals that have their own particular genetic make-up.

Each individual person also has a unique set of genes, and the effects of this can be seen just by observing the variation between people. Some people have curly hair, while some have straight hair; some have ears directly attached to their head while others have a hanging ear-lobe between the ear and the head. Just like the diversity of genes in people, populations of plants and animals also vary in their genetic make-up. To conserve genetic diversity, different populations within a species must be conserved.

Animals: 1,250,000 species, including:		**Plants: 287,655 species, including:**	**Other species**
Animals (vertebrates): 58,933 species, including:	Animals (invertebrates): 1,190,200 species, including:		
10,234 birds	950,000 insects	15,000 mosses	74,000–120,000 fungi
8,240 reptiles	70,000 molluscs	13,025 ferns	10,000 lichens
5,743 amphibians	40,000 crustaceans	980 conifers	
29,300 fish	130,200 others	199,350 flowering plants	
5,416 mammals		59,300 grasses (and relatives)	

Kava plant

Activity 3
Biodiversity at Three Levels

Teachers' notes:

Teachers will need to read and understand the background information prior to this activity. When explaining the levels of biodiversity to students, think carefully about their age and how you could present this information.

Suggested Timing

Teacher preparation time: 45 minutes
Lesson time: 90 minutes

Subject Areas

Science, Language Studies

Glossary Words

Species, ecosystem, genetic, genes, lower plants, endemic invertebrates, vertebrates, micro-organisms

Materials

- Two similar-looking leaves from each species of a range of different plant species. Collect as many leaves as you have students in the class.
- A simple summary of species diversity, genetic diversity and ecosystem diversity

Activity summary

This activity will enable students to recognise the three different levels of biodiversity, list examples of each different biodiversity correctly and identify examples from their local environment.

Outcomes

Students will be able to:

- Explain that the diversity of living things is considered at three levels (ecosystem diversity, genetic diversity and species diversity) and give examples of each.

Tuning in

Collect two similar-looking leaves from each species of a range of different plant species and bring them to the classroom. Collect as many leaves as you have students in the class, so students will get one each. Remember to collect small leaves as well as big ones, such as small grasses and even moss.

Mix up the leaves and then provide each student with one leaf. Explain that each leaf belongs to a species of plant, and that 'a species is a distinct kind of living thing whose members share a set of common features'. Ask the students to closely observe their leaf so that they can see its features. Now tell the students that they must find another student in the class that has a leaf from the same species of plant. Students will be required to compare their leaf against many others until they find a 'match'.

When students have completed the exercise, discuss the term 'biodiversity' and what it means. Your discussion and explanation should include the following points:

- Biodiversity is the 'variety of life'
- Biodiversity includes the variety of species in an area (for example, the variety of plants)
- The Pacific Island region has many endemic species (which makes our place very special)
- Biodiversity also includes the different varieties of individuals within a species
- Biodiversity also includes ecosystems

Developing understanding

Write a simple summary of species diversity, genetic diversity and ecosystem diversity. Split these up and write them on three different pieces of paper so you can provide them to your students.

You will need to prepare this before the session using the notes provided in the background reading section of this activity. The background reading information in this resource is written for the teacher, so make sure you re-write the notes so they can be presented at a level suitable for your students.

Organise the students into three groups. One group will be investigating species diversity, the second group will look at genetic diversity and the final group will consider ecosystem diversity. Give each group the relevant summary notes.

Explain to the whole class that biodiversity refers to the variety of plants and animals, the genes they contain and the ecosystems they form. Further explain that biodiversity must be considered at three different levels.

Ask each group to read and discuss the summary notes they were given about a particular level of biodiversity. Instruct the group to think of an example or examples of this level of biodiversity. Then ask each group to report back to the whole class and explain the level of biodiversity they investigated, using the example(s) they have thought of.

Practise skills

Write the following lists of living things on the blackboard and ask the students to copy them into their exercise books:

List 1	List 2	List 3	List 4	List 5	List 6	List 7	List 8	List 9
Sand dunes	Pia kava	Lake	Eagle	Rainforest	Coconut palm	Brahman cow	Peanut plant	Polynesian person
Grassland	Borogu kava	Swamp	Parrot	Coral reef	Banyan tree	Hereford cow	Breadfruit tree	Indian person
Forest	Melomelo kava	River	Heron	Woodland	Pawpaw tree	Jersey cow	Betel Nut palm	Melanesian person

Ask the students to examine each list and write down whether the examples in the list represent species diversity, ecosystem diversity or genetic diversity. When the class have completed their lists, go through the answers on the blackboard with the class. Ask students to volunteer their answers and explain the reason for their answers for each list. Write the answers on the board, taking care to further explain and correct students if they have it wrong.

ANSWERS: List 1. Ecosystem diversity;
List 2. Genetic diversity; List 3. Ecosystem diversity;
List 4. Species diversity; List 5. Ecosystem diversity;
List 6. Species diversity; List 7. Genetic diversity;
List 8. Species diversity; List 9. Genetic diversity

Application

Take the students on a short biodiversity 'discovery walk' outside the school. Ask them to take notes of the different species they see, and to also make observations of ecosystem diversity and genetic diversity. Hint: It might be difficult for students to observe genetic diversity – one good way to do this is to look at the local chickens (do they look the same or do they vary in colour?).

Discuss the observations when you return to class.

Topic

4

Hawk moth pollinating flower

Connections Between Living Things

Background Reading

Wherever you find a community of plants, animals and other ***organisms***, you will find that they are connected to each other in many different ways. The connections between living things and non-living things are the basis of all ***ecosystems*** and are an interesting and significant part of the Earth's biodiversity.

Living things can be separated into groups that describe the way they live and interact with other organisms and the environment. Ecosystems are made up of living things that live in the following ways:

Producers include all the plants and algae. These are 'power generators' of ecosystems; they take energy from the Sun and use it to make simple sugars that the plant 'burns' (respires) to produce its energy. Examples: trees, grasses, palms, moss, seagrass, green algae

Herbivores eat plants or parts of plants such as the seeds, bark, roots, fruit or leaves. Examples: stick insects, finches, caterpillars, fruit bats, parrot fish, sea urchins

Predators eat other animals. Examples: praying mantis, spiders, centipedes, hawks, herons, eels, mackerel, sharks, octopus, crown-of-thorns star-fish

Scavengers consume the bodies of plant and animals that have already died. Sometimes they are also known as ***decomposers.*** Examples: shrimps, crabs, ants, maggots, cockroaches, bacteria

Parasites live on or within the body of another living thing (host). Parasites cannot survive and reproduce without their particular host species. They feed on the host or steal its food. Examples: banyan tree, strangler fig, mosquito, flea, leech, tape-worm, ticks, marine isopods and copepods (parasitic shrimps)

Mutualism describes relationships between plants, animals and other living things, where each receives a benefit from the relationship. For example, fruit bats benefit from fruit trees because they obtain food, however, the fruit tree also benefits because the bat carries its seeds to a new place where they may have a better chance to grow.

A good example of mutualism in the ocean is the relationship between gobies (small fishes) and several species of shrimp. These animals are usually found together, often in shallow water, especially on the silty sea floor or amongst seagrass. The shrimp digs a burrow that allows the goby to hide from its predators. Gobies are not able to dig burrows by themselves. For its part, the goby alerts the shrimp (which is nearly blind) when danger is approaching, so the shrimp can also escape into the burrow.

The most easily observed example of a relationship where both organisms benefit is the connection between flowering plants and the animals that pollinate them. ***Pollination*** occurs when pollen from a flower of one plant is transferred to a flower on another plant, leading to fertilisation, which allows the plant to produce seeds. Animals that pollinate plants are called pollinators. They include insects such as bees, flies, butterflies, moths, wasps and beetles, and larger animals such as birds and bats. For example, honeyeaters are birds with long beaks and long tongues which can reach into flowers to get the sweet nectar inside. The birds benefit because they get food from the flower, and the flower benefits because the bird carries the pollen to another flower.

Living things depend on each other

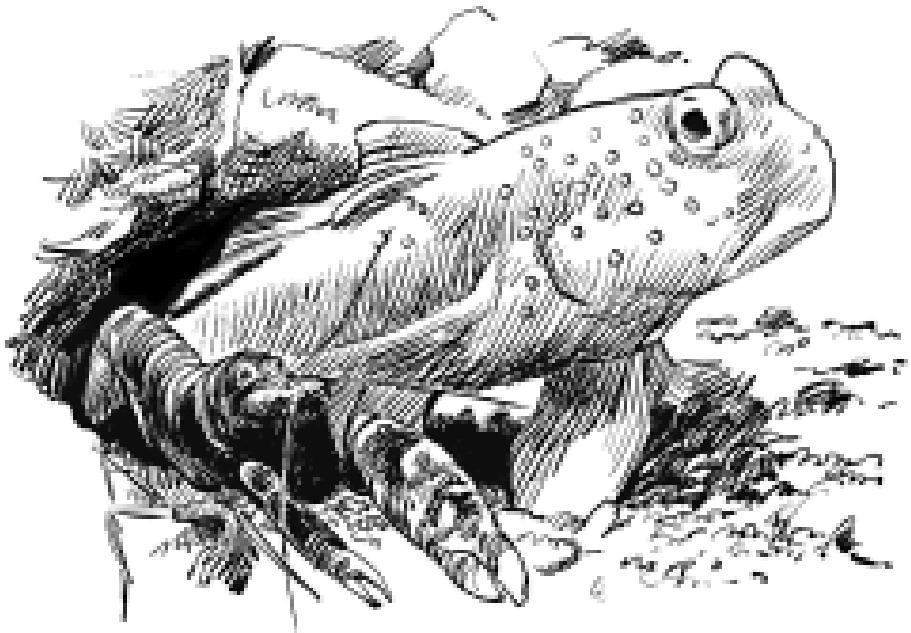
It is very important to understand the connections between living things. If a plant or animal were to disappear from an ecosystem, then this would very likely affect another plant or animal. For example, a predator cannot survive without its prey, a parasite cannot survive without its host, and a flower cannot be fertilised and make seeds if its pollinators are no longer around.

However, in reality, humans are only just beginning to understand the amazing relationships between species. These connections might be important in ways that we don't yet understand.

It is because we don't fully understand all of the relationships between living things that the loss of biodiversity is such a concern. We don't yet know how the loss of any particular species may affect other species within an ecosystem. This is one reason conservation of biodiversity is so important.

For more information about connections between living things, see Module 2, Activity 3 on p. 63, 'Food Chains, Food Webs and Biodiversity'.

A gobie and a shrimp share a burrow



Activity 4
Natural Connections Scavenger Hunt

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 90 minutes

Subject Areas

Science, Language Studies

Glossary Words

Ecosystems, organism, producer, herbivore, predator, scavenger, decomposer, parasite, mutualism, pollination

Materials

- Copy of 'Natural Connections Scavenger Hunt' list (p. 42)
- Reusable bags
- Exercise book
- Pens or pencils

Teachers' notes:

Before sending your students outside to begin the scavenger hunt, be sure to do the following things:

- Instruct students to collect leaves, flowers or other parts of a plant, but make sure that they do not kill or harm the plant.
- Tell students not to collect live animals or animal nests (e.g. bird nests). Sometimes it's hard to tell the difference between active and inactive nest and even if a nest is no longer being used by its original owners, it may still serve as a home for other living things.
- Encourage students to be gentle when turning over rocks or logs. If they find insects, centipedes, or other small animals, encourage them to observe closely, and sketch or write down the names of the animals only, leaving the animals in their homes.
- Ask students to return rocks, logs and plant matter to their original locations.
- Set boundaries and a time limit so that students don't scatter or get lost.
- Check for poisonous plants or animals before sending students into an area. If there are any poisonous plants or animals, be sure students can recognise them and know they are not to be collected and to be careful when observing.

Activity summary

This activity will enable students to discover the many ways in which plants, animals and other living things are connected with each other and depend on each other for survival. They will be involved in a scavenger hunt, and will practise skills in observation, drawing, writing and sharing ideas.

Outcomes

Students will be able to:

- Observe and explain some ways in which living things are interdependent, with reference to a small number of simple, familiar examples.

Preparation

- Make copies of 'Natural Connections Scavenger Hunt' list on p. 42 (one per group). If you do not have access to a photocopier, simply write the nature connection list on the board for students to copy to paper before doing the activity.
- Locate an outdoor area that contains a garden or natural area ahead of time and set boundaries within which the students can work.
- If desired, provide one re-usable bag for each student for collecting their items on the scavenger hunt (this is optional).
- Familiarise yourself with the collection tips in the teachers' note.

Tuning in

Collect several hibiscus or similar flowers on the way to school. Start the class by showing students the flowers and drawing a picture of a butterfly on the blackboard. Explore the following question with the class: *What is the connection between this flower and a butterfly?* You could also ask: *Why does the hibiscus plant need the butterfly? Why does the butterfly need the hibiscus plant?* And*: Who benefits from this relationship?*

Answers: The butterfly feeds on the nectar provided by the hibiscus flower. When the butterfly is feeding on the nectar, some pollen is dusted onto the butterfly's wings or legs. When the butterfly travels to a new flower it carries the pollen with it, and the pollen may be transferred to the flower and fertilise it. The flower can then produce fruit and seeds. This is the process called ***pollination*** *in which both butterfly and plant benefit.*

Developing understanding

1. Begin this activity by introducing the term 'connections' to the class. Write the following terms on the blackboard and explain what each of them means, using examples. The background reading will help you with this.
   - Producer
   - Predator
   - Scavenger (or decomposer)
   - Parasite
   - Pollinators (mutualism)
2. Organise the students into five groups. Provide each group with one of the terms (e.g. producer) from the list of connections. Ask each group to think of five examples of familiar living things in their environment which fit their term. If possible, allow the group to go for a walk around the school garden or natural area to provide them with ideas and inspiration. If you have any books or magazines about nature, these could also be used.
3. Invite the groups to share their ideas and examples with the whole class. Record the student's ideas on the blackboard.

Use concept

4. Divide the class into small groups and pass out one copy of the 'Natural Connections Scavenger Hunt' list (see p. 42) to each group. Explain that they will take part in a scavenger hunt to look for relationships or connections between living things in the natural environment. Go over the items on the list with the students to make sure they understand what each means.

An epiphyte is a plant that grows on another living plant

Note, examples are provided in *italics* for the teachers' reference only (don't give these to the students).

Natural Connections Scavenger Hunt	
1. A living thing that depends on soil *Any plant with roots, any animal that burrows, fungi*	2. A living thing that is not a plant or an animal, but feeds on dead things *Fungi such as mould or mushrooms*
3. An animal that eats live plants *Caterpillars, earwigs, seed-eating birds, fruit bats, fruit flies, snails, land crabs, sap-sucking bugs*	4. An animal home that is in or on a plant *Ants' nest, bird's nest, spider web, caterpillar's nest, tree hollow with animals inside*
5. A plant that needs an animal to help it to reproduce *Any plant with a large or colourful flower (these are used to attract pollinating animals)*	6. A plant that grows on another plant *Banyan tree, fig, orchid, fern, lichen, moss, mistletoe*
7. An animal that eats dead things *Flies, maggots, cockroaches, ground beetles, rats, ants*	8. A plant that deliberately provides animals with something to eat *Any plant that produces edible fruit*
9. A living thing that needs sunlight to grow *Any green plant*	10. An animal that helps a plant to spread its seeds (e.g. by eating fruit) *Pigeons, cassowaries, parrots, fruit bats*
11. An animal that eats other animals *Spiders, praying mantis, insect-eating birds, cats, rats, hawks, herons*	12. An animal that uses a home provided by another animal *Spiders (living in another spider's web), hermit crab, anemone (clown) fish, flea, tick*

5. Explain to the students that their task is to find one example of each item on the list. If the example is a plant, they may collect a small sample (e.g. a leaf or flower). However, if the example is an animal or an animal home (e.g. a nest) they are not allowed to collect it, but they must draw a picture of it.

6. Before the students set out into the environment, read out the collection tips to the students so they are familiar with what they are supposed to do and what they not supposed to do when scavenger hunting. (See teachers' notes)

7. Give the students a time limit to undertake the scavenger hunt in the area you have selected. Explain that if they can't find a particular item they may draw it or fill in the answer based on what they already know.

8. At the end of the scavenger hunt, ask the students from each group to tell the rest of the class what they discovered and ask them to explain how the things are connected with each other.

Reflection

1. Ask your students to write a description of one connection they observed during their scavenger hunt. Then ask them to imagine and write about what might happen if one of the species involved in the connection were to disappear (become extinct). Ask students if they think there would be any effect on humans. Invite the students to share their ideas.

2. After students have discussed the effects of ***extinction*** of different species on ecosystems, explain that the creatures they found on their scavenger hunt and the connection between them are just a small sample of what makes up biodiversity – the diversity of life on Earth. Explain that Earth is not only covered with an amazing variety of life but also, as they have discovered, the different organisms on it are connected in complex ways, and these connections are necessary for the survival of species.

Topic

5

Exploring Habitats

Background Reading

A ***habitat*** is the name given to the place where a plant or animal naturally lives or grows: e.g. under a rock, in a tree hollow, in a mangrove forest or in a rotting log. Plants and animals find everything they need in their habitat, including nutrients or food, water, shelter, sunlight and anything else they need to survive. Over time, species ***adapt*** to the specific conditions within their habitats. They also develop important relationships with other species within their habitat to help them survive. For example, many plants depend on particular animals to pollinate their flowers or spread their seeds, and animals depend on specific plants for their food.

A community of plants and animals interacting with each other, their habitat and their surrounding environment is described as an ***ecosystem***. Examples of ecosystems include a forest ecosystem, a coral reef ecosystem or a river ecosystem. Ecosystems are usually made up of a variety of different habitats.

Hundreds of habitats

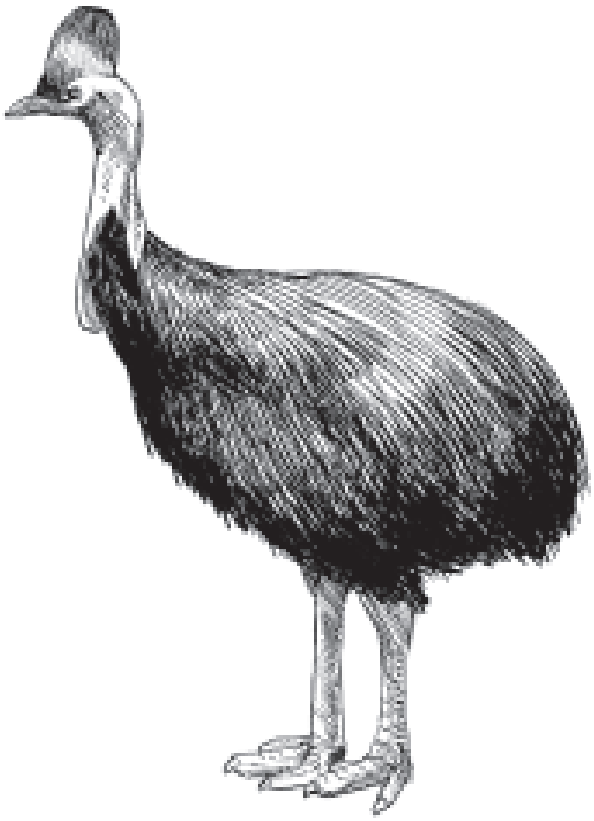
The natural environment varies greatly from one place to another, often in ways that humans do not notice. A habitat is defined by these small differences, including the amount of moisture (wetness), light, temperature, current, wind or other environmental factor.

The rainforest is the habitat of Papua New Guineas' giant flightless bird, the cassowary. Due to its size, the cassowary's habitat is a large and varied area of the forest; it walks long distances searching for its food. However, smaller organisms have smaller habitats. Within the habitat of the cassowary, there are habitats for thousands of smaller animals. The habitat for the huntsman spider, for example, is beneath the loose bark of certain types of rainforest tree. The spider hides under the bark during day and roams the tree trunk at night searching for cockroaches and moths. The habitat of the spider is sometimes called a ***microhabitat***. Every large habitat, such as a rainforest or a coral reef, is made up of many microhabitats.

The number of ***microhabitats*** found within a habitat effects the total number of species or biodiversity that occurs. The more microhabitats present, the greater the biodiversity. This is one reason why old growth or primary forest has more species than secondary or regrowth forest. Many microhabitats form in old forest, such as in tree hollows and in fallen dead and decaying trees. The regrowth forest lacks a lot of these microhabitats, and therefore it can support less species.

The same principle applies within the schoolyard. You will generally find many more species in the 'messy' areas of the school, where grass has been allowed to grow and fallen leaves and logs build up. This is because grasses, leaves and logs provide microhabitats for more species to live in.

Habitat loss is a serious threat to biodiversity. Habitat loss includes the destruction, degradation and fragmentation of habitats. It is happening for many reasons, including large-scale farming, mining, forestry, grazing and urbanisation. These are some of the main threats to biodiversity (see Module 3 for more information about 'Biodiversity: Understanding the Threats').



Cassowaries live in rainforest habitats of Papua New Guinea

Activity 5
Habitats and Homes

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 90 minutes

Subject Areas

Science, Language Studies

Glossary Words

Habitat, adapt, microhabitat, species, ecosystem

Materials

- Pencils
- Paper
- Blu Tack or sticky tape
- String

Teachers' notes:

Regularly check with the students to make sure they understand the comparison between the places that people live and animal habitats. Where appropriate, use examples of animals from your local area in place of the examples in the activities. The activities allow students to use observation skills and express opinions; don't worry too much about 'right' or 'wrong' answers.

Activity summary

This activity uses our own communities as an example to introduce the concept of habitats. Students will undertake an active investigation of habitats in their school grounds (from the point of view of a lizard) to become familiar with features of habitats in their local environment.

Outcomes

Students will be able to:

- Explore the needs of a plant or animal in a particular habitat and recognise that they depend on specific aspects of their environment for survival
- Identify various types of habitat in your local area.

Tuning in

Ask the students to close their eyes and think about what their house looks like. Ask them to try to form a picture in their mind: How many windows does it have? What material is it made of? What colour is it? What other features does it have? Ask the students to now draw the house that they saw in their mind on a small piece of paper. Once students have completed their drawings ask them to label the top of the paper 'My shelter in my habitat'. Point out that the word habitat is just another word that describes the place an animal or a plant lives. Habitat = Home. Ask students what else they need in their habitat apart from their house (shelter)? Where do they find food within their habitat? Where do they find water? Ask the students to explain why their home or habitat is important to them.

Developing understanding

Attach students' drawings to the blackboard with Blu Tack or sticky tape. Place them in different locations to show the arrangement of a small town or village. Discuss with the students what other features should be added to the town to make it complete. Ask the students to draw in things such as roads, gardens, schools, markets, stores, churches and rivers, or any other things that the class feels is missing. The final 'map' should be imaginary; it doesn't have to be a realistic map of the community.

Explain to the students that the village or town is a habitat for people. Tell the students that this is similar to what happens in nature. Use the following discussion to help establish the comparison between a town or village and habitats for wild plants and animals. Ask the students to describe the things that their habitat provides for them (answers may include the points below). Explain that a habitat for a wild animal must also provide all its essential needs for the animal to be able to survive.

- The habitat provides shelter from the weather, including rain and the hot sun
- People move freely within their habitat
- The habitat has places to find food
- People play within their habitat
- Some go to jobs within their habitat to help other people or to keep the town healthy
- The habitat has places to find water

Use concept

1. Organise the class into small teams of four or less students. Provide each team with a two metre length of string (or something similar).

2. Explain to students that they are going to go outside into the school grounds and each team will need to find a habitat that they think is suitable for a lizard. To find a good lizard habitat they will need to think about what a lizard needs to survive. Where will it find shelter from the weather? Where will it find food? Where will it bask (warm up) in the sun? Where will it hide from its enemies (predators)? The students will need to mark out their habitat by enclosing it with their piece of string. Each group should then draw a map or a diagram of the habitat they created, and label all its important features.

3. When each group has selected and mapped their habitat bring all the students together. Explain that everyone is now going to play the role of Mrs Elizabeth Ard (Liz for short or Mrs

'Liz Ard'). Mrs Liz Ard is looking for a suitable place to move into or make her home. Take the students on a tour of each of the lizard habitats that the students have marked out. Allow the team who created the habitat to talk about its features, explaining what would make it the best place for Liz to move into. Ask the other students to take notes and to ask questions that will help them to judge if it is a good habitat. For example: where will Liz be able to hide from birds? Where will Liz and her family find their food?

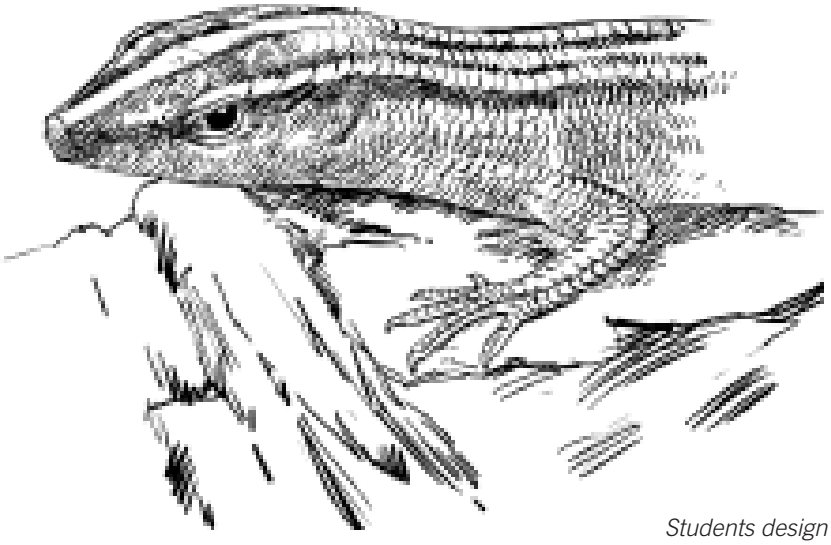
4. When you have finished, allow each student to vote for the best lizard habitat for Mrs Liz Ard and her family to move into or build their home.

Application

Take your students on a real or imaginary tour of wildlife habitats. A real tour will require you to take the students on a walk outside of the school grounds; an imaginary tour will require students to think about places that they already know. Give students the task of describing the habitat of the five animals listed below (or other animals from your area that you can suggest). For each of these animals the students should give a general description of the habitat and also take notes about where the animal finds shelter and food.

Animal	Describe habitat	Where does it find shelter?	Where does it find food?
Pigeon			
Land crab			
Flying fox (fruit bat)			
Spider			
Ant			

When students have completed the activity discuss the findings as a class.



Students design a habitat for a lizard

2 The Value of Biodiversity

"Without knowing it, we utilise hundreds of products each day that owe their origin to wild animals and plants. Indeed our welfare is intimately tied up with the welfare of wildlife. Well may conservationists proclaim that by saving the lives of wild species, we may be saving our own."

Norman Myers

Module Introduction

The Value of Biodiversity

Biodiversity is an important part of our lives, and helping to protect it should be a high priority. We use elements of biodiversity on a daily basis and although we may not realise it, biodiversity actually works for us, performing services such as pollinating plants so they produce fruit. Biodiversity also plays a big part in keeping ecosystems in balance. All living organisms rely on other living and non-living things for survival, and if even one of these relationships is disrupted, all organisms are affected. Biodiversity is also responsible for keeping the planet healthy, and without it, humans would not be able to survive in this world.

The activities in this module look at why biodiversity is important, and how we use it every day – from the foods we eat and medicines we use to the timber that is used for building materials. Students will analyse their own lives to see, at a personal level, how biodiversity affects them. Biodiversity is also important because much is yet to be learnt – new plants and animals that could benefit humans are yet to be discovered.

Different people value biodiversity in many different ways, but there is no right or wrong way to value it – there are many different reasons why biodiversity is important to us. Depending on our cultural or family background, the way we were raised and the things we do, different elements of biodiversity are important to each of us, and so define the way we value biodiversity.

Biodiversity helps maintain the atmosphere, keeps the soil fertile, purifies water and provides other functions that enable life to exist on this planet. It provides a variety of resources and products for humans, including many foods and medical products, and is the potential source for many more. Biodiversity provides products that help to boost the economy. The natural world also offers us a place to relax and reflect. Many people believe that biodiversity is important not just because it is valuable, but simply because it exists.

This module has five Topics that cover:

1. Biodiversity Provides Food, Medicine and Shelter
2. Different Beliefs and Values About Biodiversity
3. Food Chains, Food Webs and Biodiversity
4. Systems and Processes that Support life
5. The Role of Biodiversity in Natural Cycles .

These topics will allow students to develop their own views on why biodiversity is important by exploring how they are affected by biodiversity on a daily basis.

Activity Details Summary: Module 2, The Value of Biodiversity

Topic	Activity name	Activity summary	Outcome	Subject Areas	Timing
Biodiversity provides food, medicine and shelter	Activity 1 – Biodiversity Diary	Students will explore the importance of biodiversity and talk about some ways in which biodiversity is important to them in their daily lives. This will foster their interest to conserve significant aspects of the biodiversity in their local community.	Examine how humans derive all their food, many medicines and industrial products from biodiversity.	Science, Language Studies	Teacher preparation time: 60 minutes Lesson time: 90 minutes
Different beliefs and values about biodiversity	Activity 2 – Spice of Life	This activity will help students to explore different beliefs and values about why biodiversity is important, why it should be protected, and how different views can have an effect on biodiversity.	Learn how people use and value biodiversity differently and examine the effects of these different views on biodiversity	Social Science, Science	Teacher preparation time: 30 minutes Lesson time: 60 minutes
Food chains, food webs and biodiversity	Activity 3 – Chains of Life	This activity will help students to identify the interrelationship between plants and animals in an ecosystem and develop a sense and appreciation for the delicate balance of food webs and their importance in supporting biodiversity.	Identify and construct a food chain and develop a sense and appreciation for the delicate balance of food webs and their importance in supporting biodiversity.	Science, Language Studies, Art	Teacher preparation time: 30 minutes Lesson time:90 minutes
Systems and processes that support life	Activity 4 – Biodiversity Performs	Students will act out the different ecosystem services which will help them to realize the important services those ecosystems provide which we sometimes overlook. They will also learn about some of the secret services that ecosystems and the species within them provide by creating charade-performances for their peers	Describe several important services that biodiversity provides humans and explain how these make life on earth possible	Science, Language Studies, Art	Teacher preparation time: 60 minutes Lesson time: 60 minutes
The role of biodiversity in natural cycles	Activity 5 – Carbon Cycle	Students will learn how to estimate the weight of a tree using its diameter and height, then use this to measure amount of carbon stored within trees around the school. Students will gain an understanding of why the trees and therefore biodiversity are so important in keeping carbon out of the atmosphere.	Explain the role of biodiversity in natural cycles including the carbon cycle and its role in controlling the Earth's climate.	Science, Maths	Teacher preparation time: 30 minutes Lesson time: 90 minutes

Pawpaw trees are a source of food and medicine

Topic 1

Biodiversity Provides Food, Medicine and Shelter

Background Reading

Animals, plants and other ***organisms*** (biodiversity) are used by people in many different ways. They provide almost all the materials to meet our basic needs and many other useful services. This biodiversity is the direct source of our food crops, animal products, and plant oils. It is also a major provider of many building materials, handicrafts, medicinal products, fibres, dyes, resins, gums, adhesives, rubbers, clothing items and custom dress. People could not live without biodiversity and our lives would be much poorer if we were to loose the richness of the biodiversity that we have.

A large proportion of the products that people use from this biodiversity come from a limited number of plants and animal species that are ***domesticated*** or grown in gardens. However, many products are also collected from the natural bush or forest. For example, wild foods are very important, especially when agricultural supplies fail. Many medicinal plants are also harvested from the wild.

Foods

Pacific Islanders have traditionally enjoyed good nutrition because of the diversity of healthy 'whole foods' available. Whole foods refer to food that is unprocessed and is harvested from gardens or from nature. Health conditions such as heart disease, obesity (being too fat) and diabetes are on the rise across the Pacific because people are eating more Western-style foods that are highly ***refined*** and contain high levels of sugar and fat. This highlights the importance of maintaining the biodiversity of traditional gardens and wild foods in Pacific diets.

Examples of important food in Pacific diets:

Foods domesticated or grown in gardens		Wild foods	
Banana	Cucumber	Fig	Sago palm
Bread fruit	Pumpkin	Yam	Spanish mackerel
Cassava	Pawpaw	Pili-nut	Cuscus
Choko	Taro	Tropical almond	Megapode eggs
Beans	Pig	Pandanus nut	Flying fox
Cabbage	Chicken	Banana	Pigeon
Tomato	Goat	Red mangrove	Mud crab

Taro

Noni fruit

Medicines

According to the World Health Organization, 80% of people living in developing countries depend on traditional medicines from locally grown plants. Traditional healers use more than 100 plants in the South Pacific to treat malaria, infections, colds, stomach ulcers and many more diseases. Not only do developing countries benefit from medicines taken directly from nature, but Western medicines in developed countries also benefit from local plants. A recent survey showed that of 150 prescriptions of drugs used around the world, 118 are based on natural sources. In fact, 74% of these come from plants. ***Microbes*** and animal species have also contributed to a range of medicines, including antibiotics and many other drugs.

Examples of Pacific Island plants commonly used for medicines:

- Marsh taro
- Kava
- Pacific rosewood
- Pandanus
- Beach scaevola Betel nut
- Beach hibiscus
- Noni
- Wild ginger
- Fig

Other uses of biodiversity

In addition to food and medicines, biodiversity provides many other uses; some of these are provided in table below.

Examples of Pacific Island biodiversity and its uses

Product or service	Plants and animals that can be used
Building materials	Most trees – some widely used: bamboo, kauri pine, island teak, rosewood
Carving and handicrafts	Pacific rosewood, coconut, vesi (Nambangura), bamboo
Fibre and weaving	Coconut, tree fern, dye fig and paper mulberry (tapa)
Dyes	Candlenut, Indian mulberry, red mangrove
Essential (fragrant) oils	Paperbark, pili-nut, sandalwood
Soaps	Vanilla, coconut, sandalwood
Food wrapping	Banana, Ti, Wild Ginger
Thatching	Sago palm, nipa palm, banana, pandanus
Decoration and custom dress	Pigs (tusks), whale (teeth), birds (feathers), dye fig and paper mulberry (tapa)

Resources for the future

Scientists have identified and named approximately 1.3 million species of plants and animals so far, but they predict that there are millions of other species that haven't yet been identified. As we learn more about plants and animals we are likely to find new species with valuable uses for people. Although people have been using biodiversity for thousands of years, only a relatively low number of plant species have been grown in gardens and only some animal species have been domesticated. Many current foods (harvested wild or grown in Pacific gardens) are not widely used elsewhere and have the potential to become important in the future. Indigenous Pacific peoples' use of plant and animal species is a potential source of ideas for developing species for wider use and economic benefit. Some potential products that may be derived from biodiversity in the future include new varieties of banana, sunscreens from corals, fibres from spiders' silk, glues from barnacles and medicines from sea cucumbers (beche de mere).

Breadfruit is a highly valued food plant in the Pacific

Activity 1
Biodiversity Diary

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 90 minutes, plus time for collection of items and keeping a diary.

Subject Areas

Science, Language Studies

Glossary Words

Organism, domesticated, refined, microbe

Materials

- Blackboard
- Selection of items from home (see Preparation section)
- Note paper / exercise books
- Pens or pencils

Teachers' notes:

The 'Biodiversity Diary' and the students' short story will be useful in assessing whether students understand the important role that biodiversity plays in our daily lives, providing us with food, medicine and clothing as well as other important materials to meet our basic needs. You might like to follow this activity with another activity in this module, 'Biodiversity Perform' which introduces Biodiversities role in essential Systems and Processes that Support life.

Activity summary

Students will explore the importance of biodiversity and talk about some ways in which biodiversity is important to them in their daily lives. This will increase their interest to conserve biodiversity in their local community.

Outcomes

Students will be able to:

- Examine how humans derive all their food, many medicines and many industrial products from biodiversity.

Preparation

You, as the teacher, will need to plan in advance for this activity to get maximum benefit.

Before the lesson (during the lead-up time) ask your students to come to class with different examples of items from home that come from or have ingredients derived from nature. You and the students should collect as many different items as possible and bring these to the lesson (you will need at least one item per student).

It might work best if you give students a copy of the biodiversity use categories (right) so they know what kinds of items to collect (examples have been included). You should also try to collect a range of items in case some students are unable to bring something in. When students arrive with their item make sure it is clearly labelled with their name so it can be returned to them at the end of the activity. Gather all the items in one place.

Biodiversity use categories

Categories	Examples of item
Medicine /medical item	Panadol, detol, Aloe vera, noni juice
Food or drink	Tinned fish, tinned beef, breakfast crackers, cooking oil, snack food, fruit and vegetables, rice, flour
Building materials	Palm fronds, wood, bamboo, pandanus, rope (vine)
Laundry or bathroom items	Bathroom soap, toilet paper, laundry powder, dishwashing liquid, toothpaste, shampoo, hair oil, body lotion
Clothing	Any item made of cotton, silk or linen, or tapa
School items	Books, pencils, wooden ruler (not pens or plastic ruler)
Art / craft	Whatever is relevant in your area
Cultural activity	Whatever is relevant in your area

Tuning in

Before you begin using the items students have collected, draw a picture of a coconut palm on the blackboard, large enough for all the class to see. Alongside this drawing, list the following categories:

- Food
- Medicine
- Building materials
- Art/craft
- Cultural activity.

Ask your class to write down in their exercise books how products or materials from a coconut tree are used locally for each of the categories on the list. Give the students time to find something for each category and allow them to talk and share their ideas with fellow students while they are completing their lists. After everyone is finished, invite students to share their ideas with the rest of the class. This could be done by asking for suggestions for each category. A combined class list could be made on the blackboard. You might like to draw lines from the drawing of the coconut tree and place the students' suggestions at the correct part of the tree.

Developing understanding

Now that students have started to think about the kind of things people get from biodiversity, it is time to look at the items that the students have collected. Split your class into small groups of about five students. Ask each student to draw a table in their exercise book that looks like the one below.

You might like to draw a similar table on the blackboard to help students get the idea. Once everyone has drawn their table, ask each group to go to the table or area where you have assembled all the collected items one at a time. Ask each student to select one item and take it back to their group (students do not have to select the item that they brought in from home).

Once all students have selected their items ask them to work within their groups to fill in the table they drew in their exercise books. It might be helpful for you to select an item yourself and fill in the table on the blackboard with the class as an example of what is expected of them.

At the end of the group work, each student should have all items collected by their group members entered into their 'Biodiversity Use Table'. Ask a representative from each group to share the information on their table. You can do this in a 'show and tell' session with the other group members holding up the particular item to show the class while the items are being explained.

Use concept

The next part of the activity can be done over a day or a weekend as a homework task, or you can set it as a longer task to be done over a school week. During this time have your students create a 'Biodiversity Diary'. The diary should include a description of anything they use that comes from biodiversity and all the ways biodiversity affects their lives.

Biodiversity Use Table

Item	Use	Origin from nature

The table below can be used as a guide to help students write up their journal.

Name of the plant or animal (Bislama, Pidgin, English or local language)	How did you use it? OR How did it affect you?	Parts used

To get the students started, go over the following examples to give them some ideas about things that biodiversity provides us with daily:

Food – the variety of food that we eat is one way that biodiversity affects us daily. Everything we eat has been derived from plants or animals.

Clothing – from cotton to silk to wool, much of what we wear comes directly from nature. Even synthetic fibres like nylon or polyester are made from the fossilised remains of plants.

Animals – they work for us, feed us, clothe us, entertain us, live with us as pets and even become symbols and mascots for our sports teams.

Medicines – biodiversity is like a medicine chest: it provides us with countless pharmaceuticals, medicinal herbs, and other medical products.

Art – music, stories, poetry, paintings and other art forms draw heavily on the natural world for inspiration.

Miscellaneous – consider wooden desks, chairs, floors, pencils, paper textbooks, magazines, napkins, notebooks, cotton sheets and towels, canvas backpacks, herbal shampoos and toothpaste.

Provide the students with an opportunity to report back to the class about what they have recorded in their diaries. This can be done once the activity is completed if you choose to do this over a shorter time, or set aside some time each day if you are running it over a school week. After each presentation, explain to the students that humans can't get through a day without using, eating, wearing, or otherwise being influenced by biodiversity – whether you realise it or not! Try to link this idea with the need for biodiversity to be valued and protected and that it is very important to look after biodiversity, because we all depend on it for so many things we use every day.

Reflection

To conclude the activity, set your class a writing task. Ask your students to think about their 'Biodiversity Diary' and the things they use every day that come from or are inspired by biodiversity.

With this in mind, tell your students to imagine that when they wake up tomorrow, items that come from plants can no longer be found. Have them write a short story about what their day would be like and ask them to consider things such as:

- Food – what did they eat?
- Clothing – what did they wear?
- School – how was it different?

After everyone is finished their short story invite students to share their ideas with the rest of the class.

Adapted from Biodiversity Basics—An Educator's Guide to Exploring the Web of Life (World Wildlife Fund, 1999). Reproduced with permission

Local biodiversity provides a wide variety of foods

Topic

2

Different Beliefs and Values About Biodiversity

Background Reading

There are many reasons people believe that protecting biodiversity is important, from the food, medicine and building materials it can supply, the opportunity it offers for recreation such as walking or picnicking, to the clean air or flood control it provides. The way in which an individual values biodiversity is dependent on how they were raised, the experiences they have had and what they have learned in their lifetime. While different people will value biodiversity differently, these values can generally be grouped into three: ecosystem services, biological resources and social benefits.

Let's look at these groups and values more closely.

Biodiversity value: ecosystem services

Biodiversity may be valuable because of the services that it provides to both living and non-living things. Below are some of the direct services that biodiversity provides for the benefit of plants and animals (including humans).

Protecting water resources Biodiversity can be valued for the way it helps to keep our water clean. The natural vegetation cover in water catchments helps to maintain healthy water systems, regulate and stabilise water runoff, and helps to prevent extreme events such as flood and drought.

Soil formation and protection Biological diversity helps to form and maintain soil structure and helps keep the soil moist and nutrient-rich. Dead and decaying organic matter will break down with the assistance of fungi and microscopic organisms, leaving nutrients in the soil.

Nutrient storage and cycling Ecosystems play a vital role in recycling nutrients. Plants take up nutrients from the soil. These nutrients are passed on to animals that eat them. When plants or animals die and decay, the nutrients are released by micro-organisms so that the cycle can start again.

Pollution breakdown and absorption Ecosystems and ecological processes play a very important role in the breaking down and absorption of ***pollutants*** created by human activities. These include wastes such as waste water, rubbish and oil spills. All parts of the ecosystem, starting from bacteria to higher life forms, are involved in the breakdown and absorption of these pollutants. Some ecosystems, such as wetlands, have qualities that are particularly well suited to breaking down and absorbing pollutants.

Contribution to climate stability Evidence shows that undisturbed forest helps to maintain rainfall in an area by recycling water vapour in the atmosphere, as well as locking away some of the harmful greenhouse gases that are released by the burning of fossil fuels, intensive agriculture and land clearing which cause climate change. Preserving these forests and maintaining biodiversity helps stabilise the climate. To learn more about the role biodiversity plays in locking away green house gases see Activity 5 in this module.

Biodiversity value: biological resources

Biodiversity may be valuable because of the materials and resources that it provides for humans to make use of. Below are some of the valuable resources that biodiversity provides.

Food Humans depend entirely on plants for survival, both directly as food and indirectly as food for other animals. A lot of plant species have been used as food but only few have been farmed to feed the world's population. Conservation of biodiversity is important because having a wide variety of plants and animals helps with fighting diseases – if all plants and animals were the same variety they could all be potentially affected by the same pests and diseases. Having different varieties helps to provide disease resistance, and improve productivity and the ability to adapt to environmental changes.

Medicinal resources

Pacific Island people have a long history of using nature around them to provide medicines and many different ***native*** plants are still used as traditional medicines. When developing new medicines, modern researchers are now also looking more and more towards biodiversity. Many animal and plant species have been useful in the past for finding new treatments and cures and it is possible that many species could hold the answer to future medical cures – so, the more species that are conserved, the more chance there is of discovering something new of medicinal value.

Biodiversity provides a range of building materials

Timber products

Wood is a basic product used in the Pacific and is still largely harvested from the bush. A lot of people in the Pacific use wood as a source of fuel and also as timber for construction. Most of the building materials are extracted from the local forest and this gives great advantage to people living in the local community in the Pacific because they don't have to go and buy other building materials. To ensure biodiversity is maintained, however, trees harvested for human use need to be replaced by replanting.

Biodiversity value: social benefits

Biodiversity may be valuable because of the social benefits that it provides. The natural world with all its diversity offers opportunities to relax and enjoy ourselves as well as valuable opportunities for learning. Below are some of the social benefits that biodiversity provides.

Research, education and monitoring

There is much more to learn about the natural world than we already know. Our environment provides a perfect natural laboratory for learning and research. Natural areas provide a reference point for comparison with other areas under different systems of use, and provide opportunities for valuable research into ecology and evolution.

Recreation

One of the reasons that the Pacific is valued for tourism and recreational purposes is its wonderful biodiversity. Eco-tourism activities have been very successful as a result of the range of biological diversity found in the Pacific. People value natural areas for several reasons: they provide inspiration for filming, photography or writing; the beauty of natural habitats and natural features; birdwatching, diving, fishing, ecological field study and other nature-based activities.

Bird watching and other nature based recreation make valuable use of biodiversity

Other values

As well as the reasons already mentioned, many people in the Pacific have cultural, spiritual and traditional links to biodiversity. Many important ceremonies and customs are linked with natural things and processes and several species of plants and animals are essential for certain cultural practices. To learn more about biodiversity in custom and culture see Module 5 in this resource.

Some people believe that biodiversity should be preserved not just because it is valuable to humans in some way, but simply because it exists. People who believe this feel that each species should be respected and protected because we don't have the right to destroy something that we did not create and that future generations have the right to inherit a natural world that is rich and varied.

Because people have different values and desires, conflicts over the conservation of biodiversity often develop. Understanding what biodiversity is and how different people value it is an essential first step to designing strategies for conserving biodiversity into the future.

Activity 2
The Spice of Life

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 60 minutes

Subject Areas

Social Science, Science

Glossary Words

Rehabilitation, native, erosion, pollutants

Materials

- Marker pen
- Butchers' paper
- Blu Tack or sticky tape

Activity summary

This activity will help students to explore different beliefs and values about why biodiversity is important, why it should be protected, and how different views can have an effect on biodiversity.

Outcomes

Students will be able to:

- Learn how people use and value biodiversity differently and examine the effects of these different views on biodiversity.

Preparation

Before the class, write up on separate sheets of butchers' paper each of the six 'Why care about biodiversity?' statements from p. 62 (you can adapt, shorten, add or combine as needed). Also write the word 'other' on a seventh piece of paper. Use thick marker pens and write large enough so that students can read the statements from all areas of the room. Be sure to read through and familiarise yourself with the statements and the information in the background reading. When you get to step 5, your knowledge and understanding of these values will help you to guide the students' discussion.

Tuning in

1. Ask your students whether they think protecting biodiversity is important. Explain that many people feel that it's important to protect biodiversity and that they have a variety of reasons for thinking so. Ask students how they feel. What reasons can they give to protect biodiversity? (These may be reasons they have read, have heard others express, or their own personal views.) Write their ideas on a blackboard or piece of butchers' paper. (It may also help to give them a few minutes to write down their ideas before sharing them with the rest of the class.)

Developing understanding

2. Using different locations for each statement, tape the seven statements you copied earlier around the room. Place each one high enough for every one to see. (Or you can put up the statements before class, folding each bottom half up and taping it in place so the students can't read the words until you uncover them.) Explain that the statements represent many of the key reasons people have given for why it is important to protect biodiversity. As a group, go over each of the statements. Compare the ideas

represented in the statements with the ideas that the students generated in the 'tuning in' section.

Use concept

3. Ask your students to carefully consider all of the statements on the wall. Encourage them to walk around and read to themselves all of the statements again. Then have each of the students choose one of the statements and go and stand next to it. Explain that the statement the students choose should be one that they feel most strongly about – because they think it is an important reason to protect biodiversity. If they don't see a sign that reflects their viewpoint, they can stand at the sign marked 'other'. Explain that there is no correct answer and that it's OK to stand either alone or with a group. If a student nominates to stand near 'other' ensure that you ask them to give you their alternative reason, which should be different from those in the other statements.

4. After everyone has made a selection, have the students standing at each poster discuss among themselves why they chose that particular statement. Remind them that each person will have personal reasons for making the choice he or she made and that they should explore some of those reasons. Give the students about five minutes to discuss their thoughts before asking one person from each group to summarise the discussion. You might want to record each group's point on a blackboard or piece of butchers' paper. Ask the students to write each groups' points down in their notebooks.

Reflection

5. Once all points of view have been recorded, ask the students to look at all the different reasons there can be for protecting biodiversity. Explain that no one answer is correct, but that all are correct as the reasons mean different things to different people. Explain that no matter the reason, protecting biodiversity is important.

6. As homework, students could be asked to give opinions on what values each of the following people may have for protecting biodiversity:

   a. Developer (big business person or company)
   b. Environmental scientist
   c. Pharmacist
   d. Tourist officer
   e. Indigenous land owner
   f. Ordinary villager
   g. Wood carver

Why care about biodiversity?

Plants and animals provide us with food, medicines, building products and other products. For medical and economic reasons we should conserve diversity of life because there may be many other products yet to be discovered that could save lives and benefit society.

Our lives would not be as rich if we lost species such as cassowaries, beetles, cuscus, frogs, lizards and crocodiles and the habitats they live in. The rich diversity of life also allows many ways to enjoy nature, such as bush walking, fishing, camping, swimming and having picnics. Imagine what your life would be like without this.

It is important to protect the diversity of life because biodiversity provides inspiration and provokes curiosity and imagination. Art, music and poetry are often inspired by the diversity of life. Examples in nature are also the inspiration for many of our technological advances, such as flight.

It is important to protect the diversity of life because biodiversity helps maintain important ecological processes such as oxygen production, pollination and flood control that, in turn, help support all life on Earth.

It is important to protect the diversity of life because the planet belongs to future generations. No generation has the right to destroy the environment and resources on which future generations depend. It is our responsibility to take care of the diversity of life.

It is important to conserve the diversity of life because all species have a right to exist.

It is important to protect the diversity of life because nature plays an important role in culture, tradition and people's beliefs. Many ceremonies and customs are linked with natural things and processes. Several plants and animals are essential for certain cultural practices.

Adapted with permission from WWF, Windows on the Wild: Biodiversity Basics, An Educator's Guide to Exploring the Web of Life

Plant eaters help to convert plant energy to be used by other animals

Topic

3

Food Chains, Food Webs and Biodiversity

Background Reading

Every living thing needs energy for survival. But where does this energy come from? It comes from eating or creating food, and in this way all animals and plants rely on each other to survive. Energy in the form of food is transferred from one ***organism*** to the next. This sequence of transferring energy through a chain of organisms is called a ***food chain***. Each link in the food chain feeds on and obtains energy from the one before it, and provides the nutrients and energy required for the one after it to survive. These links between organisms are important because they represent how animals need and rely on each other for food and therefore survival. They also show the flow of energy through the ecosystem.

How a food chain works

A food chain consists of four main parts or links:

1. **The Sun**, which is the original source of energy and provides the energy for everything on the planet. Every food chain begins with the Sun.

2. ***Producers***: include all plants. They are called producers because they are able to make their own food. The raw energy from the sun is used by plants to produce their own food in the form of sugar from carbon dioxide and water (a process known as ***photosynthesis***).

3. ***Consumers***: Consumers include every organism that eats something else. There are different levels of consumers:

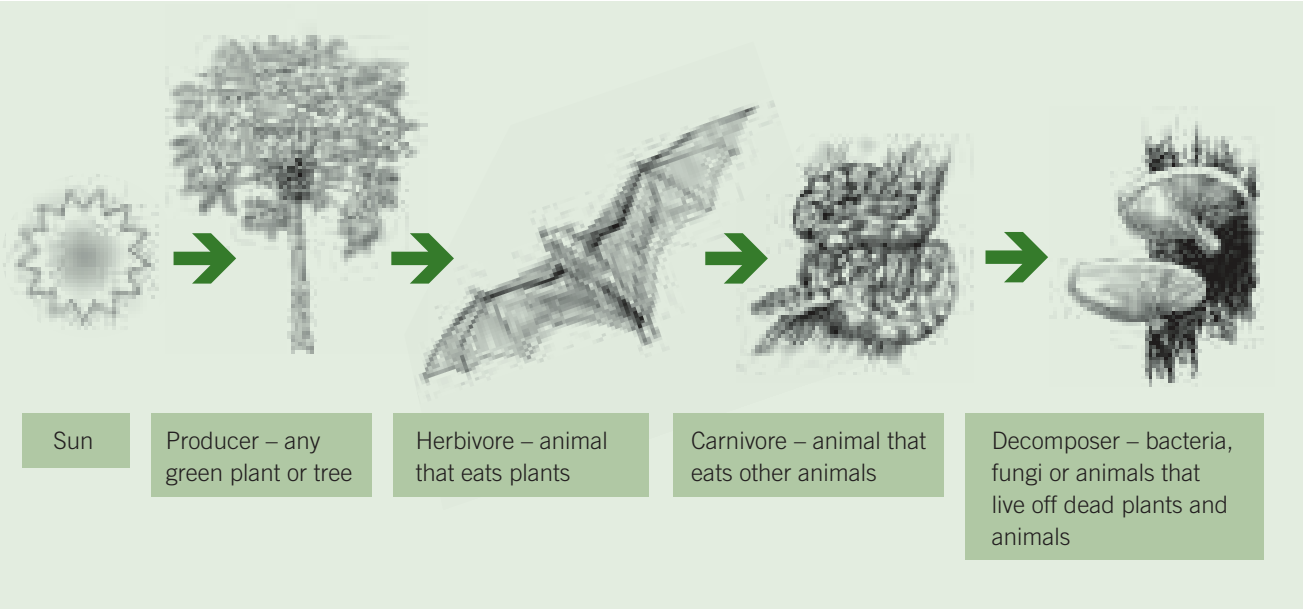
   - ***Herbivores*** (animals that eat plants)
   - 1st level ***carnivores*** (animals that eat herbivores)
   - 2nd level carnivores (carnivores that eat other carnivores)

- ***Omnivores*** (animals that eat both plants and other animals)
- ***Parasites*** (animals that live off other organisms by harming them)
- ***Scavengers*** (animals that eat dead animal carcasses).

4. ***Decomposers***: These are mainly bacteria and fungi, but also include animals such as millipedes and worms. These organisms break down dead plants and animals into gases such as carbon and nitrogen to be released back into the air, soil or water. Even though most of us overlook fungi and moulds, they actually play a very important role. Without decomposers, the Earth would be covered in rubbish. Decomposers are necessary since they recycle the nutrients to be used again by producers.

Food chains usually follow a similar pattern, starting with the producers and ending with decomposers. The arrows in a food chain could be substituted with the words 'eaten by'.

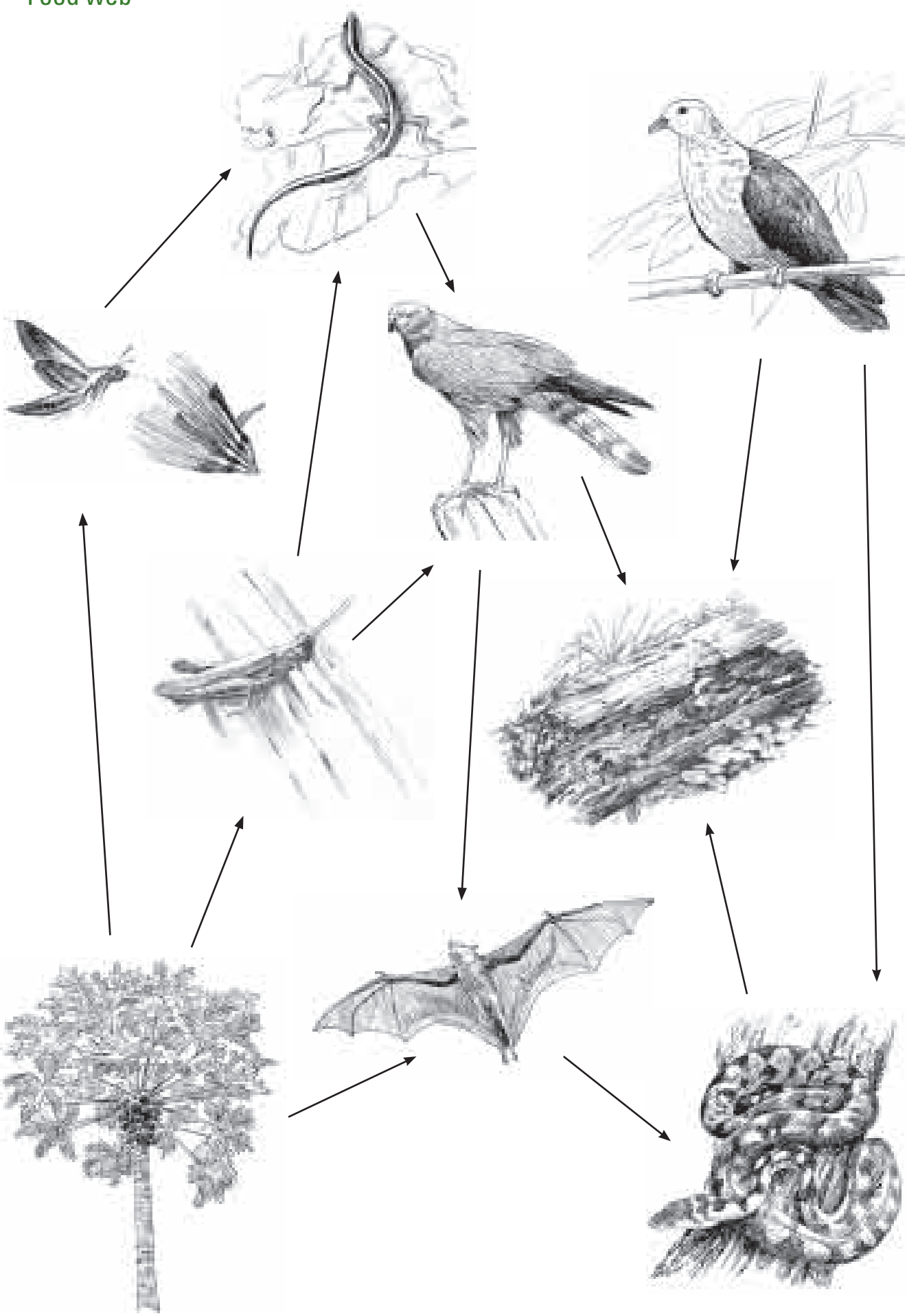
In a food chain, energy is passed from one organism to the next, but the energy that is passed on is only a small amount of the energy that was consumed by the first organism. For example, a herbivore that eats plants (e.g. a caterpillar) will use the energy it gets from the plants for many different functions, such as growth, movement or having babies. When a herbivore is eaten by a carnivore (e.g. lizard), it only passes on a small fraction of the total energy it received from the plant. That energy will be used by the carnivore much more quickly, so carnivores need to eat a lot of herbivores to get enough energy to grow. The biodiversity of an area will reflect this: there will always be more producers in order to support fewer consumers. Decomposers, however, should always be in large numbers because they are small organisms and need to decompose organisms much larger than themselves.



Food webs

A simple food chain like the one above does not exist on its own, but is just one path an animal might take to find food. Most animals are part of more than one food chain because they eat many different foods to get enough energy to survive. These interconnected food chains form a large and more complex ***food web***. Food webs better represent how animals and plants interact in an ecosystem because plants and smaller organisms at the lower end of the food chain are usually eaten by more than one animal.

Food web



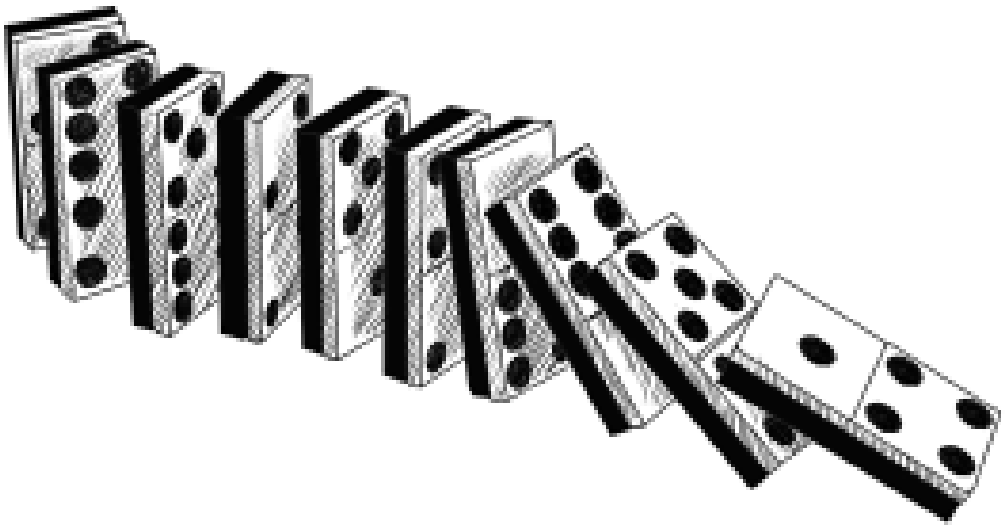
Supporting biodiversity

Food chains and food webs and the interconnections of organisms inside them are delicately balanced and play a very important role in supporting biodiversity. All organisms in food webs and food chains have a role to play whether they are a producer, consumer or decomposer, and any change in the links or connections between organisms can cause problems for the whole food chain.

Organisms can be removed from a food chain or food web through natural processes, such as fires, cyclones or climate change, or by humans through actions such as over-hunting or land clearing. A good example of how human activity can have an impact on a food chain is when we spray pesticides to kill insects. The animals that normally eat the insects wouldn't have as many to feed on, meaning that some would either starve or have to rely more on other food sources. This would impact both on the animals further along the food chain, and other animals in the food web that may also feed on the insects. Breaking one link in the chain means all of the organisms after that link are affected. It works like a game of dominos: when one falls, the others in the line are also at risk of falling. A 'chain reaction' in the food chain can be threatening.

Food chains and food webs ensure that biodiversity is supported. Organisms at the start of the chain or web need to be in large enough numbers to provide energy to the animals that eat them. If they are not then biodiversity will decrease, as there will not be enough food for the larger animals later in the chain to eat, and they will either starve or move on to other areas.

Lots of different living things in one ecosystem usually mean that it is a healthy and stable system and a good environment. If for some reason an organism is removed, it is likely that another will take its place and the ecosystem will keep functioning the way it should. However, if the ecosystem contains only a small number of different organisms, with limited interconnections, it will be hard for the ecosystem to keep functioning the way it should once an organism is removed. Therefore, it is important that we protect biodiversity to help maintain these delicate relationships.



A game of dominos: when one falls, the others in the line are also at risk of falling

Activity 3
Chains of Life

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 90 minutes

Subject Areas

Science, Language Studies, Art

Glossary Words

Food chain, food web, organism, consumer, producer, decomposer, photosynthesis

Materials

- Scissors
- Ruler
- Pencil or pen
- Paper
- Glue or sticky tape
- Coloured pencils or marker pens (optional)

Teachers' notes:

Food chains form the basis of all ecosystems, and they demonstrate the interconnectedness of all living things. You can easily make a paper model that demonstrates this interconnectedness using items you have in your classroom. See instructions at the end of this activity about how to make a simple paper food chain. You can use this food chain during this activity or as the basis of a number of biology and environmental science lessons. Why not hang your food chains around to decorate your class room?

Activity summary

This activity will help students to identify the interrelationship between plants and animals in an ecosystem and develop a sense and appreciation of the delicate balance of food webs and their importance in supporting biodiversity.

Outcomes

Students will be able to:

- Identify and construct a food chain and develop a sense and appreciation of the delicate balance of food webs and their importance in supporting biodiversity.

Tuning in

1. Begin this activity by drawing a simple food chain on the blackboard. Try to use animals and plants that live in your local area so that students can recognise and relate to them. They may even be already aware of the relationships between the organisms if they have seen them themselves, e.g. they may have seen a bird eat a caterpillar in their own garden. If you do not know any local food chains, redraw the one given in the background reading.
2. Go through each organism in your food chain and identify the role they play, i.e. Are they a producer, consumer or decomposer, and what does each of these mean? What are the arrows in your food chain supposed to represent? (Exchange of energy or feeding). This doesn't need to take more than 15 minutes. The most important outcome of your introduction is for students to be able to relate where an animal/plant is in the food chain and to understand the relationships between producers, consumers and decomposers.

Developing understanding

3. When your students have these two basic understandings, tell them that they are going to build a paper model of a food chain. With the class, go through the process of making a paper food chain as per instructions at the end of this activity (p. 70).
4. Once students have completed their paper food chains ask them to think about the individual links that they represent. Lead an open discussion by posing the following questions to the class:

- What is the first link in all their chains?
- What kind of organism is representing the consumer?
- What kind of organism is representing the producer?
- What kind of organism is representing the decomposer?
- Can they think of any other organism that could take the place of the producer, consumer or decomposer in their food chain?

**Students do not have to provide answers to these questions. Just ask them to take a look at their own food chain and think about the answers.*

5. Now ask all students to stand up and walk around the room, looking at other students' food chains to see if they are able to find a connection or relationship with theirs, i.e. Does another student have the same producer, but a different consumer? Could their consumer also eat your producer? Can you find other ways that your food chains might link or overlap? Once all students have found at least one other food chain that they can connect with, ask for volunteers to share with the rest of the class how their chains are connected. Explain to students that this connection of food chains is called a food web and that food webs are much more extensive than the individual chains that they made themselves.

Preparation

Students will take part in a practical demonstration that will help them to understand the food chain model of energy transfer in natural systems and how energy and nutrients flow around a food chain. You might like to hold this part of the activity outside.

6. Before the lesson, prepare small organism cards. You will need to have one per student in your class. The ideal size for these is a piece of A4 paper folded into quarters and then folded into quarters again. Once you open it out, you can cut or tear along the folds and get 16 pieces A4 per sheet. On these cards, write the names of common organisms and the role they play in a food chain. Use the table below as a guide:

Role in the food chain	Organism
Producers	Plants
Herbivores	Caterpillars
1st level Carnivore	Birds
2nd level Carnivore	Owl
Decomposer	Millipedes/worms

The size of your class and, hence the amount of cards required will vary. When you are creating cards there should be more producers than herbivores, more 1st level carnivores than 2nd level carnivores, and quite a few decomposers; this is how you would naturally find a community in an ecosystem.

Note: you may need more than one of each type of card. Use the following table as a guide.

No. of People	Producer	Herbivore	1st Carnivore	2nd Carnivore	Decomposer
10	3	2	2	1	2
18	6	4	3	1	4
25	8	6	4	2	5

When you are ready to start the demonstration, take your students outside into an open area; if this is not practical, move the furniture in your classroom so that you have a large open space in which to do the demonstration.

Use concept

7. Hand each student an organism card. You might like to ask each group to gather together i.e. all the producers, the herbivores, the carnivores and the decomposers all in individual groups. In their groups they can discuss how they carry out their role in the food chain.

8. Once you are sure that everyone is clear on the role they play, jumble the class up again and ask them to form a large circle. You can call it the circle of life and explain that the circle represents an ecosystem.

9. In the first round, ask all the students who are representing plants (holding an organism card with a plant on it) to enter the open space within the circle. Now explain to the class the important role that plants play in the start of the food chain by converting the Suns' energy into oxygen and food through photosynthesis.

10. In the next round, ask the students who are representing herbivores to enter the circle. At this point you need to explain that herbivores are consumers and they survive by eating plants. Students playing this role need to take the organism cards from the plants, symbolising having eaten them.

11. Next, the first 1st level carnivores are asked to enter the circle, taking the place of the herbivores and taking all the accumulated cards.

12. The next to enter the circle will be the 2nd level carnivores, and they will have all the cards, having taken energy and nutrients from others in the food chain before them. These organisms are at the 'top' of the food chain. Explain to participants that these creatures can only survive because of all the organisms that preceded them. They survive on the energy taken from the other organisms that are in the chain before them.

13. The highest carnivores will eventually die too so at this point the students representing the decomposers enter the circle and take all the accumulated cards from the highest carnivores and break them down into small pieces as they eat them (the decomposers tear the cards into progressively smaller pieces). Explain to the class that this is the role that decomposers have in the food chain: they breakdown dead organic material and wastes so that nutrients can be recycled through the food chain.

14. Finally the plants are asked to re-enter the circle to collect all the torn up organism cards from the floor. Explain to the class that this is what happens in real ecosystems: decomposers release nutrients that plants then absorb through their roots. The final step shows the continuation of the cycle (and also helps to clean up the mess!).

Reflection

Back in the classroom, ask the students to create their own food chain or food web using the information they learned during the lesson. Encourage them to try to think about food webs or food chains that have not all ready been presented in the lesson. You might like to make a suggestion of a different ecosystem that the students are familiar with but has not been covered in your lesson.

In creating their food chain or food web, ensure students include all levels: the Sun, producer, consumer (at least one herbivore and one carnivore) and a decomposer. Students could choose to present their food chain or food web as a diagram in their exercise books or as a paper model. After everyone is finished, invite students to share their food chain with the rest of the class. This could be set as a homework task or collected for assessment.

Worksheet: Make a Paper Food Chain

Food chains form the basis of all ecosystems. They demonstrate the interconnectedness of all living things. You can easily make a paper model that demonstrates this interconnectedness using items you have in your classroom.

Materials

- Scissors • Ruler • Pencil • Glue or sticky tape
- Paper (this can be paper that has all ready been used or even old newspapers)
- Coloured pencils or marker pens to decorate (optional).

Method

1. Cut lengths of paper about 20 cm X 4 cm. (Hint, if you are using A4 paper, 20 cm is the length of the paper and 4 cm is about the width of your ruler.)
2. Using your pencils or marker pens, on each piece of paper write the name of (or draw if you want to) one part of the food chain. You can use one of the examples below or try to come up with your own.
3. Choose the first strip of paper. Like all food chains you need to start with the Sun. Bend it to form a circle.
4. Over lap the ends of the paper and glue together or fasten with sticky tape. You now have your first link of the food chain.
5. Choose the next strip of paper. Like all food chains, the link that is closest to the Sun should be a plant. Pass one end of the strip through the first link you made and bend the strip to form a circle. (Hint, make sure the label or drawing is facing the outside so you can see it.)
6. Again, overlap the ends of the paper and glue together or fasten with sticky tape.
7. Continue these steps, adding each new link to your food chain until it is complete. Remember to always make sure your label or drawing is on the outside and that your food chain links stay in order.

Examples for food chain

Sun ➜ Algae ➜ Mosquito larvae ➜ Fish ➜ Human ➜ Bacteria

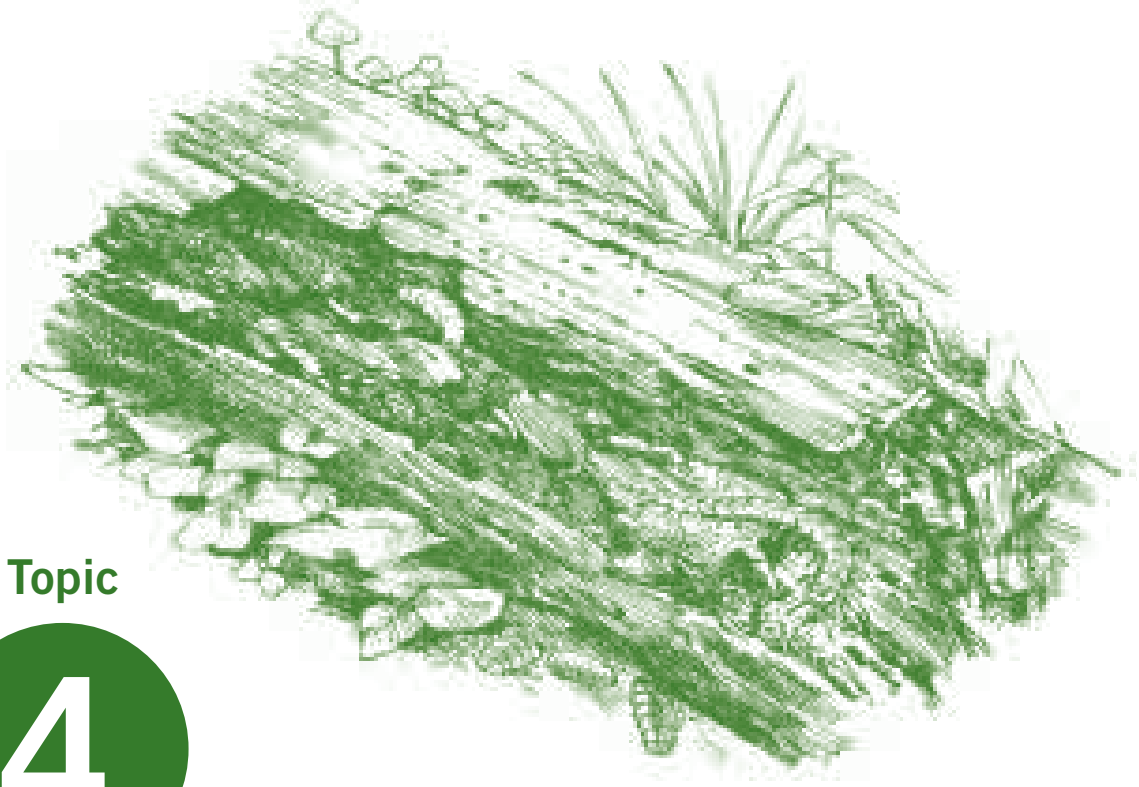
Sun ➜ Grass ➜ Cow ➜ Human ➜ Microscopic organisms

Sun ➜ Island cabbage ➜ Snail ➜ Bird ➜ Bacteria

Sun ➜ Rock algae ➜ Parrot fish ➜ Reef shark ➜ Microscopic organisms

Sun ➜ Mangrove tree ➜ Prawn ➜ Heron ➜ Algae

Sun ➜ Pawpaw tree ➜ Flying fox ➜ Pacific boa ➜ Fungi



Topic

4

Systems and Processes that Support Life

Background reading

Whether we realize it or not, ***ecosystems*** and the ***species*** within them are working around the clock to perform the many jobs that help make human life possible and more livable. Much of the work ecosystems do is difficult to watch or see, so it's easy to take these 'secret services' for granted. Just remember, while you're eating, sleeping, working, driving or watching TV, forests are helping to clean the air, oceans are regulating the ***climate***, and wetlands are helping to purify water, minimise storm damage and perform flood control.

What is an ecosystem?

An ecosystem is a community of plants, animals and other ***organisms*** that interact with each other and the physical environment and that are linked by a flow of energy and nutrients. The soils beneath a fallen log, a tropical rainforest, a river in the interior part of an island or a small cluster of corals are all examples of different-sized ecosystems.

The ecosystem as a whole and the individual species that live within it perform many functions. Through their day-to-day activities aimed at their own survival, individual organisms carry out actions or jobs that end up making life more livable for us human beings, as well as other living things. Not only do individual species carry out these important services, but the combined efforts of many species within an ecosystem can have effects that also help make our lives more livable.

While species in an ecosystem provide services, they don't intentionally perform certain activities to make the planet a better place to live. Rather, the actions that organisms take in order to survive can have positive side effects for other living things.

Let's look at some examples:

In the process of looking for their own food, animals such as insects, birds and bats ***pollinate*** flowers. These animals fly from tree to tree, stopping to feed on the nectar from the flowers, and whilst doing so, pick up pollen on their fur or feathers. When they visit the next tree, the pollen gets brushed off and ***fertilises*** other flowers. Without this 'service' it would be very difficult for plants to pollinate and they would have to rely on other methods such as wind. This service is so important that some flowers are specially shaped to match the tongue of the particular animal they are trying to attract.

One of the most important 'services' offered by ecosystems is plants providing oxygen. Plants absorb carbon dioxide, which is breathed out by animals and released when things such as wood or fossil fuels are burnt. Through the process called ***photosynthesis***, green plants are able to make their own food while also making a by-product called oxygen. Oxygen is released by the plant back into the air through respiration, and is then available for us to breath. Without this 'service' we would not have breathable air.

Another 'service' that ecosystems provide is the breakdown of ***organic*** matter. Some living organisms, such as worms, millipedes, bacteria and fungi, have the very important job of breaking down dead plants and animals. These organisms are called ***decomposers.*** Decomposers will dispose of dead plants and animals, and the energy that is passed to them through eating the dead organic matter will then, in turn, be passed onto animals that eat the decomposers. Decomposers will also release nutrients from the rotting organic matter into the soil where it can be absorbed by plants. Without this valuable 'service', imagine the build-up of dead animals just lying around!

Plants and trees play an important role in helping keep soil from being washed away (***erosion***). The roots of plants and trees help the soil to stay in place after heavy rains or floods, and allow the soil to soak up the water, which also helps to prevent floods. When land is cleared of trees and plants, it is likely to flood more easily, because vegetation usually slows down the movement of water and helps it to get into the soil. When hillsides are cleared of trees, the soil is no longer able to stay in place and will wash away so that nothing will be able to be planted there again. If land clearing is needed to plant crops, it is important to always leave some plants and trees to help prevent erosion and flooding.

Thanks to another 'service' provided by some animals, many potential pests are kept under control so they don't become too much of a problem. Some animals, such as dragonflies, spiders, bats and birds (called ***predators***), will catch and eat insects, reducing the amount that will attack our gardens and crops. This, in turn, reduces the need for insecticides and pesticides and improves the health and productivity of our gardens and crops.

On pp. 75–78, you will find a series of 'Biodiversity Perform' cards to be used in this activity. These provide more information about other important services provided by ecosystems.

Flying fox pollinating a flower

Activity 4
Biodiversity Perform

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 60 minutes

Subject Areas

Science, Language Studies, Art

Glossary Words

Ecosystem, species, climate, organism, pollinate, fertilise, photosynthesis, predator, erosion, decomposers, organic

Materials

- Thick card
- Paper
- Scissors
- Glue
- 'Biodiversity Performs' cards (see pp. 75–78)

Teachers' notes:

A good extension of this activity into English or other writing subjects is to ask your students to write a script based on the ecosystem service they performed to the class. There should be dialogue among at least three characters from their performance.

Activity summary

Students will learn about some of the secret services that ecosystems and the species within them provide, and which we sometimes overlook, by creating charade-performances for their peers.

Outcomes

Students will be able to:

- Describe several important services that biodiversity provides humans and explain how these make life on Earth possible.

Tuning in

1. Begin this activity by asking your students to suggest some examples of common ecosystems (such as deserts, rivers, forests, wetlands, coral reefs, and so on) they are familiar with. If your students are not familiar with what an ecosystem is then you may want to spend a bit of time building their knowledge before you attempt this activity. You could lead a discussion that helps the students to understand that an ecosystem is 'a community of plants, animals and other organisms that interact together with the physical environment and that are linked by energy and nutrient flow'.
2. Once they are comfortable with the term 'ecosystem', ask students to think about the term 'service'. Get the students to make suggestions of the services they are familiar with around the school or community, and you can record these on the blackboard. Suggestions could include things such as bus transport to and from school, the council collecting rubbish, someone cutting the grass at the school or food being prepared at the school canteen. Once your students are comfortable with the terms 'ecosystem' and 'service', you are ready to bring the two together in the next part of the activity.

Developing understanding

3. Now get your students to focus on the 'services' provided by ecosystems. Explain to them that both ecosystems as a whole and the individual species that live within them perform many functions, just like the communities we live in and the people within them that have different jobs. Through their day-to-day activities aimed at their own survival, individual organisms end

up performing jobs that help make life more livable for humans and other living things. To help students understand the idea, ask them to give examples of how a plant helps (supports) the environment. Students' answers should include:

- Plants provide food for animals
- Plants produce oxygen
- Plants help absorb carbon dioxide
- Plant roots can help reduce erosion by holding soil together.

Explain to the students that species don't perform certain activities to make the planet a better place to live, rather the actions that organisms take for their own survival can have beneficial side effects for other living things.

4. Ask students to suggest other services that ecosystems might provide. You may need to help them with this if they have not spent much time studying ecosystems previously. You could do this by suggesting things such as clean water, healthy soils, fresh fruit and vegetables etc., and get students to think about ways ecosystems contribute to these things. If you think students have enough background information, you can skip this bit and move onto the next part of the activity.

Use concept

5. Divide the students into small groups. The number of students in your class will determine the number of groups, but you want at least four students in each group. Each group will be responsible for 'performing an ecosystem service' in the next part of the activity. Depending on the number of students in your class, you may perform only some of the services.

6. Explain that each group will be given a card that describes one of the free services that ecosystems and species provide. Groups will have time to discuss and practise a performance that gets across the idea described on the card. Make sure students understand they do not have to act out the words on the card, just the idea or the service it represents.

   By watching the performance, the audience (the members of the other teams) should be able to figure out what the service is and how it works. Some groups may need to divide their performance into several segments in order to get the full message across. The rules are that students may not use words during their performance, but if you would like to make the game less challenging, they can use sound effects and props.

7. Give each group a 'Biodiversity Performs' card (found at the end of this activity) and allow the groups plenty of time to develop and practise their performance. Encourage each group to include all team members in the performance.

8. When the students are ready, call one group at a time to perform. Students might like to hold their performances outside. Make sure you know which card each group has. You will judge whether a student's guess is a correct answer. Student guesses will come from the audience. You may also want to make a list of possible answers on the board. Let the performers finish their skit before the audience guesses. If the students can't guess correctly, you may want to provide additional clues while the performance is repeated.

9. When you feel a correct answer has been given, choose a student (from the group performing) to read the card to the class. You might like to get the students to perform their skit again while you talk through and explain their actions; this is to be sure everyone understands how each service works. Repeat until every group has had a chance to perform.

Reflection

Invite students to choose one of the ecosystem services they have learnt about during this session and ask them to draw a picture that illustrates that service. Get the students to write at the top of their page, 'I am grateful for the ecosystem service of .....' and get them to fill in the service they are illustrating. This is a good way of making students think about how lucky we are to have the free services provided by ecosystems and species that make life on Earth possible. Remind your students that whatever we call the important jobs that ecosystems and their species provide – 'secret services' 'Nature's services', or 'free services' those services are happening around the clock and help make our lives more livable.

To conclude this activity, relate a healthy environment or ecosystem to a healthy body; if we are not healthy it is difficult for us to perform our jobs at home or our work at school. This is the same as ecosystems – if they are not 'healthy' they will not be able to perform the important services that we rely on.

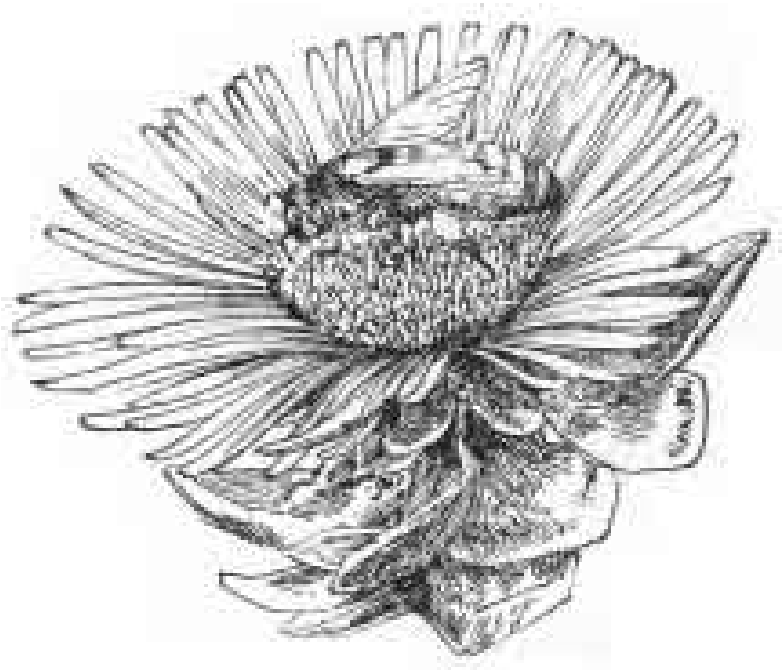
Every living thing plays an important role in an ecosystem, so it is important to protect and keep the Earths' biodiversity healthy, because you just don't know what important services they may be providing in order to help us to survive.

Biodiversity Perform cards

These boxes can be photocopied, cut out and glued to card or you can ask students to re-write this information and illustrate them.

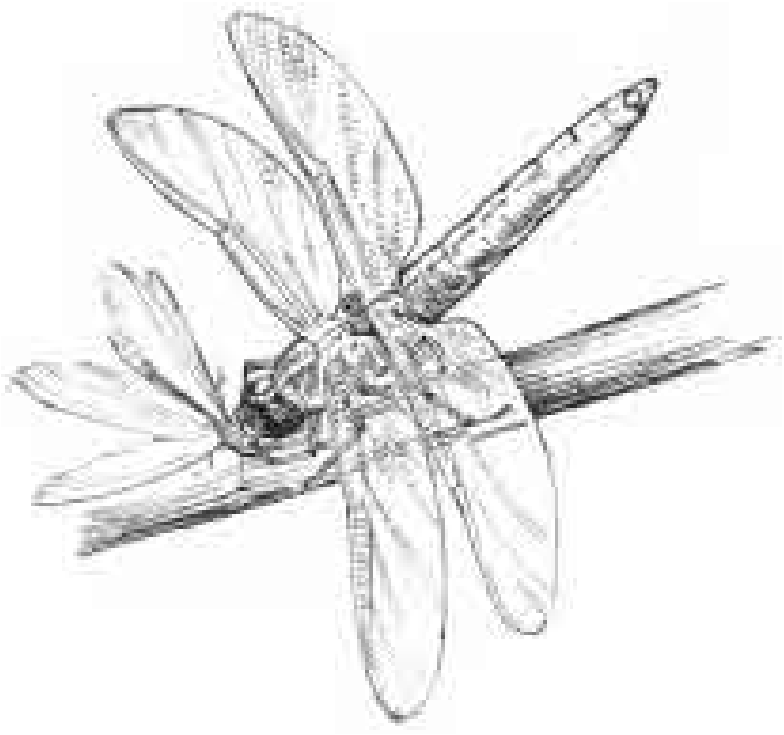
Insects, birds and bats help pollinate

In their daily search for food, bees and other insects, as well as some birds and bats, end up moving pollen from plant to plant. While stopping at a flower for a sip of sweet nectar, the animals get dusted with pollen. When they fly to another flower, some of that pollen brushes off, and the pollinated flowers are then able to make seeds. Pollination not only helps wild plants but is also important for crop plants. Most of our crops depend on these natural pollinators.



Some species help control potential pests

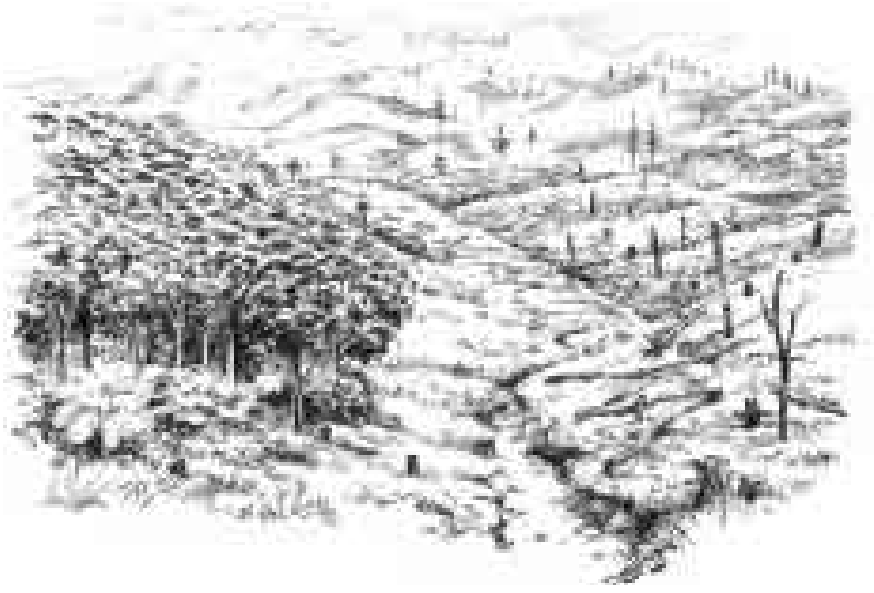
Predators often help keep the population of potential pests under control. For example, birds, bats and dragonflies are responsible for eating millions of insects that might otherwise eat up crops or give us 'itchy bites'.



Plants help control erosion and flooding

Have you ever seen rainwater rushing down a hillside that does not have a lot of plants growing on it? Maybe the hillside has been cleared for logging or to grow gardens. Without plants to absorb the water or plant roots to hold the soil together, soil is washed away very quickly. Plants also help to slow down water, allowing the soil to soak it up.

Plants help prevent the loss of soil through erosion and reduce flooding.



Wetlands help clean water

If you pour dirty water through a filter, you would expect cleaner water to come out. A similar thing happens in nature when water passes through a wetland. Wetlands are areas that have waterlogged soils or are covered with shallow water either all the time or off and on.

By slowing the flow of dirty water as it goes by, the vegetation growing in a wetland traps some of the pollutants and sediments. But plants aren't the only living things that clean water. Aquatic animals that pump water through their bodies to filter out food for themselves, such as oysters, also end up cleaning the water they live in.

Plants convert the Sun's energy into energy we can use

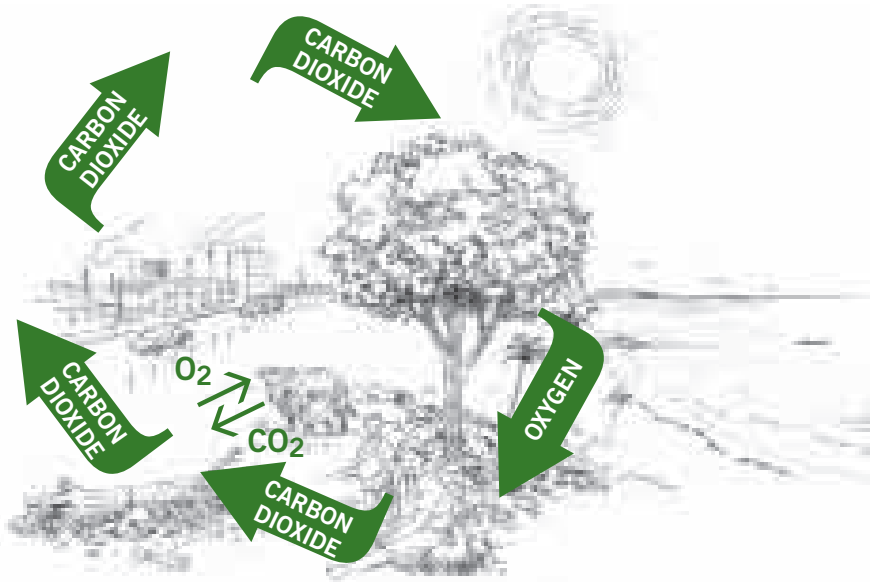
Although warm days may make you feel energetic, humans (and other animals) can't get the energy we need to fuel our bodies directly from the Sun. Instead, we rely either directly or indirectly on plants for energy.

Green plants capture the Sun's energy and convert it to starch and sugar through a process called photosynthesis. They store some of the energy in their leaves and stems. When animals eat plants, the animals get the energy that the plants stored and they use it or store it in their bodies to use later. When animals eat animals that have eaten plants, they get the energy that has been passed along. Without green plants we'd all go hungry.

Plants and animals work together to help keep the balance of gases in the air

Plants and animals continuously cycle gases among themselves, the soil and the air. Plants take in carbon dioxide from the air and then release oxygen back out into the air during photosynthesis. Animals, including humans, use oxygen to breath and release carbon dioxide into the air. Water vapour and other gases such as nitrogen also cycle from the air to animals and plants, to the soil and back again.

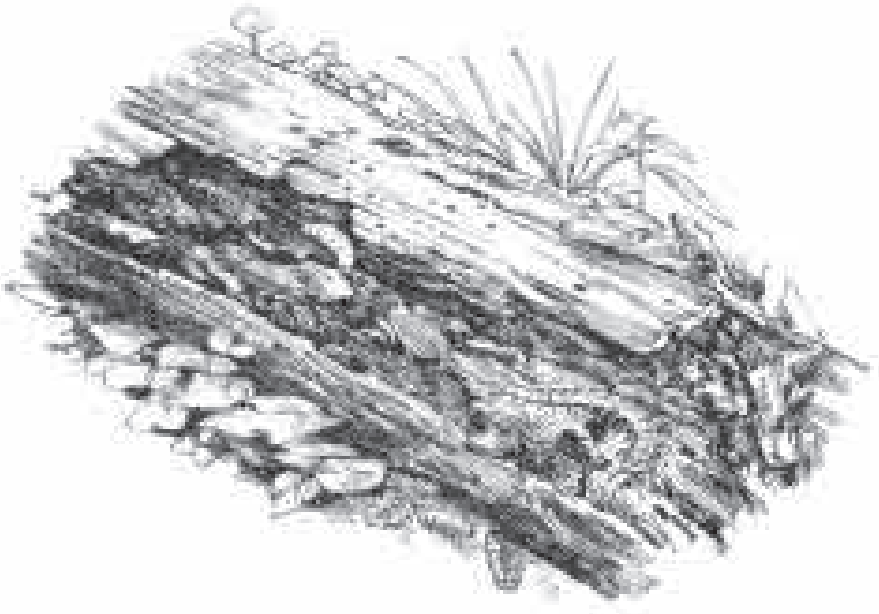
Without living things, the air just would not be the same!



Some organisms decompose organic matter

Some living things, called decomposers, get the food they need by feeding on dead things. Decomposers not only keep dead organisms from piling up, they also make the nutrients in the dead organisms available to living plants and animals. Any nutrients they use to build their own bodies become available to the animals that eat them.

Also, the nutrients that pass through the decomposers as waste end up in the soil in simple forms that plants can absorb through their roots. Imagine what life would be like without decomposers.



Adapted from Biodiversity Basics—An Educator's Guide to Exploring the Web of Life (World Wildlife Fund, 1999). Reproduced with permission

Plants have an annual cycle of growing flowers and bearing fruits

Topic

5

The Role of Biodiversity in Natural Cycles

Background reading

Pacific peoples have always lived very close to nature and are familiar with many of the ways in which plants and animals interact and respond to changes in their environment. For example, rainfall and changing seasons bring about predictable changes in the availability of fish and fruit. Traditional knowledge of these cycles is very important if people are to take advantage of the resources that biodiversity offers. For example, it is important for people to know the time of year that yams or turtles' eggs can be harvested or when flying foxes will pay a visit to the mango trees. See Module 5, Topic 1 & 2 for more about traditional knowledge of cycles.

Scientists have also studied interactions between organisms and their environment and describe many of these processes through 'cycles'.

A cycle is something that repeats itself, and is a good way of explaining certain processes in nature that go through different recurring stages. For example, the life history of a tree may be linked to the time of year (season). A tree goes through an annual cycle of growing flowers and bearing fruit. This happens at the same time every year and, therefore, is a predictable cycle.

Some natural processes include cycles that take much longer than one year and happen on a global scale. Examples include the water cycle, the oxygen cycle and the carbon cycle. The carbon cycle is a natural cycle of world importance, because it affects every living organism on the planet, including people. Changes to the carbon cycle are responsible for the biggest environmental problem facing the planet today: global warming.

The carbon cycle

Carbon is the most common element found in the human body and in the structure of organic matter (all living and once living things). The carbon cycle is the process through which carbon is cycled through the air, ground, plants, animals, dead organic matter and fossil fuels. The carbon cycle and biodiversity are very closely linked.

Carbon is present in the atmosphere in the gas carbon dioxide (CO_2), which is found in the air we breathe at a relatively low concentration of about 0.038% or 380 parts per million parts (ppm). Although low, relative to other gases, the current concentration of CO_2 in the atmosphere is the highest it has been for 650,000 years!

Carbon dioxide is taken out of the air by green plants during the process of photosynthesis. Plants capture the carbon and use the energy provided by the Sun to make their own food in the form of sugars. This is the basic building block of almost every food chain and ecosystem on the planet. Carbon is stored in the tissues of the plant, such as in the woody trunk, stems, leaves and roots.

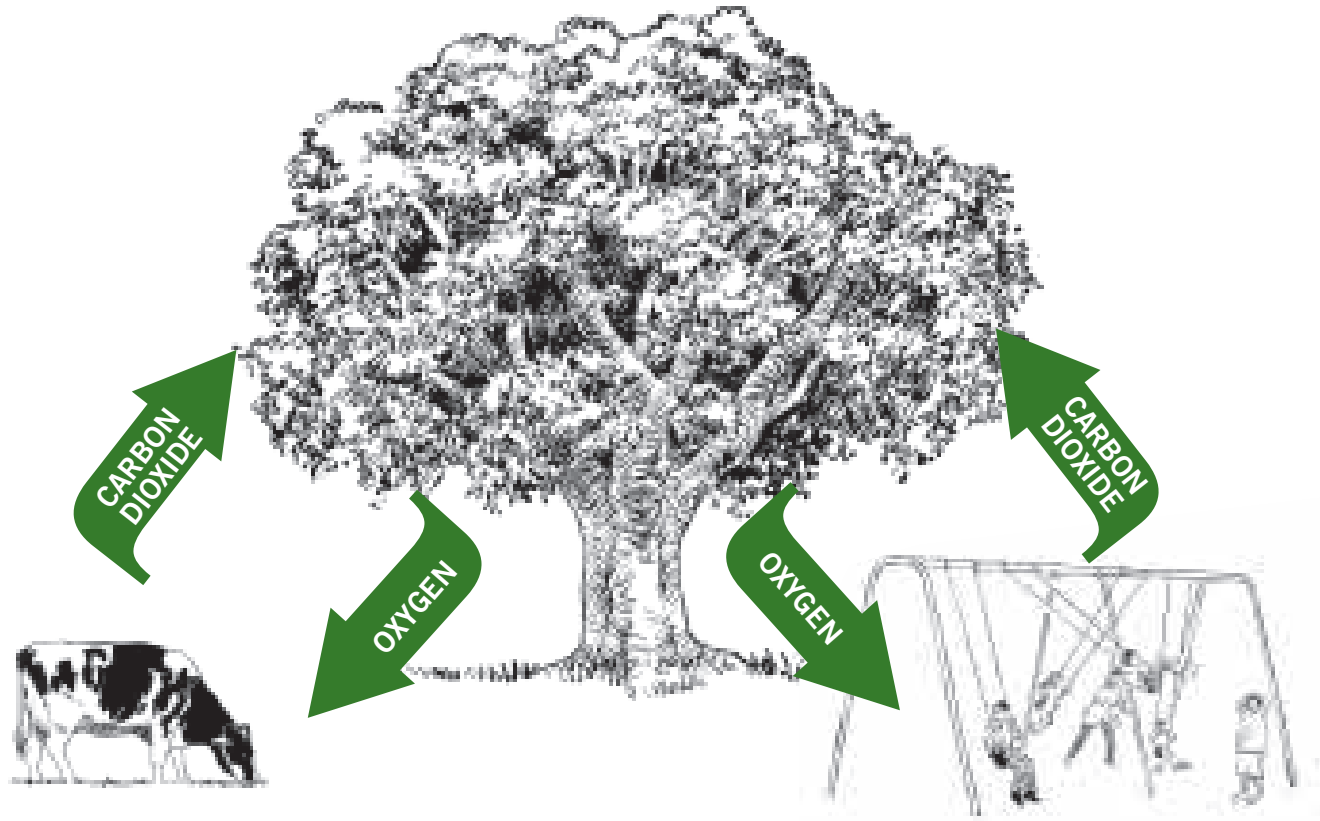
Animals that feed on plants take some carbon into their own bodies. However, as animals use up the sugars obtained from the plants, they also breathe carbon dioxide back into the air as a waste product. This process is called respiration. The air that animals breathe out has a concentration of about 4.5% CO_2, which re-enters the ***atmosphere***.

When an organism dies it is decomposed by the action of ***decomposers*** which include small animals and organisms such as bacteria.

Decomposers also respire and breathe out carbon dioxide into the air. Decomposers play a very important role because without them, all the carbon would be locked up in dead carcasses and other waste lying about. Can you imagine a thousand years' worth of accumulated dead leaves if they were not decomposed?

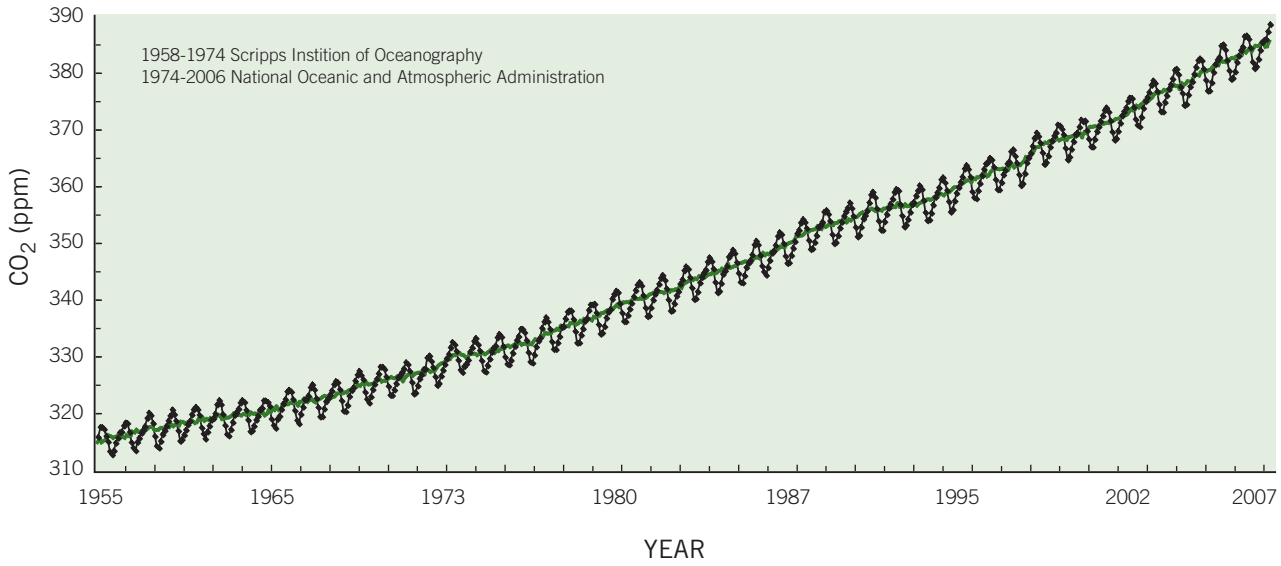
A large amount of carbon is also found dissolved as CO_2 in the oceans. This CO_2 is used by marine plants such as algae in photosynthesis. Land plants and marine algae photosynthesise and use carbon in similar ways, but marine algae obtain their CO_2 from the water.

When organic matter is buried and then stored underground for extremely long periods of time it may become what is called a ***fossil fuel***. The word 'fossil' means something that was once living and has been preserved. Fossil fuels, such as coal and oil, are actually the remains of long dead organisms, which have been squeezed and cooked under the pressure and heat of accumulating rock over millions of years. The gasoline and diesel that drives our motor vehicles was created by biodiversity that existed long ago.



Mauna Loa Monthly Mean Carbon Dioxide

NOAA ESRL GMD Carbon Cycle



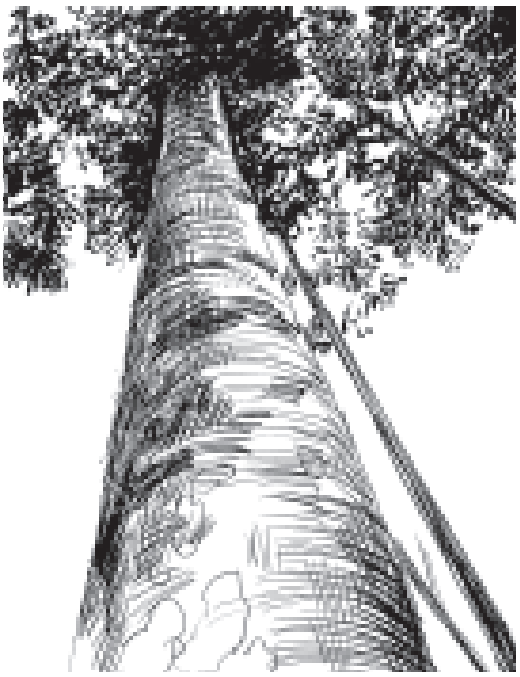
Watch the planet breathing!

The graph above was recorded on a mountain in Hawaii, and shows a continuous record of CO_2 levels in the planet's atmosphere. Notice how the line in the graph goes up and down each year. This line shows that biodiversity has a major impact on the carbon cycle. Each year the extensive forests in the northern hemisphere continents loose their leaves. When this happens, the leaves are broken down by decomposers and release CO_2 into the atmosphere, making the planet 'breathe out'. In Spring, the leaves on the trees grow back again, drawing in and storing CO_2 and allowing the planet to 'breathe in'. Biodiversity has a major role in maintaining CO_2 levels. However, there is a second trend in the graph that shows that the total amount of CO_2 in the atmosphere is climbing rapidly every year. This rise is caused by human activity and is not part of the natural cycle.

The carbon cycle in crisis!

The carbon cycle is currently in crisis, which is causing the entire world's climate to change. Six out of the seven warmest years on record have happened since 2001. The main source of the problem is that too much CO_2 is going into the atmosphere. Before the invention of factories, mass production and motorised transport, the level of CO_2 in the atmosphere was about 280 ppm, but today it is 380 ppm and rising. CO_2 has a major role to play in regulating the planet's temperature, and the increase in its concentration is the main cause of global warming.

One of the main causes of increased CO_2 in the atmosphere is the burning of fossil fuels. Coal, oil, natural gas and gasoline are consumed by industry, power plants and automobiles. When they are burned to release energy, they also release their carbon dioxide into the air.



But what does this have to do with biodiversity? As well as the biodiversity that existed in the past, today's biodiversity plays an important role in capturing CO_2 from the air and storing it. For example, trees store carbon in their wood, leaves and roots. Clearing of bush and forests for agriculture and urban development has led to an enormous loss of biodiversity, but has also allowed the carbon stored within these organisms to be released into the atmosphere.

Next time you look at a forest, don't just think of it as a supply of timber and other resources or just as a home for animals. The forest also traps and stores carbon and helps prevent the world from overheating. At the present time, clearing of tropical forests is contributing about 20–25% of the total amount of new carbon dioxide that is being added to the atmosphere in the world each year.

Activity 5
Carbon Measure

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 90 minutes

Subject Areas

Science, Maths

Glossary Words

Atmosphere, decomposer, fossil fuel

Materials

- String
- Tape measure
- One-metre ruler
- Pen or pencil
- Paper or exercise book

Teacher's Notes

This activity can be a good introductory activity before students carry out the Replanting Project found on p. 187, in Module 4 'Hands on for Biodiversity'.

Activity summary

Students will learn how to estimate the weight of a tree using its diameter and height and then use this to measure amount of carbon stored within trees around the school. Students will gain an understanding of why the trees and therefore biodiversity are so important in keeping carbon out of the atmosphere.

Outcomes

Students will be able to:

- Explain the role of biodiversity in natural cycles including the Carbon Cycle and its role in controlling the Earth's climate.

Tuning in

1. Explain to your students that many natural processes occur in cycles. For example, trees produce flowers and fruit at certain times during the year. Ask your students to think about some other cycles that are found in nature. Some examples are:
   - The changing of the seasons
   - The time of year trees lose their leaves
   - The water cycle.
2. Once your students are familiar with the term 'cycles', discuss some global cycles that happen not just locally but around the world and that affect all living organisms. Focus on the carbon

cycle. Draw a diagram of the carbon cycle and ask students to copy it into their books.

Explain that all living things store carbon, and that when they die the carbon is released into the atmosphere. Some of the carbon is not released into the atmosphere, but is locked inside the Earth as fossil fuels. Explain that up until recently, the amount of carbon locked in the Earth and the amount released into the atmosphere have balanced out, but by cutting down trees and burning fossil fuels, humans have disrupted the balance by releasing more carbon into the atmosphere. This is a problem for the environment because too much carbon in the atmosphere is causing the Earth to 'warm up'. To find out more about global warming to assist with this activity, see Module 3, Topic 7 'Climate Change' (pp. 137–141).

Developing understanding

3. Explain to the students that all living things contain carbon, and that it is possible to estimate how much carbon they hold. Explain that in this activity they are going to measure the weight of a living tree to determine how much carbon it is storing.

4. Get the students to form groups of four, and give each group a length of string long enough to go around a tree trunk. Students will use this string to measure the circumference of the tree trunk. Do this around the tree at about chest height. Once students have placed the string around the tree to determine the circumference, the length of string will need to be measured using a measuring tape or a ruler. By measuring the circumference, students will be able to work out the diameter of the tree trunk. The diameter is needed to estimate the weight of the entire tree.

To work out the diameter, students will need to know the following equation:

Circumference (C) = 2 x π x r where r = radius, and π = 3.14

This equation can be converted to C/π = 2 x r, where 2 x r is the diameter.

For example:

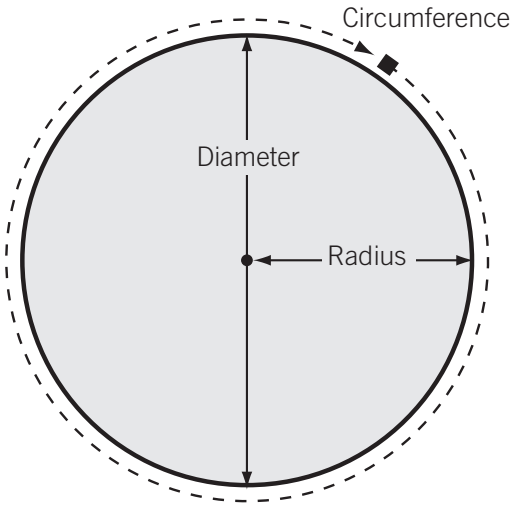
C = 2 metres

C/π = 2 x r

2/3.14 = 2 x r

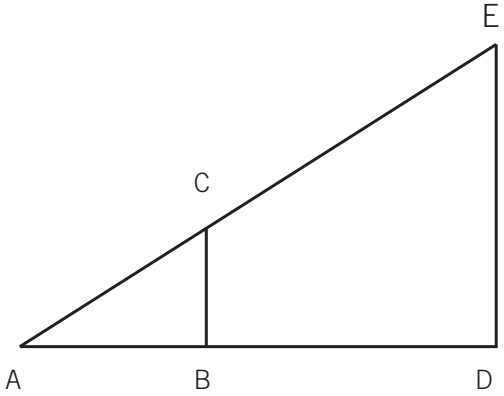
0.64 = 2 x r

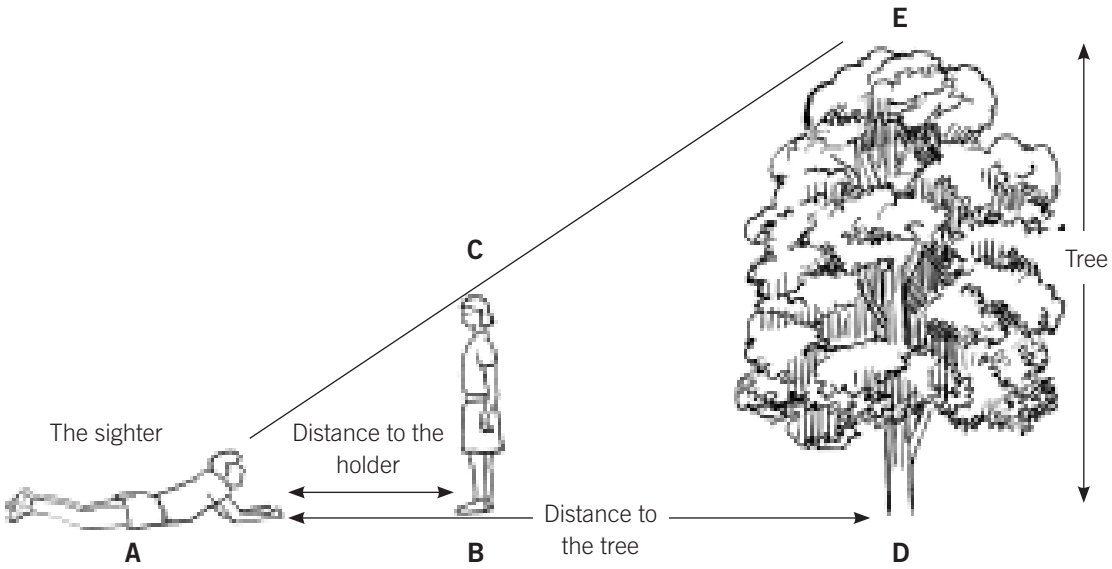
So the diameter is 0.64 metres, or 64 centimetres.



If your class is too young to do this kind of maths problem, ask them to form the string that measured the circumference into a circle. They can then use their ruler to roughly measure the diameter of this circle.

5. Students will also need to measure the height of their tree. To do this, students will need to understand the concept of triangles. The ratio of two triangles of different size but similar shape can be compared if their angles are the same. (See example below.)





If you know the values of AB, BC and AD, you will be able to work out the value of DE (height of the tree). This is because the ratio of BC/AB is equal to the ratio of DE/AD (BC/AB = DE/AD).

So, if BC = 3 metres and AB = 4 metres, then 3/4 = DE/AD. AD is the measurement of how far away you are from the tree. If AD = 16 metres, then you can work out DE by multiplying each side of the equation by 16 (AD).

BC/AB = DE/AD

3/4 = DE/16

3/4 x 16 = DE/16 x 16

48/4 = DE

12 = DE

Therefore, the height of the tree is 12 metres.

For this part of this activity, the four students will need particular roles:

i. the *Recorder*, who records the data and the measurements

ii. the *Sighter*, who visually aligns the 'holder' and the top of the tree

iii. the Holder, who stands between the measuring being done and the tree to be measured, holding the end of a string on the top of his or her head.

iv. the *Measurer*, who needs to use the metre ruler or a measuring tape to take the measurement.

Measuring the tree

The *Holder* stands at point B and holds the end of a long string on top of his or her head.

The *Sighter* takes the other end of the string and moves to a place where he or she can lie face-down and still see the top of the *Holder's* head in such a way that it is lined up with the top of the tree. The *Sighter* uses the string pulled tight to 'align' the tree and the *Holders* head. The *Sighter* may have to move several times. Once the *Sighter* finds the place with the best alignment this place becomes point A and the top of the *Holder's* head becomes point C.

The *Measurer* now measures the distance on the ground (not the string) between the *Sighter's* eye and the feet of the *Holder* (point A to point B). Without moving the metre ruler (or the tape measure if using instead), the *Measurer* reads the measurement and tells the *Recorder* what it is.

The *Measurer* now continues to measure from the feet of the *Holder* (point B) until they reach the tree (point D). The *Measurer* reads the measurement and tells the *Recorder* the total distance between the *Sighter's* eye (point A) and the base of the tree (point D).

The *Measurer* measures the height of the *Holder* (point b to point C) and the *Recorder* writes it down.

Now that the students have all the measurements they are ready to do the equation.

6. Once back in the classroom, ask the students to use the measurements in the equation on the opposite page to calculate the height of the tree.

7. Once students have both the diameter and height of their tree, they are able to calculate the 'green weight' of their tree. The green weight is the weight of the tree when it is alive. The equations below will determine the weight of your tree. As the weights of different species of tree will be different, these equations will only provide an approximate weight for your tree. There are two equations – one for trees with a diameter of less than 30 cm and one for trees with a diameter equal to or greater than 30 cm.

   W = green weight, D = diamter and H = height

$W = 0.005(D)^2(H)$, where D is in centimetres and H is in metres, for trees equal to or over 30 cm in diameter.

$W = 0.015(D)^2(H)$, where D is in centimetres and H is in metres, for trees under 30 cm in diameter.

Examples:

i. If your tree has a diameter of 20 cm and a height of 10 m then

$W = 0.015(20)^2(10)$
$W = 0.015(400)(10)$
$W = 60$ kg

ii. If your tree has a diameter of 35 cm and a height of 15 m then

$W = 0.005(35)^2(15)$
$W = 0.005(1225)(15)$
$W = 91.875$ kg

These calculations will only give you the weight of the tree you see above the ground, and does not factor in the roots. The weight of the roots is about 20% of the weight of the tree above ground, so multiplying the weight of the tree above ground by 120% (or 1.2) will give you the weight of the tree and the roots.

Example: Weight of the tree is 91.875 kg. Multiply this number by 120% (1.2): 91.875 x 1.2 = 110.25 kg . 110.25 kg is the weight of the tree and its roots.

8. Once students have found the total weight of their tree, they need to calculate the tree's dry weight. This is the weight of the tree once it has died and becomes dry. We need this measurement to work out the amount of carbon the tree is storing. On average, a tree is about 72.5% dry weight to 27.5% moisture. So, to calculate the dry weight of the tree, get the students to multiply the green weight of their tree by 72.5%.

   Example: Green weight of a tree is 72 kg (including the roots). 72 x 72.5% = 52.2 kg dry weight.

9. Scientists have discovered that about 50% of a tree's dry weight is carbon, so to calculate the amount of carbon, get the students to halve the dry weight of the tree they measured.

Use concept

11. Ask the students where they think the carbon found in the tree comes from, keeping in mind the carbon cycle. The correct answer will be that plants and trees take in carbon dioxide (CO_2) for the process called photosynthesis. The carbon comes from other living things as they respire (breathe).

12. Tell the students that we can calculate how much CO_2 the tree we have measured has taken in. We know that CO_2 is made up of 1 molecule of carbon and 2 molecules of oxygen. The atomic weight of carbon is 12 and the atomic weight of oxygen is 16. So, the combined weight of CO_2 is C + 2 x O = 44. The ratio of CO_2 to C is 44/12 = 3.66

Therefore, to determine the weight of carbon dioxide taken in by the tree, we multiply the weight of carbon in the tree by 3.66**.**

Example: the weight of the carbon in the tree is 26.1 kg. 26.1 x 3.66 = 95.53 kg

Reflection

Instruct the students to find out the amount of carbon that was stored in the trees measured by all the other groups. Add this to their own result to find out how much carbon is stored in the sample of trees the class measured.

Knowing how much carbon one tree can store and knowing how much carbon the class sample of trees can store, ask your students to think about how much carbon would be stored in all the trees in the school compound or all the trees in a forest.

Ask students to think about what might happen if the forest was cleared or burned and there were no trees or plants to take in the carbon. Encourage them to write down their answers to share with the class later. Some possible answers could be:

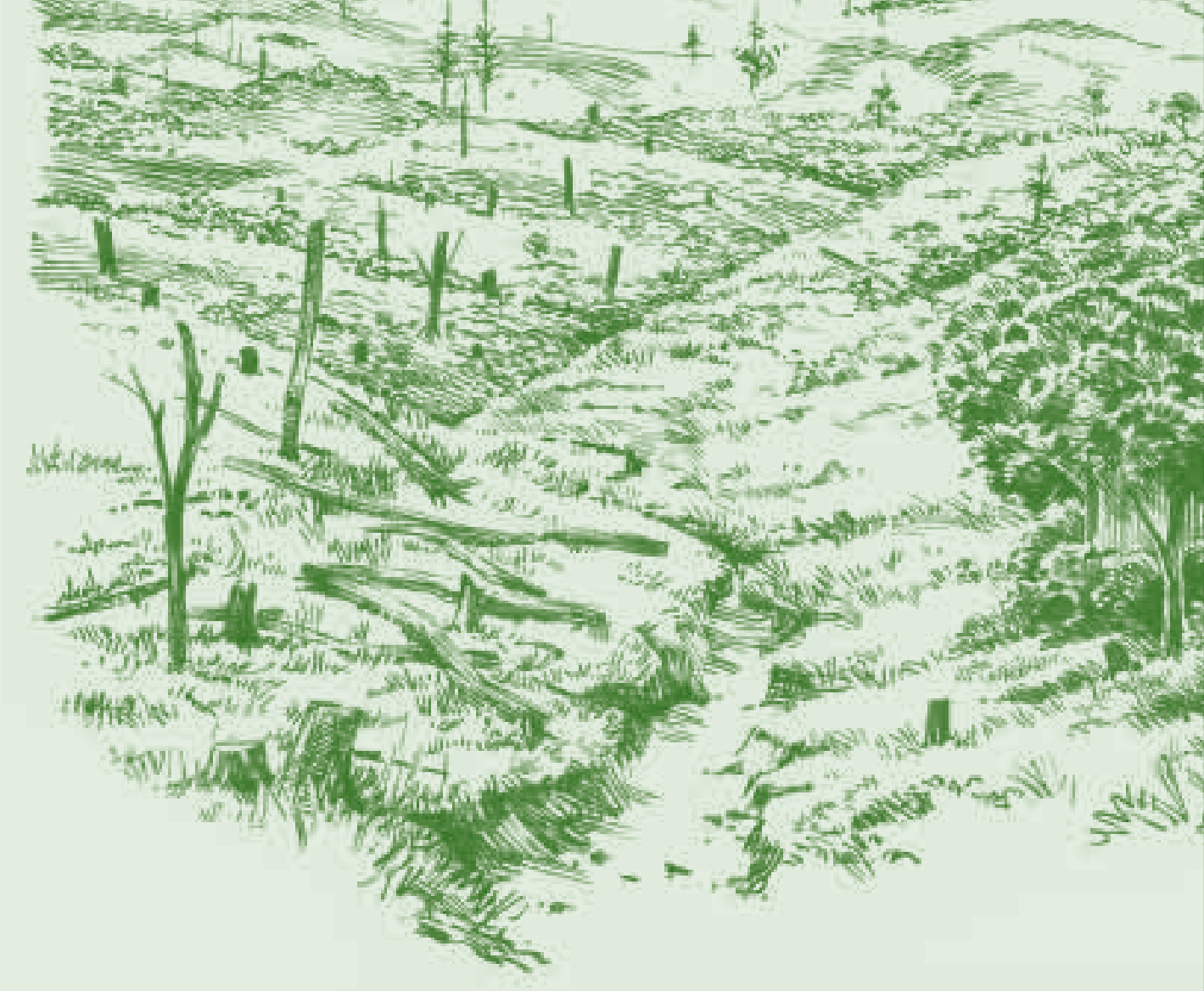
- *The carbon cycle would be out of balance even more than it is now*
- *Global warming would be a bigger problem*
- *The Earth would get hotter*
- *Sea levels would rise because the ice at the polar caps would melt*
- *The climate would change dramatically*
- *The health of humans would be affected.*

Ask the students what they can do to help keep carbon out of the atmosphere. The main answers would be to not cut down so many trees and to plant more trees. Here you could start a discussion about the fact that while trees are needed for things such as building houses, any trees that are cut down need to be replanted.

3 Biodiversity: Understanding the Threats

"We consider species to be like a brick in the foundation of a building. You can probably lose one or two or a dozen bricks and still have a standing house. But by the time you've lost 20% of species, you're going to destabilise the entire structure. That's the way an ecosystem works."

Donald Falk, Restoration ecologist



Module Introduction

Biodiversity: Understanding the Threats

Threats to our incredible and unique biodiversity in the Pacific are numerous; we are losing our biodiversity faster than the Earth has ever seen before. This loss, called extinction, is forever; the species will never be seen again. Sadly, more and more species are at risk of extinction every day because of our activities. To make things worse, it is happening at a time where we are only just starting to understand how and why biodiversity is so important to our world and to us. Biodiversity not only keeps the world healthy, but keeps us healthy as well.

This module looks at various ways in which our biodiversity is threatened. The threats range from habitat loss to wildlife trade to climate change. The module aims to provide students with an insight into these and other issues. It is important for students to understand how we, as individuals and communities, threaten biodiversity locally and globally. Activities that seem harmless, such as driving a car or burning plastics and other rubbish, are having a much bigger impact than many of us realise.

activities are not as gentle on the Earth as they may have been a long time ago. When population growth is also considered, this highlights the big challenges we face today. If we can minimise our impact, we will do much to save our biodiversity and keep the planet and ourselves healthy.

This module has seven Topics that cover:

1. Loss and Degradation of Habitats
2. Human Population Growth
3. Endangered Species
4. Trade in Endangered Species
5. Waste and Pollution
6. Invasive and Introduced Species
7. Climate Change.

The topics not only define these issues and allow students to understand them in their own context, but they allow students to investigate and critically look at how and why they have an impact on the Earth's biodiversity.

Today we are seeing a trend toward ever increasing growth in the use of many of the world's resources, including land, food, minerals, water and fuels such as oil and timber. The Earth's resources are already being used up at a rate never known before. The world is faced with a problem because the supply of resources is limited, which means there are limits to how much we can take.

Another big issue affecting our communities and the planet as a whole is that of population growth. The world's population of people recently reached 6.7 billion people, and is predicted to reach 9 billion by 2050. If each person alive today was to hold hands with another and stand in a line, this line could wrap around the Earth 160 times!

Much of the human use of Earth's resources has happened with little thought about how this will impact us and our world in the future. Human

Activity Details Summary: Module 3, Biodiversity: Understanding the Threats

Topic	Activity	Activity summary	Outcomes	Subject Areas	Timing
Loss and degradation of habitats	Activity 1 – Space for Species	Students will develop an understanding of how habitats and 'space' is important for a species to survive by taking part in a role play that shows how human activities can impact upon a habitat and its biodiversity. The activity extends to invite an older member of the community into the classroom to tell the students about changes in the local area.	Identify human activities that lead to the destruction or loss of habitat. Explain how loss of habitat affects plant and animal species	Language Studies, Science	Teacher preparation time: 30 minutes (plus time to organise a guest speaker) Lesson time: 90 minutes
Human population growth	Activity 2 – The Midwife and the Grave Digger	In a short demonstration, students observe how populations grow when the birth rate is higher than the death rate, and they will also observe the effects of migration. Students will also be able to understand how the world's resources are limited through a visual demonstration. Students will examine whether the demands placed upon the planet by an increasing population can be sustained.	Identify factors that contribute to the changes in population of your country Explain that the world's population is growing rapidly and requiring more resources and that the amount of resources in the world is limited, and this impacts on biodiversity	Social Science, Science, Maths, Health, Art	Teacher preparation time: 30 minutes Lesson time: 90 minutes
Endangered species	Activity 3 – Gone Forever	This activity allows students to explore reasons why species have become extinct in the past and then relate these factors to species that are in danger of becoming extinct today. Students will reflect on how extinction makes them feel, and develop an understanding of how humans are part of the problem and future solutions.	Define and use the terms endangered, threatened and extinct and give examples of endangered, threatened and extinct species Investigate some species of plants and animals whose populations have been reduced because of human activities	Science, Language Studies	Teacher preparation time: 30 minutes Lesson time: 90 minutes
Trade in endangered species	Activity 4 – Wildlife for Sale	Students are introduced to the concept of wildlife trade by considering a picture showing the different aspects of the trade. They will experience wildlife trade by participating in a fun game about how wildlife trade impacts on rare species. Students will use their learning to create awareness raising posters to take some action against the trade.	Investigate why trade in Endangered Species happens and what impact this has on biodiversity	Social Science, Science, Physical Education	Teacher preparation time: 1 hour Lesson time: 90 minutes
Waste and pollution	Activity 5 – Story of a River	Students will investigate sources of waste and pollution in their area and be able to understand its effect on the food chain and its impact on biodiversity. They will then be able to develop a storybook that illustrates their understanding of the issues and suggest actions that could be done locally to address pollution problems.	Identify ways in which humans pollute the environment and explain the effects of pollutants on biodiversity	Language Studies, Arts, Health, Science, Social Science	Teacher preparation time: 30 minutes Lesson time: 45 – 90 minutes
Invasive and introduced species	Activity 6 – Deadly Invaders	Students will learn the difference between native, introduced and invasive species, and play a fun game to explore the impacts that introduced Brown Tree Snakes had on native birds in Guam. Students will apply the concepts learned through creative writing.	Define the term invasive and give examples of invasive species and the impact they have on Biodiversity	Social Science, Science, Physical Education, Language Studies	Teacher preparation time: 15 minutes Lesson time: 90 minutes
Climate change	Activity 7 – Global Warming a Hot issue	In two demonstrations students will learn how the greenhouse effect works, be able to explain why the climate is changing and understand how climate change will impact on biodiversity	Investigate the causes of climate change and its impact on biodiversity	Social Science, Science, Maths	Teacher preparation time: 30 minutes (plus time to make or organise the ice) Lesson time: 90 minutes

Topic

1

Loss and Degradation of Habitats

Background Reading

Every living ***species*** has certain needs for survival, which are provided in the environment or ***habitat*** in which it lives. Many animals and plants have very specific needs. Where conditions vary, sometimes by even the slightest amount, these animals and plants will not be found. For example, the clownfish is only found in shallow, warm water on coral reefs, where certain types of sea anemones are found. You will never find a clownfish where the water is deep and cold.

A habitat is the 'place' where an animal and plant is found. It includes water, soil and the relationships between all the plants, animals and non-living things. Each species has a particular habitat that it prefers, e.g. seagrass beds for dugongs, sandy beach for hermit crabs or rainforest canopy for parrots.

Perhaps the most important threat to wildlife species today is habitat loss.

What is habitat loss?

Habitat loss occurs when human activity, such as the construction of new roads and the clearing of land for gardens or new houses, removes or divides a habitat. Here are some examples of activities that result in habitat loss:

- Cutting down a forest to get timber
- Clearing mangroves to make a boat ramp
- Collecting coral to build a house
- Cutting down bush and burning land to plant a garden of cassava

One of the main ways that habitat loss affects biodiversity is that the amount of space for plants and animals to live in becomes smaller. When a habitat is destroyed, plants and animals that are unable to escape may be killed. Animals that can easily move (especially birds) might escape into the remaining areas of habitat. However, this can lead to overcrowding and increase the competition for ***resources***, such as food and water, in a smaller area. An area can only support a certain amount of plants and animals due to its limits of space and resources.

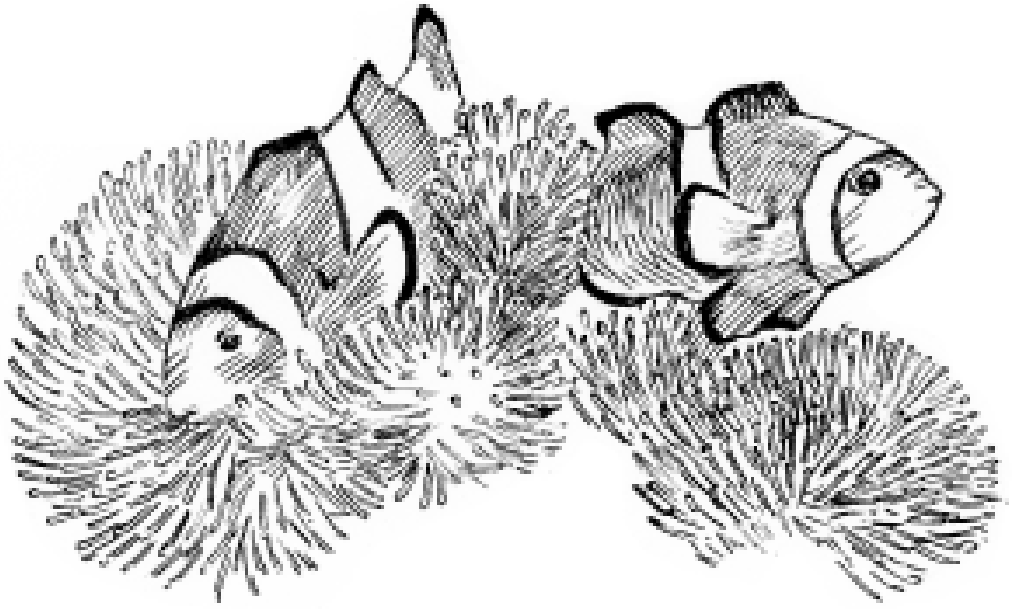
Small habitats can only support small populations of plants and animals, and sadly the small populations are more at risk of ***extinction***. So, small changes to the climate or the amount of resources available and other factors that would normally be of little concern in large populations can be disastrous in small, isolated populations.

Historically, most Pacific Island countries have relied on coastal areas for much of their resources, particularly food, fuel such as timber, and land for gardening. The growth in population, increase in the number of towns and cities, and agricultural and economic development over the years has placed increasing pressure on these coastal resources. On many islands, coastal forests have been cut down and replaced by huge coconut and oil palm cash crops. Today, on many Pacific islands there is very little natural coastal vegetation left. This is because the land is under high demand from human populations, which are growing by 1% to 3% a year. In Fiji, for example, logging has affected nearly all coastal forests.

The combined effects of agriculture, logging and development has lead to the sad situation where only 21% of original vegetation remains in Polynesia and Micronesia.

Another way that human activity leads to habitat loss is when destructive harvesting methods are used to gather resources. A common example is dynamite fishing, where dynamite is used to stun the fish but also destroys patches of coral reef. Over time, whole reefs may be destroyed. When people cut down a rainforest, destroy coral reefs or cut down mangrove forests, they change the natural habitat of the species that live there. Not only can such changes drive out or kill any animal or plant living there, but they also disturb the very complex relationships between species. These relationships make the habitat what it is and make sure it's a healthy place, so it's very important to ensure that habitats are not badly affected by human activities.

Humans and their relatively few ***domesticated*** plant and animal species are competing with all other native species for land and water. Intense land uses such as urban expansion, agriculture and plantation forests displace rich native ecosystems replacing them with just a few species for human use.



Sea anemones provide habitat for the clownfish

Activity 1
Space for Species

Suggested Timing

Teacher preparation time:
30 minutes (plus time to organise a guest speaker)
Lesson time: 90 minutes

Subject Areas

Language Studies, Science

Glossary Words

Resource, habitat, species, extinction, predators, domesticated

Materials

- A long rope or a number of chairs (one per student) to make a circle to fit all the students inside
- Butchers' paper or blackboard
- Marker pens or coloured pencils

Teachers' notes:

To learn more about habitats go to Module 1: Discovering Biodiversity. In Activity 5, Habitat and Homes on p. 44, students use human settlement as an analogy to introduce the concept of habitats and ecosystems.

Activity summary

Students will develop an understanding of how habitats and 'space' is important for a species to survive by taking part in a role play that shows how human activities can impact upon a habitat and its biodiversity. The activity extends to invite an older member of the community into the classroom to tell the students about changes in the local area.

Outcomes

Students will be able to:

- Identify human activity that lead to the destruction or loss of habitat
- Explain how loss of habitat affects plant and animal species.

Tuning in

1. Tell the students the following: Imagine you are an animal (e.g. frog, snake, bird, stick insect, dragonfly, butterfly, pig, cuscus etc.) living on a small island. Imagine that the habitat you live in is being reduced by a number of activities – logging, fire, clearing for gardens or plantations of oil palm or copra. The plants that you need to survive are running out and it is too far to escape to another island. Even if you did, the same is happening there.
2. Ask students to suggest some of the challenges animals and plants face every day to survive. Answers could include the following: being more vulnerable to ***predators*** or diseases; inability to find enough food to survive; not enough places to shelter; population too small to be able to find a mate to breed etc. Write the students' ideas up on the blackboard.

Developing understanding

3. In this part of the activity, students will be involved in a simulation / role play that will explore the problems associated with habitat loss. Ask four of your students to volunteer for a role, and provide them with a role card such as the ones on p. 94.

Role No. 1

You represent a logging company that comes in and clears some forest around this area.

Role No. 2

You are a farmer who comes into the area and clears some land for your large cash crop.

Role No. 3

You are a road builder who comes into the area because it is starting to develop and you have been asked to build a road next to the forest.

Role No. 4

You are a factory builder and you want to build three factories on the river next to the forest to make a lot of money.

4. Ask the students to each carry a chair and place them in a large circle. The circle should be large enough so that everyone can walk around easily, with room to move. Ask the students (with the exception of the four volunteers) to stand inside the circle. Tell the students that the circle represents a forest habitat and that the students standing inside the circle represent plants and animals that exist in the forest. If you do not have any chairs, use a rope – but you will need a couple of volunteers to help you hold the rope.

5. While the majority of students are getting the habitat ready, make sure the four students understand their roles.

6. When the habitat is ready, tell the students in the circle that this is their home (habitat) and that you all require a particular amount of space to live but, unfortunately, there are many pressures on this space that affect your lives.

7. Round One

- Tell students in the habitat circle to walk around and enjoy their space. Then ask the student with '**Role No. 1' card** to come to the circle and read out their role.
- Explain to the students in the circle that this student will be acting his or her role. Ask students what they think will happen.
- The student in role 1 should remove a few chairs or explain how the rope needs to be shortened. Some habitat is lost and the circle shrinks. Ask students what happened. How do they feel? Do they have enough room to move around?

Round Two

- Repeat the process with the student who has '**Role No. 2' card** and so on until you have completed four rounds of the game.

Note: After each round, the circle should be getting smaller, and at the end of round four, the circle should be very small so that the students inside do not have much room to move. You can also ask some students to leave the circle as it gets smaller; this represents a decline in the population. For some extra fun, you could ask these students to act out a 'dramatic death' as they are excluded from their habitat.

8. To make sure that the students understood the purpose of the above activity, have a debrief session with them. Ask students if they understood what was happening and how it relates to real life. Lead the discussion with the following questions. Possible answers have been included in italics to help the discussion get started.

- What happened when each role student came to the circle? *The circle or the habitat got smaller.*
- Why did that happen? *The loggers, farmers, and road and factory builders cleared land so they could use it.*
- If this was real life, what do you think this would mean for the animals and plants?
  For example, if someone did this in forest near your school or community what sort of impact would you expect to see or experience? *There would be less food for everyone, not enough space for the animals and plants to live in, some animals and plants would die etc.*
- Does anyone know of any examples where this has happened in our place? *Encourage a student to share a story.*
- In real life, some plants rely on birds to spread their seeds, and birds rely on flowers for food and trees for shelter. Pose this question to your students: If birds or flowers started disappearing, what do you think would happen? *If one disappeared then the other would soon disappear because they rely on each other to survive.*

Use concept

9. Invite a guest speaker from the local community to the school to talk about how habitats have changed over time in the local area. This person does not need to be an expert on science or nature, but does have to be knowledgeable about the local community. An older person would be ideal. Ask the guest to share their stories about how the landscape has changed. Encourage the students to ask questions such as:

- How has the area of natural habitat (e.g. forest) changed?
- Why did it change?
- What was it like before?
- What types of animals could you see before?

10. Ask the guest speaker to assist the students to make a big map on butchers' paper or the blackboard showing where the habitat (e.g. forest) is today, and mark where it used to be. Ask the students what they think would have happened to the plants and animals when this habitat was lost.

Reflection

11. To conclude these activities, ask the students to write a letter as if they were one of the species that was affected by the habitat loss from the local area as investigated above. They can use this letter to express their concerns and the specific effect that it had on their lives.

Topic

2

Human Population Growth

Background Reading

Population growth occurs when a species' ***birth rate*** is higher than its ***death rate*** or when individuals from outside move (immigrate) into a population. Worldwide, the human birth rate is currently three times the death rate. The world population reached 6 billion in 1999, and we are adding another billion people to the planet about every 12 years. Such rapid population growth is quite new in human history. Scientists believe people lived on Earth for about 3 million years before the world population reached 500 million around the year 1600. Until then, birth rates and death rates were about the same, keeping the population stable. People had large families, but many children died before the age of five from common diseases. But by the late 1700s and 1800s, more children survived and adults lived longer too, thanks to improved medicine, ***sanitation***, nutrition and farming techniques. In 1810, the world population reached 1 billion and things really began to take off! After 1800, the human population increased rapidly, reaching 2 billion in 1930, 3 billion in 1960, 4 billion in 1975, 5 billion in 1987 and 6 billion in 1999.

This rapid increase in population is sometimes called the ***population explosion***. We are currently adding about 78 million people to the planet each year – 13 times the current population of PNG! All of these people require food, fuel and homes, straining our planet's natural resource supply. Our planet is a limited system and can only support so many people. How many people can the Earth support? No one knows for sure.

What we do know is that every environment has a ***carrying capacity***, which is a limit to the number of members of a certain species it can support. Humanity's rapid population growth has the potential to go beyond the carrying capacity of this planet. Usually we think of carrying capacity in terms of animals or plants (e.g. the amount of cows that can live in a paddock or field), but it applies to humans, too. More than just the basics of food, water and shelter are considered when we measure

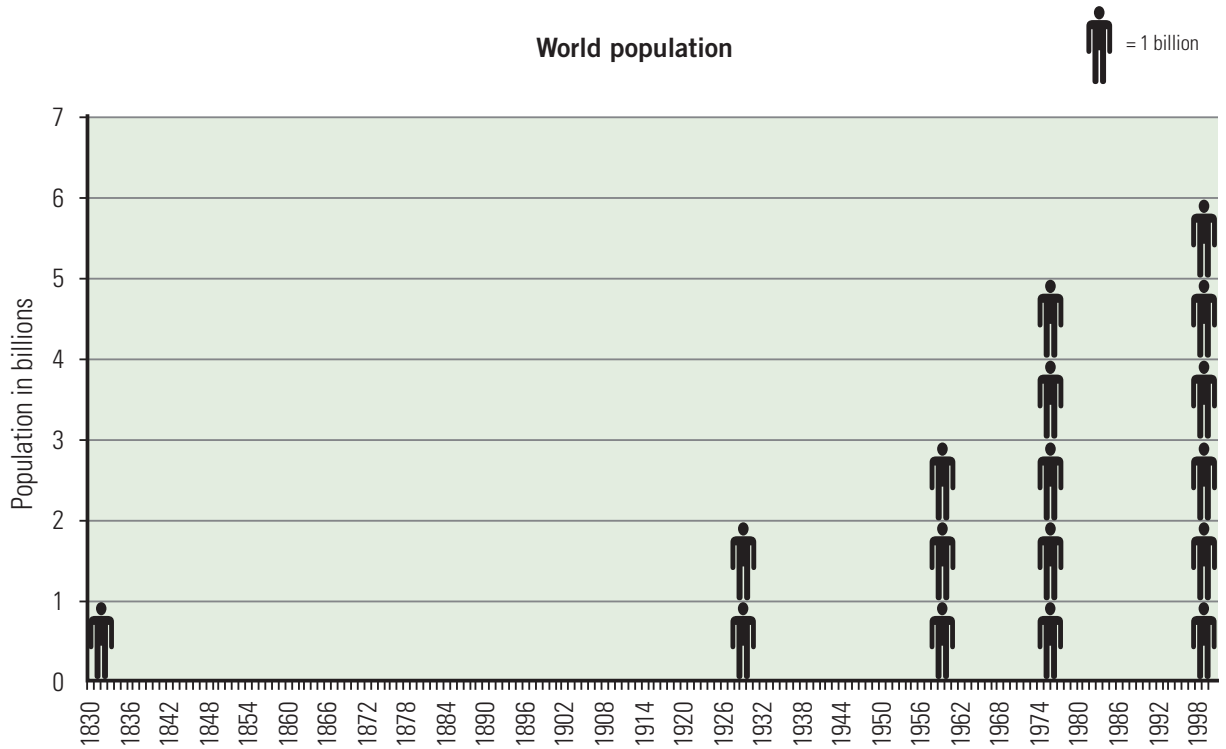
an area's carrying capacity. We also include the quality of life. Because we expect so much more from our surroundings than animals do, we have to be more thoughtful about how many of us can live in one place.

Migration is a cause of population increase in certain areas. The population of an area is affected by the movement of people into (***immigration***) and out of (***emigration***) that area. Migration within Pacific Island countries, especially from rural to ***urban*** areas, plays an important role in the population structure. Urban areas such as cities and larger towns are the main centres for new and better paying jobs, education, better health care and trade; as a result, people are attracted to urban areas in search of jobs, education, a 'better' life and freedom from the limitations of village life. People may also be pushed out of rural areas by factors such as poverty, lack of land, and limited work and education opportunities. The Pacific is still a mostly rural region, with only one in four Pacific Islanders living in urban areas. However, towns and their associated urban lifestyles, including diet, employment, health and leisure activities, are becoming home for a rapidly growing number of people. Throughout the Pacific, most households will have a relative living and working elsewhere in a town, mine or plantation, or in the case of most Micronesian and Polynesian countries living and working overseas (possibly in New Zealand, Australia, New Caledonia or America).

How can an increase in population affect our biodiversity?

Human beings have had an effect on the environment and biodiversity for the last 50,000 years. But in the last 200 to 300 years we have seen this impact increase and become global rather than regional, meaning that it is much more widespread than it once was. In the Pacific, we have seen that our impact has increased over the last 100 years.

One of the main reasons for the growing human impact on biodiversity is our continually growing populations. To support this growth we need more ***resources***, such as water, food, shelter, medicines, transport etc. This need for more resources is having a serious impact on the world's biodiversity. Although the population is getting bigger, the world is not getting any bigger and the amount of space and resources in the world stays the same or is reduced through time. Sadly, many species of plants and animals are becoming ***extinct*** or very rare where they were once common.



When our populations grow we need more space to build houses, to grow food and to build towns and factories. This space is found at the expense of ***habitats***, which are cleared to make way for development. In our world today, money has become the driving force behind much of our activity. What we are seeing is that we are quickly clearing and destroying natural areas for a fast reward: money. For example, we are seeing an increase in the removal of forests to create agricultural land for cash crops such as oil palm, and there is an increase in mining for valuable resources such as copper and gold, which results in large-scale mining that clears large areas of land.

Over-harvesting to provide for growing human populations has a big impact on our biodiversity. Over-harvesting is when we take more than we need to. Many species are disappearing because we take too many, such as the giant clam in the Pacific. Some species of giant clams have become extinct because of over-harvesting. Coconut crabs are also disappearing in the Pacific; they are in very serious danger in Vanuatu and the Cook Islands. We are seeing a reduction in certain fish populations, for example, the tuna population is critically low and the world is concerned about how long tuna fishing can remain possible. With an increase in population and increased demand for these resources, this problem will only continue to get worse.

Over-harvesting follows this typical pattern:

1. A species is taken from the wild and creates a source of income e.g turtle shells, black coral, coconut crabs, reef fish for aquariums and butterflies.
2. The promise of an income encourages more people to get involved in the harvesting of the species.
3. There is increased competition for the species as more and more people become involved. This creates larger and more efficient methods of harvesting.
4. As a result, the population of the species that is being taken decreases quickly.

Another big problem that comes with an increase in population is pollution. As populations grow we see more towns being built, more factories, more roads, more schools – many good things. However, when these areas are built we usually see that there are more problems with pollution, especially in the Pacific because there are few organised places or services to collect the rubbish and waste. As a result, rubbish piles up or is dumped in rivers, mangrove forests, the sea or the bush. Animals and plants suffer from the effect of this activity, as do humans. For more information on pollution refer to Topic 5 – 'Waste and Pollution' in this module.

We're all in this together

Humans rely on biodiversity for the basics of life: air, water, food, medicine, clothing, building materials and pest control for agriculture. It is important to have a huge variety of plants and animals to maintain a healthy planet, maintain our water resources, produce healthy soils and break down pollution. If biodiversity continues to disappear because of the increasing human population and its needs, this may lead to a very unhealthy future.

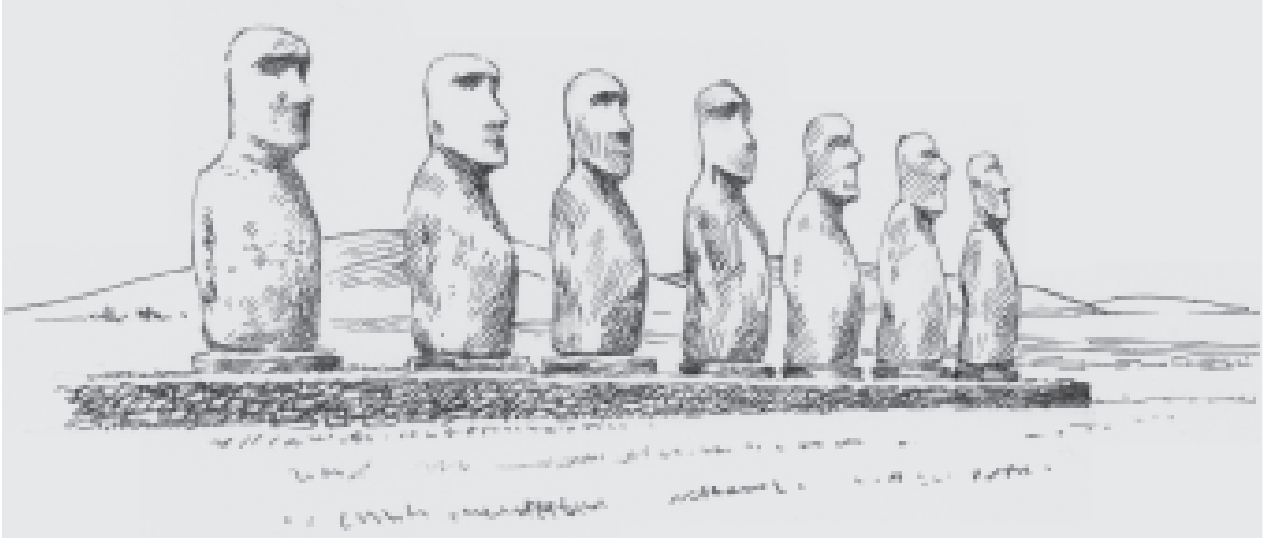
If we lower our demand on resources we can reduce our impact on ecosystems. We can do this by just taking what we need and by planning the size of our families to reduce the world population.

The case study (on the opposite page) of Easter Island in the Pacific illustrates how human activities and an increase in population can have a bad impact on the biodiversity of an area.

Case Study:

Vegetation Loss and Extinction – the Case of Easter Island

Extinction rates on many islands around the world have been high, especially where clearing of forests have been on a large scale. Easter Island is a very good example. This island in the Pacific, the most isolated populated land on Earth, was covered in native forest prior to the arrival of Polynesian people a long time ago, about 400 BCE. When the Polynesians arrived, they cleared nearly the entire island of its forests. This removal of the trees and other plants has been linked to the extinction of a land snail, the loss of all native species of land birds, and the extinction of 15 to 22 species of seabirds, of which the remaining 7 species are restricted to a handful of tiny islands. As a result of this unsustainable rate of consumption of the island's resources, the people drove themselves to death as their food and fuel resources disappeared. There were no survivors.



The Moai statues on Easter Island

Activity 2:

The Midwife and the Grave Digger

Suggested Timing

Teacher preparation time:
30 minutes
Lesson time: 90 minutes

Subject Areas

Social Science, Science, Maths, Health, Art

Glossary Words

Carrying capacity, birth rate, death rate, migration, emigration, immigration, resource, sanitation, nutrition, habitats, extinct, urban

Materials

Materials listed below right.

Teachers' notes:

This activity can raise some difficult and controversial issues regarding family size, birth control, religion, culture and poverty. It is worthwhile contacting other teachers, educators and leaders in your community to discuss the best ways to address the links between population, resource use and biodiversity in your local context. It is important in this situation not to be critical or judgmental and to be objective rather than push your own personal feelings about this issue.

Activity summary

In a short demonstration, students will observe how populations grow when the birth rate is higher than the death rate, and they will also observe the effects of migration. Students will be able to understand how the world's resources are limited through a visual demonstration. Students will examine whether the demands placed upon the planet by an increasing population can be sustained.

Outcomes

Students will be able to:

- Identify factors that contribute to the changes in population of your country.
- Explain that the world's population is growing rapidly and requiring more resources and that the amount of resources in the world is limited, and this impacts on biodiversity.

Materials

Demonstration 1

The Midwife and the Grave Digger

- 'Midwife' and 'Grave Digger' name tags
- Immigration/emigration cards: Cut a piece of A4 paper into quarters and write one of the following statements on each piece: *'I hope to find a job', 'I am going to study', 'I need to be closer to the hospital', 'I want to be closer to my family.'* Try to think of some more statements that explain why people might move that are relevant to your area.
- Masking tape or small pins
- 3 large containers or buckets that can hold water (preferably one will be clear or see-through)
- An old towel or paper towels (this is only needed if you plan to do this demonstration inside the classroom)
- Food colouring (or you could use something else that would change the colour of the water)

- 3 cups or something similar to hold water (you will need the cups to be different sizes, with one being a third of the size of the other two).

Demonstration 2
Paper Earth

- A sheet of A4 paper for each student
- Scissors
- Colour pencils

Tuning in

Begin the activity by asking the students if they know what causes changes in population. If students are unfamiliar with the word 'population', introduce this to them first. An easy way for students to start thinking about population is by asking them to think about their own families.

- What is it that causes increases to the number of people in their family? *Births and marriages. (Marriage can represent migration.)*
- What is it that causes decreases in the number of people in their family? *Deaths and maybe people moving away to other places (this could represent emigration).*

Tell the students that this is also what happens to the population throughout the world. In the last 300 years, the population of the world has increased very rapidly . This has caused problems for the environment because an increase in people means an increased need for food, water and shelter to support these people and we depend on the environment to supply us with all of these things.

Developing understanding

Conduct the following demonstration to show students the impact of birth rates and death rates on the world's population.

1. Fill a bucket with water and add food colouring so it will be more visible in the clear container. Put some of the water into the clear container until it is about 1/4 full, and place it on top of a towel in front of the class. Alternatively this can be done outside.
2. Ask two volunteers from the class to assist. Ask one to be the 'Midwife' and the other to be the 'Grave Digger.' Each student should tape or pin the appropriate name tag to himself/herself. Provide the Midwife with a full container of water and the Grave Digger with an empty container.
3. Hold up the clear container. Tell the class that this container will represent the world, and the coloured water inside it will represent the population of people. Tell the Midwife that they'll be adding people to the world by pouring cups of water into the clear container from their own container. Tell the Grave Digger that they'll be taking people from the world by scooping water out of the clear container and pouring it into their separate container.

At this time, the world's birth rate is 22 per thousand and the death rate is 9 per thousand. This means that in an average group of 1,000 people, we'd expect 22 children to be born and 9 people to reach the end of their lives over the course of one year. Ask the students, based on these rates, who should receive the large cup? *(Midwife)* Who should use the small cup? *(Grave Digger)*

4. Give the bigger cup to the Midwife and the smaller cup to the Grave Digger. Signal the Midwife and Grave Digger to start. Make sure that for every cupful the Midwife adds, the Grave Digger takes one cupful. They should continue in turn while the class observes. When it becomes clear that the water level is steadily rising tell the Midwife and Grave Digger to stop.

Use concept

5. Once the demonstration is completed, split the class into small groups and use the following questions as a guide to hold a discussion with the class. Encourage the students to discuss their ideas within their groups and record their answers. Some possible answers have been supplied to help you.

- Why did the water level rise steadily? What does this show us about population growth? *Because more water was being added than taken out. When the birth rate is greater than the death rate, a population grows.*
- What would happen if the Midwife and the Grave Digger kept adding and subtracting water? *The water would eventually overflow.*
- What would this mean if the clear container really was the world? *It would mean that there are more people than the planet can support and that not all of these people could survive.*
- What size would the Midwife's cup have to be for the water level to stay the same? *The same size as the Grave Digger's cup.*
- Throughout history, the Midwife and Grave Digger's real-life cups were usually about the same size. But over the past 200 years, the Grave Digger's cup has become much smaller than the Midwife's. Can you think of some reasons why the death rate has gone down in recent years?

Advances in medicine: *Doctors gradually became better at healing people because of new discoveries in the sciences and from increased contact with other countries, which allowed people to learn from each other.*

Better sanitation: *People invented safer ways of disposing of rubbish and human waste so their surroundings were cleaner and didn't breed so much disease.*

Better nutrition: *Advances in farming made it possible to grow better food in greater quantities. Also, improvements in medicine made people more aware of the importance of eating a variety of foods. All of these things worked to allow more people to survive infancy and childhood and extended the average life span.*

6. Now it's time to introduce migration into the scenario. Return the class's attention to the clear container. This time rather than being the world, it will be a city or town (choose a town that your students will be familiar with). Remove water from the clear container until it is again only ¼ filled. Tell the students that they will repeat the demonstration, but now include immigration and emigration.

7. Hand out the immigration/emigration cards to the class. Ask the Midwife and Grave Digger to resume their previous roles. Explain to the class that as the Midwife and Grave Digger are taking turns to put in or take out 'population' from the town, each person holding a card will need to come forward one at a time and use the 'migration cup' to add population to the town. As they are doing this, ask them to read out their reason for migrating (this is written on their card).

8. Signal for them to begin. They should continue in turn while the class observes. Be careful as this time the container will probably overfill. Continue until all migration cards have been read out, (you may like to ask the Midwife and Grave Digger to work slower than last time to prevent too much spillage).

9. Repeat the previous step, but this time have the migration cardholders remove water rather than add it (representing emigration, moving away from a town or a village). What happened to the water level (the population) this time?

10. Once this demonstration is completed ask the students to 'brainstorm' reasons why people might migrate to or from your local area. Encourage their ideas by asking them to think about what industries, resources or services your area has. Make a list of the reasons on the blackboard.

Reflection

Paper Earth

As a conclusion to this activity do the following exercise with your class. This gives the students a visual idea of how the Earth's resources are limited and are not endless as many may think.

Ask each student to cut out a circle from paper to represent the Earth. Give students time to draw the planet on the paper. They can mark their country on their 'Earth' or use colours to represent what they think the Earth looks like, with areas of land and areas of water. It would be useful if you, the teacher, also had a paper Earth to do the demonstration at the same time.

Once your students have completed their coloured paper Earth, get them to draw a quick black and white sketch of this Earth in their notebooks.

1. Now, ask your students to hold up their coloured Earth and cut it into quarters. You could do one at the same time. Ensure that they cut it into equal parts. The text in quotation marks in the following instructions is what you need to say to your students at each stage of the exercise.

2. Hold up ¾ of the Earth and ask the students what they think it represents. "*The ¾ represents the oceans of the world, because oceans take up almost ¾ of the space. "What fraction is left?"* ¼

3. Now ask the students to take the last quarter, which represents the land, and divide it in half with the scissors. Hold up one of the pieces. *"This portion represents the area where people can't live: the polar area, deserts, swamps, and very high or rocky mountains."*

   Ask students to set this piece aside.

4. Hold up the other piece. *"What fraction of the Earth is left?"* ⅛ "What do you think it represents? *"It represents the land where people can live, but not all the soil is good for growing food."*

5. Again ask students to divide their last piece into four equal sections. Ask them to hold three of the sections in one hand and one in the other. *"What fraction of the Earth is the one piece?"* $^{1}/_{32}$

6. *"So, the others represent* $^{3}/_{32}$*. These areas contain the cities, suburbs, highways, shopping centres, schools, parks, factories, parking lots and other places people live, work and use in other ways, but that can no longer grow food."*

7. *"This tiny bit of paper (*$^{1}/_{32}$*) represents the surface, the very thin layer of the Earth's crust upon which people grow food. It is less than five feet deep. It takes a very long time, about 100 years, for good soil to form."*

8. Get the students to glue this last coloured fraction of the Earth onto their black and white copy of the Earth in their notebooks. By sticking the small coloured fraction on to the large black and white drawing it helps students to see what a small fraction of Earth we actually have to sustain life. To link the simulation to biodiversity, ask students to look at this small amount of land available for us to use and to think about and discuss some ways that an increase in population can affect biodiversity.

Make an ideas web

Ask the students to write 'Increase in population' in a circle under the Earth in their notebook and ask the students to create an 'ideas web'. The ideas web starts with the issue (increase in population) written in the middle. Ask the students to think of an effect of increasing population and write it down, then join this to the issue with a line. See example on p. 104.

Continue the exercise by making a web of connected effects. To help students, ask them to use the 'if – then' test. For each thing that they written down they should ask themselves 'if' this happens 'then' what will happen as a consequence. They then write the consequence or effect down.

You might like to introduce some words that might help the students think about the effects. These could include: food, water, shelter, energy, soil.

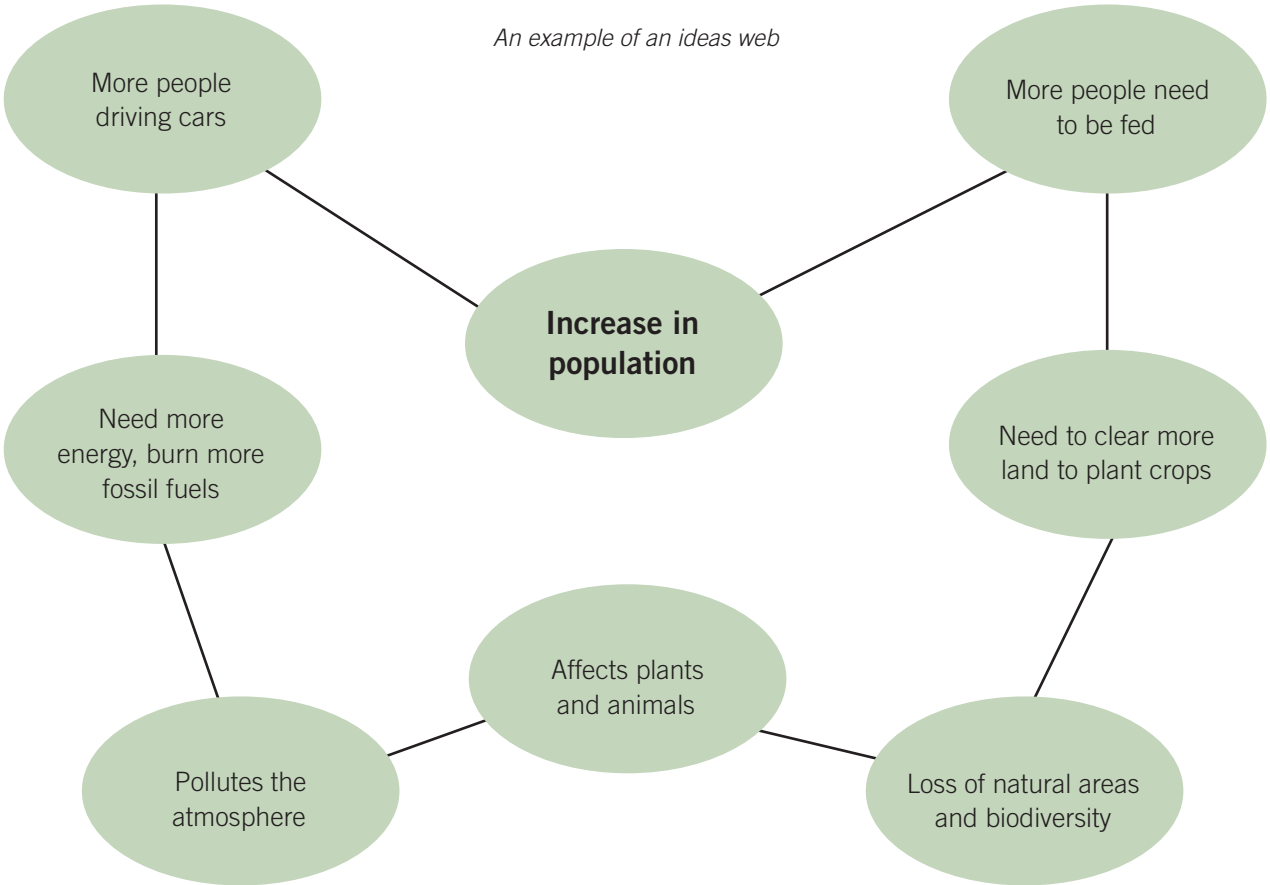
As a reflection on this whole activity, you could get students to write a short piece of work in their notebook with the heading: 'How do I feel about the increase in population and its impact on biodiversity?'

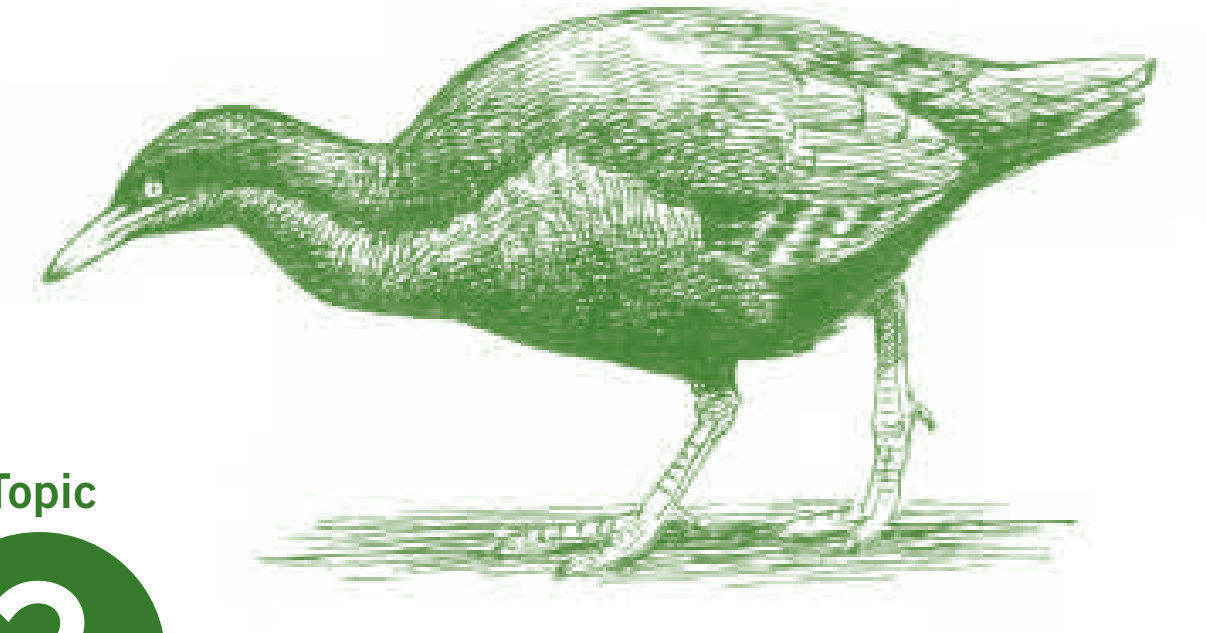
Additional consideration

For younger students, if you think this activity is too long, you could separate the Paper Earth activity and do it on consecutive days. Make sure it is done consecutively so that students can grasp the concept of the impact of increased population on biodiversity.

For older students, you could extend this activity by asking the local hospital or statistics office for the birth and death records from your area; the students could use this information to create graphs in their mathematics lessons. If this information is not available, do a quick survey of your classroom, finding out who has had a birth or a death in their family in the last year; use these results to create graphs.

An example of an ideas web





The extinct bar-winged rail

Topic

3

Endangered Species

Background Reading

A century ago, a bird called the passenger pigeon lived in North America. There were so many passenger pigeons that people often saw great numbers of them flying overhead in flocks containing thousands, even millions, of birds. Today, there is not a single one left. The passenger pigeon is now ***extinct***. All living passenger pigeons disappeared from the Earth entirely. The passenger pigeon became extinct for two reasons. First, the forests where it lived were cut down to make way for farms and cities. Second, many pigeons were shot for sport and because they were good to eat. At that time, there were no hunting laws to protect ***endangered*** species like there are now.

The passenger pigeon is one of the many plants and animals that once lived on our planet and have now become extinct. For example, dinosaurs and mammoths all became extinct long ago. ***Extinction*** has been going on since life began on Earth. But today, extinction is happening faster than ever before.

Endangered species are those plants and animals that have become so rare they are in danger of becoming extinct. You may no longer see them in the wild as often as your ancestors did.

Why are they endangered? What is threatening them?

Species are at risk of disappearing because of changes to the Earth caused either by nature or by the actions of people. Sometimes a terrible natural event, such as a volcano erupting, can kill an entire species. Small island ecosystems are, by nature, highly fragile and vulnerable to disturbances such as volcanoes and cyclones. Other times, extinction will happen slowly as nature gradually changes our world. For example, many species became extinct during a time in history referred to as the Ice Age, when the Earth became much colder than it is today. Many species died because they could not live in the cold conditions.

However, today people are the main reason that plants and animals are becoming extinct or becoming endangered. People are threatening many different plants and animals because of the changes that we have made to the natural world.

The following are some of the main ways that humans endanger species:

- Introducing animals or plants into new places
- Over-harvesting (catching, hunting or collecting too many)
- Destroying habitats (e.g. cutting down forest or dredging seagrass beds)
- Polluting the environment (e.g. allowing chemicals to enter rivers or the ocean)

Introducing new species

People have changed natural habitats by moving, or introducing, new species into areas where they do not naturally live. Some of these species do so well in their new habitat that they endanger those species already living there, called the ***native*** species. For example, when some fish are introduced into a lake or stream, they may prey upon or eat the food of the native fish. The native species may then have to find a new source of food or a new home, or face becoming endangered or extinct. Many species of birds have become endangered or extinct due to the introduction of the rat on many Pacific Islands, and in Fiji birds such as the Pacific rail have disappeared due to the introduction of the mongoose. To find out more about introduced species see Topic 6 in this module, 'Invasive and Introduced Species?'.

Over-harvesting

Over-harvesting simply means that a plant or animal is being hunted, fished or collected faster than they can replace themselves through breeding. When the number of individuals that are removed becomes greater than the rate of reproduction, then the population will drop. Examples of over-harvesting causing species to become threatened or endangered in the Pacific include sea turtles, green snails, giant clams, conch shells, coconut crabs, megapode birds, fruit bats and tuna. To find out more about over-harvesting see Topic 5 in Module 6, 'Trade and Exploitation of Resources'.

Habitat loss

The loss of habitats due to changes made by humans is possibly the biggest cause of species becoming endangered or extinct. Habitat loss happens when natural environments, such as forest or seagrass beds, are destroyed or removed. This happens when people cut down forests for timber or to make gardens or grow cash crops such as copra (coconut) or oil palm. In the ocean, dugongs have become endangered due in part to the loss of seagrass habitat. If seagrass is destroyed by human activity, then the dugongs have nothing to eat. To find out more about habitat loss see Topic 1 in this module, 'Loss and Degradation of Habitats'.

Pollution

Pollution is caused when the waste products of human activities enter the environment. For example, wastes are produced in every house by toilets and waste water and the burning or dumping of rubbish. Pollution also comes from our cars, trucks and buses, and from industries. Plastics, such as supermarket bags, that enter the ocean are one of the threats to sea turtles and rare birds such as the albatross. These animals may accidentally eat plastic, which then gets stuck in their digestive system. If this causes a blockage then these creatures will suffer a slow death from starvation. To find out more about pollution see Topic 5 in this module, 'Waste and Pollution'.

Activity 3
Gone Forever!

Suggested Timing

Teacher preparation time:
30 minutes
Lesson time: 90 minutes

Subject Areas

Science, Language Studies

Glossary Words

Extinct / Extinction, Endangered, Conservation, Native species, Non-endangered.

Materials

- Extinct Species articles (pp. 112–113)
- Loose sheets of paper to write descriptions of why species go extinct
- Endangered Species articles (pp. 109–111)
- Tape or Blu Tack

Teachers' notes:

This is a very 'student-centred' activity. Try to encourage your students to share their ideas and opinions in a non-judgemental way. It might help to tell students that there are no wrong answers, and that everyone's opinion is important.

Activity summary

This activity allows students to explore reasons why species have become extinct in the past and then relate these factors to species that are in danger of becoming extinct today. They will reflect on how extinction makes them feel, and develop an understanding of how humans are part of the problem and future solutions.

Outcomes

Students will be able to:

- Define and use the terms 'endangered', 'threatened' and 'extinct' and give examples of endangered, threatened and extinct species.
- Investigate some species of plants and animals that have reduced numbers because of human activities.

Tuning in

1. Discuss with your students what it means for a species to be extinct, endangered or ***non-endangered***. As a class, come up with a definition for each term.

2. Show pictures of extinct and endangered species (supplied in the relevant articles on pp. 109–113) and explain a little about each. Do not read the whole article. Ask students to identify some plant or animal species that are not endangered in their local area. Ask students to sort the species from the articles and those that they identified under the headings of 'Extinct', 'Endangered' and 'Non-endangered' and to record this in their notebooks in a table, as on p. 108. Discuss students' classifications.

Extinct	Endangered	Non-endangered

Read the 'Extinct species' articles to the class and discuss why the thylacine, moa, bar-winged rail, woolly mammoth, sabre-toothed tiger and dinosaurs became extinct.

Developing understanding

3. As a class, brainstorm and identify three or four main reasons for extinction. Write these on the blackboard. For example:

- Habitat loss
- Natural disasters (flood, volcanic eruptions, drought, fires)
- Environmental changes (e.g. ice age or global warming – students may come to this suggestion if already familiar with the terms)
- Introduced species
- Over-harvesting (e.g. too much hunting, collecting or fishing)

4. Write the reasons why species go extinct on separate pieces of paper and place these in different locations in the room. Ask students to think about which reason they believe is the biggest cause of species extinction.

5. Ask your students to then move to stand at the extinction reason they have chosen. Ask students in each place to state why they are standing where they are. Students can move their position in response to what other students have discussed or can remain where they have chosen.

Use concept

6. Introduce students to the concept of endangered species in the Pacific. You might like to read aloud one of the 'Endangered Species' articles. Explain what endangered means.

7. Divide the students into small groups of about four students each. Give each group a different article about endangered species. It does not matter if there are two groups that get the same article. Ask each group to read the article to find out why this species became endangered. Then ask the groups to think of ways to help the species recover from the brink of extinction.

8. Once they have finished, ask students to take on the role of a ***conservation*** organisation that works to save endangered species. They should present information about the species back to the rest of the class, including: the reasons for its endangered status (consider if it is one of the causes they identified above in the extinction activity) and what they are going to do to save this species.

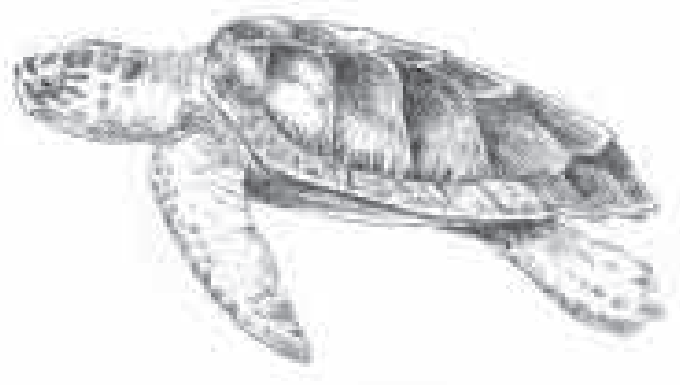
Reflection

9. Set the students with the task of writing a reflective essay about extinction. Write the heading "When I think about extinction…" and ask them to copy it down. Then provide students with the list of six questions (below) to answer. Allow students to share their ideas with a friend if they wish, and explain that there is no right or wrong answer. Encourage some students to share their answers with the class.

- What do you know to be true? What have you learned?
- How does learning about endangered species and extinction make you feel?
- What are bad things that come from extinction?
- What (if anything) could be a good thing that comes from extinction?
- What might be some of the ways to prevent extinctions?
- How has this changed your thinking about biodiversity/species?

Endangered Species

Marine Turtles



Turtles are incredible survivors. They have travelled the seas for over 100 million years. They have outlived almost all of the prehistoric animals with which they once shared the planet, such as the dinosaurs. It is amazing that they are still present in the world's oceans today.

There were once many turtles around and we could see lots of marine turtles crawling ashore to nest on tropical beaches in the Pacific. Of the seven species of marine turtles, three are critically endangered, three are endangered, and the status of the last is 'unknown'. Threats include: hunting for meat, shell and eggs; habitat destruction; being accidentally caught when large scale fisheries put out their big nets; pollution; being hit by boats; and introduced predators.

Tenkile Tree Kangaroo

When it first became know to scientists in Papua New Guinea in 1989, the tenkile tree kangaroo was already on the verge of extinction. With less than 100 of them remaining in the wild, it is considered critically endangered. The tenkile tree kangaroo is found only in one area of forest in Northern PNG where only 25% of its original habitat remains.

Many of PNG's people still continue a traditional way of life, decorating themselves with feathers and skins from wild species as well as hunting wild populations for meat. With an increase in human population, more pressure is being placed on wild animals to support these traditional uses. There are many villages close to where the tenkile tree kangaroo lives. The tree kangaroo population is greatly affected by hunting because they reproduce very slowly and they are easy to catch, especially by hunters with dogs.

Endangered Species

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.

Fiji Banded Iguana

The Fiji banded iguana is the most isolated iguana in the world. They are believed to have evolved from green iguanas that were able to drift across the Pacific Ocean from South America on logs or branches floating in the ocean. Male Fiji banded iguanas are emerald green with broad, light-coloured bands. The females are solid green with occasional spotting. They are found in tropical forests in Fiji and Tonga. You may also see them in Vanuatu where they were introduced not too long ago.

Populations of these iguanas have been declining over the past century because of habitat destruction, and they are killed by mongooses and house cats that were introduced to the islands. Fijian iguanas are considered to be endangered and have full protection under both Fijian and international laws.

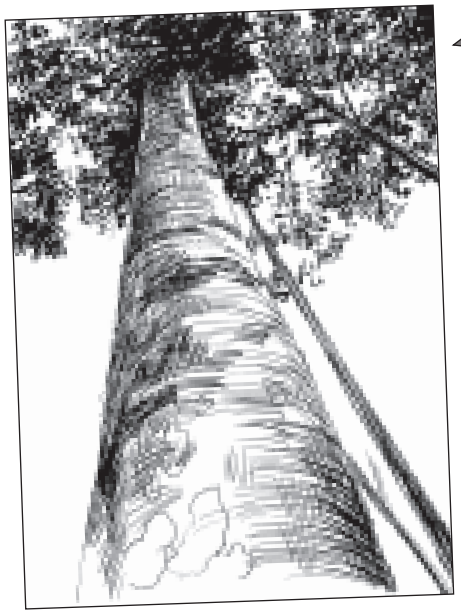
Endangered Species

Aquilaria Species

Trees producing agarwood, also known as gaharu, aloeswood and eaglewood, are increasingly becoming threatened in the Pacific. Agarwood is formed in the roots and the trunk of *Aquilaria* trees that have been infected by a fungus.

This fragrant heartwood is highly valuable and has been traded since biblical times for cultural and medicinal purposes. Incense made from agarwood is being used in religious ceremonies and agarwood is used commonly in Asian medicine.

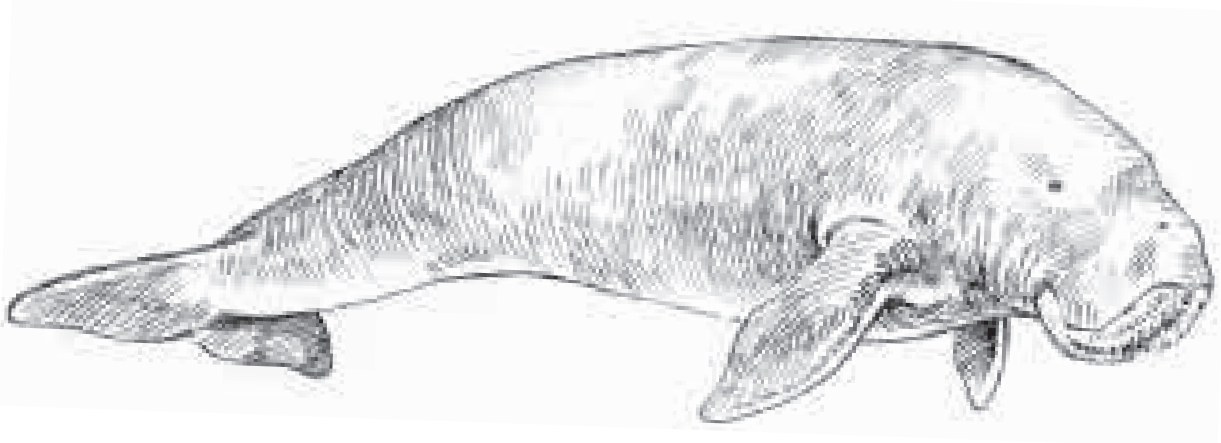
Agarwood-producing trees are under threat because demand for this product is greater than supply. Several *Aquilaria* species are recognised as threatened species and six of these are at risk from over harvesting.



Dugong

The dugong is a shy and gentle sea mammal. Its name came from the Asian Malay word 'duyang', meaning lady of the sea. Dugongs have been around for a very long time, with records showing that they have existed for the last 50 million years. They are found near seagrass beds and in shallow tropical waters.

Dugongs can live for a long time but do not give birth very often. They are very slow breeders, and may start breeding between 9 and 17 years of age, and only have a baby once every 3 to 7 years. Dugongs are becoming endangered in the Pacific region because of hunting. It is hunted both for its meat and oil, and the hunting also has great cultural significance. Habitat loss caused by pollution that kills seagrass also has a huge impact on the dugong's survival. Dugongs are also killed or injured by boats as they live in very shallow water.



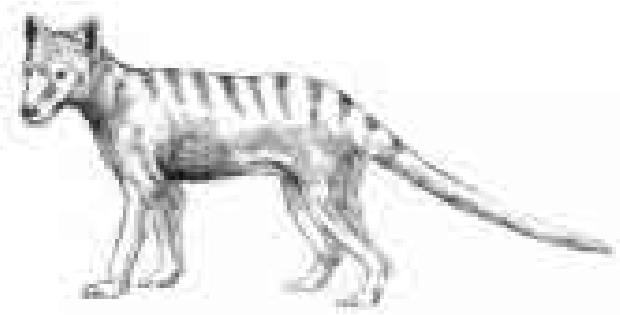
Extinct Species

The Woolly Mammoth

Woolly mammoths were very large relatives of the elephant that lived from about 120,000 to 4,000 years ago. We know about them because we have found bones and entire bodies preserved in ice. They also feature in very old European cave paintings. They lived at a time when the Earth was very cold; this was called the Ice Age. They were well suited to this environment because of their 'woolly' coats.

The woolly mammoth probably became extinct because it couldn't cope to the warming of the climate at the end of the Ice Age. It was also hunted by Stone Age humans.

The Thylacine



The thylacine (*Thylacinus cynocephalus*, dog-headed pouched-dog) was a large meat-eating marsupial that lived in Australian and Papua New Guinea. A marsupial is an animal related to the kangaroo and koala. Thylacines liked to eat kangaroos and other marsupials, small rodents such as rats, and birds. It is also known as the Tasmanian tiger or Tasmanian wolf. The main reasons for the extinction of the thylacine from Australia was competition with the dingo (a species of dog introduced to Australia) and the introduction of domestic dogs. All 3 animals need the same food. It was finally wiped out when the Government offered a reward for shooting them because they were killing domestic sheep. By the time people realised that the thylacine was endangered it had already disappeared forever; it had become extinct.

The Sabre-toothed Tiger

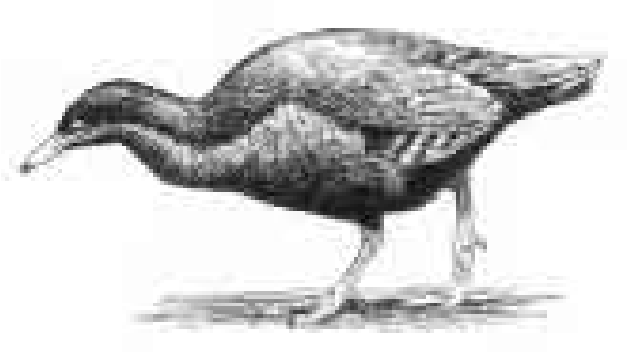
The sabre-toothed tiger had two large front teeth, which often reached a length of over 20 centimetres! This cat lived in the last Ice Age, dating from 1.5 million years ago to around 9000 years ago. These cats were the biggest and most fearsome predators of their time and used their front teeth to stab the soft tissue of their prey's underbelly – yuk!

The sabre-toothed tiger became extinct for the same reasons as the woolly mammoth. It could not cope with the warming of the climate at the end of the Ice Age. It's food became hard to find.

Extinct Species

The Bar-Winged Rail

The bar-winged rail was a land-based bird that was found on several islands in Fiji. The last time it was recorded was in the 1800s. The rails became extinct after mongooses and cats were introduced to Fiji. These introduced animals were very good at catching adult rails and raiding their nests. You can no longer find bar-winged rails in Fiji; they are just a memory.

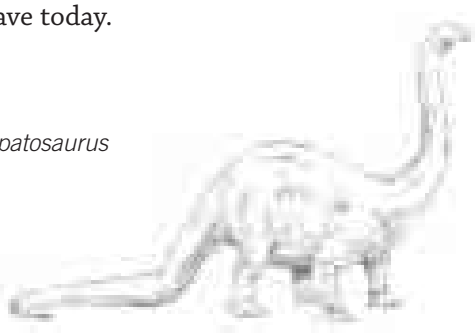


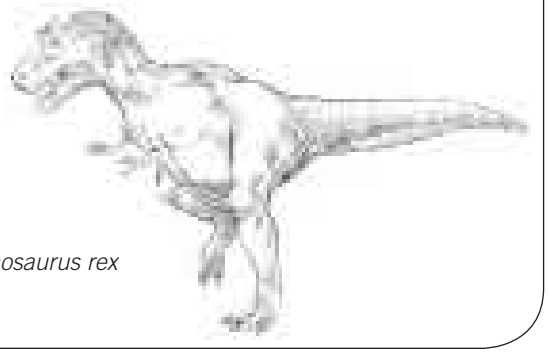
Dinosaurs

Dinosaurs were a group of many different types of giant reptiles that lived 230 to 65 million years ago. Some of the famous ones include *Apatosaurus* (sometimes called Brontosaurus), and *Tyrannosaurus rex* (shown below). They were very different looking reptiles to the ones that we have today.

There are many theories as to why dinosaurs became extinct, such as a huge volcanic explosion, an asteroid landing on Earth, or because of climate change such as an ice age. However, no one really knows the real reason they became extinct.

Apatosaurus





Tyrannosaurus rex

The Moa

There were many different types of moa that were once found in New Zealand. The biggest moa was called the giant moa. It was more than 3 metres tall and weighed about 250 kilograms! The giant moa was one of the biggest birds ever to have lived in the world. You can still find their bones in caves, swamps and sand dunes.

The main reason that moa are thought to have become extinct is from hunting or the clearing of their habitat by Maoris (indigenous people of New Zealand).

Coconut crab, tied up for sale

Topic

4

Trade in Endangered Species

Background Reading

The international ***trade*** in wildlife is big business, estimated to be worth billions of dollars annually and involving more than 350 million plant and animal specimens every year. When uncontrolled, international trade can be a major threat to the survival of threatened and ***endangered*** species, especially when combined with habitat loss and other stresses.

Wildlife trade, in simple terms, is any sale or exchange by people of wild animal and plants. This can involve live animals and plants for the pet and agricultural trades, or trade in a broad range of wild animal and plant products needed or prized by humans – including skins, medicinal ingredients, tourist goods, timber, fish and other food products. Most wildlife trade probably occurs within a nation, but there is a lot of wildlife trade that crosses international borders.

How and why does it happen?

As with any business activity, the major reason that people are involved in wildlife trade is for money, whether to support their family or as part of a larger business project.

Wildlife trade is driven by many different social, economic and cultural factors, such as:

- The need for food
- Healthcare (from herbal medicines to ingredients for pharmacy medicine such as quinine for malaria)
- Providing industrial materials (for example, timber and a wide range of materials used in manufacturing, such as gums and resins found in plants)
- Religion/culture (live animals and a wide range of wild plants and animal parts are used for religious/cultural purposes)

- Collecting (of live animals and plants: a range of wildlife specimens are 'collectibles')
- Clothing and ornaments (leather, furs, feathers, cotton etc.)
- Sport

What is the impact of wildlife trade on biodiversity?

When the planet had fewer people consuming fewer resources, the use of wildlife for food and other products was ***sustainable***. However, as populations grow, this is no longer the case. The biggest problem with wildlife trade is that it can cause over-exploitation. Historically, such over-exploitation has actually caused extinctions or has severely threatened species and, as human populations have expanded, the demand for wildlife has only increased. Recent over-exploitation of wildlife for trade has affected many species.

Wildlife trade is not always a problem and some wildlife trade is legal. However, it can be very damaging, especially when combined with the impact from habitat loss and other pressures. Scientists have recorded a decline in the numbers of individuals within populations of many species, especially in the last 40 years.

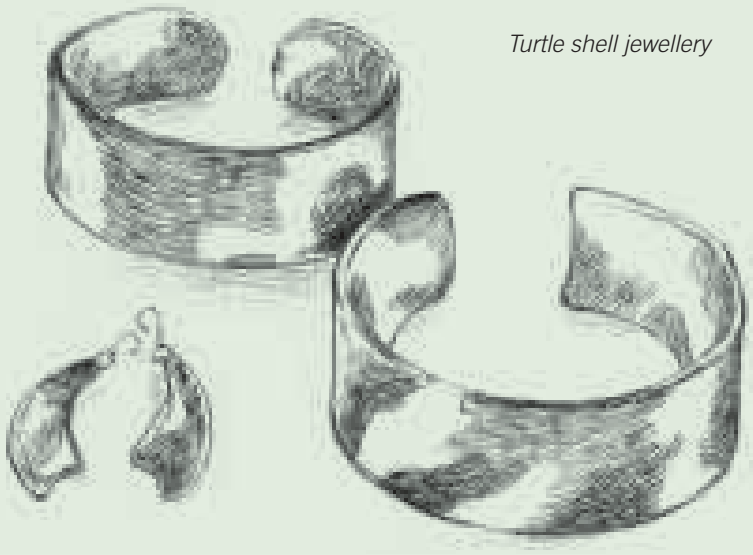
So with already shrinking populations, wildlife trade is an extra problem that can lead to species becoming endangered or even extinct. An example of an animal from the Pacific that has become threatened in this way is the coconut crab. It was once common, but in countries such as Niue, Vanuatu and Cook Islands, coconut crab numbers have declined dramatically.

Illegal wildlife trade is a big problem as it usually involves the trade in rare, protected species that are already highly endangered. Sadly, as some species become rare or less common, their value in trading markets increases because there is greater demand than supply. For example, rare orchids, cycads, tiger products and even rare snakes can be worth thousands of dollars.

When species are moved around illegally, the conditions of transport for live animals are usually poor and wildlife is more likely to have been obtained in an environmentally damaging way. Illegal trade happens in secret, so animals are often packed away in containers where they can't be seen – with very little space to move or breath. For example, turtles and lizards are sometimes transported while squeezed into rolled up pieces of cardboard. Many of these animals die before they reach their destination.

The trade in turtles

Turtles, both alive and dead, are very popular with tourists in the Pacific Islands. The shells of adult turtles are taken in order to produce jewellery or little sculptures to sell to the tourists, as well as for traditional purposes. But it is not only the adult shells; in some places you will find baby shells, as small as 20 to 30 cm for sale to tourists. There is also a sizeable market for turtle leather products and stuffed whole turtles. Although there is a ban on this practice, illegal trade still occurs.

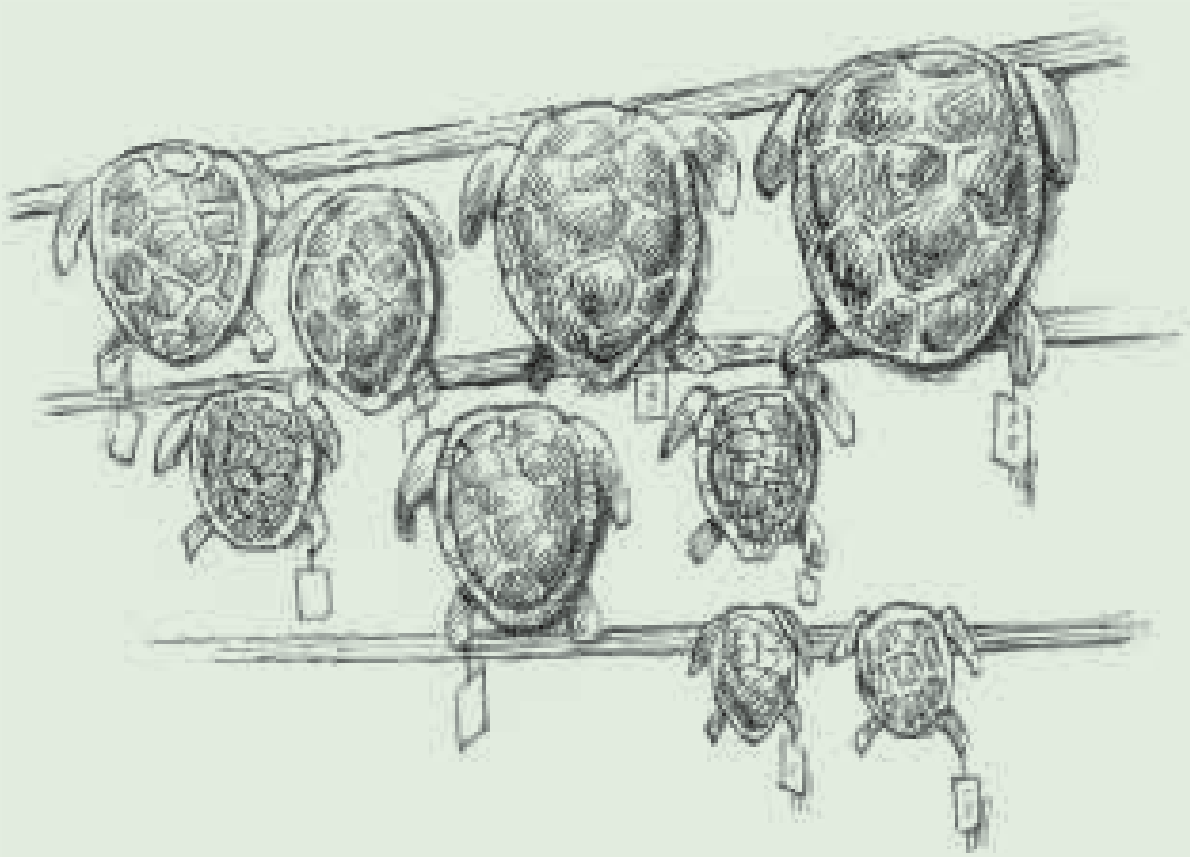


Turtle shell jewellery

Laws to protect animals and plants involved in trade

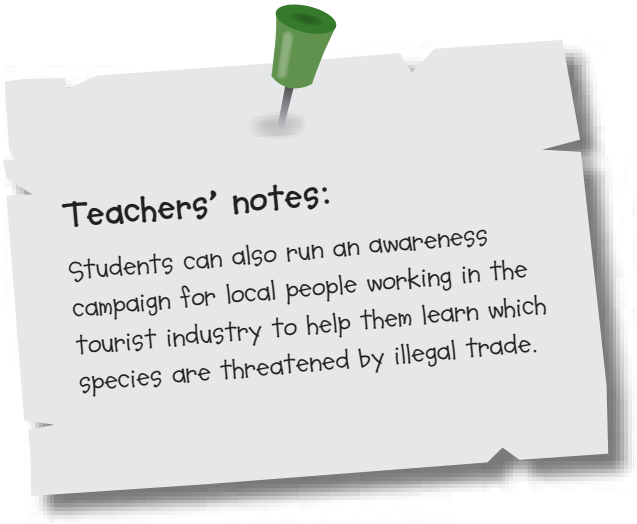
CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments signed in 1975. Under this convention, the international trade in endangered species is banned. For example, if someone purchases a turtle shell in Fiji they cannot take it to Australia or any other country that has signed CITES. If a person is discovered bringing a turtle into Australia, it would be confiscated by the quarantine service and the person would be fined and could even go to prison. The convention aims to make sure that trade in endangered species does not continue, and that legal trade does not threaten the survival of wild animals and plants. If trade is managed and controlled properly, wildlife trade does not necessarily threaten native species.

CITES only applies to international trade and, therefore, it may still be legal to sell an animal or plant species inside a country. Countries in the South Pacific Islands that are signatories to CITES include Fiji, Palau, PNG, Samoa, Solomon Islands and Vanuatu.



Turtle shells on sale to tourists in a market

Activity 4
Wildlife for Sale



Suggested Timing

Teacher preparation time: 1 hour
Lesson time: 90 minutes

Subject Areas

Social Science, Science, Physical Education

Glossary Words

Trade, rare species, endangered species, sustainable, over-exploitation

Materials

- Wildlife Trade pictures (see p. 120)
- Marker pens, colour pencils, crayons
- Area for game: about 20 m by 20 m – use coconuts or draw a line in the dirt to mark the area
- Species cards (see p. 119)
- Hunters/Traders cards (see p. 119)

Activity summary

Students are introduced to the concept of wildlife trade by considering a picture showing different aspects of the trade. They will experience wildlife trade by participating in a fun game about how wildlife trade impacts on ***rare species***. Students will use their learning to create awareness-raising posters to take some action against the trade.

Outcomes

Students will be able to:

- Investigate why trade in endangered species happens and what impact this has on biodiversity.

Tuning in

1. Show students the Wildlife Trade pictures (see p. 120). If you have a photocopier you could give students a copy, or you could draw this picture on the blackboard.

2. Ask the students to guess what is happening in the pictures. Assist them by asking questions, for example: What is happening in the first picture? What is this person doing? Why is he catching the bird? What is the meaning of the money in the second picture?

The picture shows wildlife trade in action:

- **Picture 1:** The men are catching a rare species of parrot.
- **Picture 2:** The exchange of money represents the sale or trade of the rare parrot.
- **Picture 3:** The aeroplane represents the transportation of the bird out of the country.
- **Picture 4:** The man in this picture is sad, because the parrots that once lived on his customary land have now disappeared.

Use the picture to begin the discussion on wildlife trade. Ask the students if they think it is a problem in their community, province or country. Encourage students to contribute to the discussion with their ideas, opinions and experiences. Using the background reading as a guide, explain what wildlife trade is, why it happens and what its impacts can be.

Developing understanding

3. Prepare the Hunters/Traders and Species cards (see p. 119).

4. This activity is like a game of 'tag'. Five students will play the role of traders or hunters. Select five students and give them a Hunter/Trader card. Give the remaining students one Species card each. The Species cards include various animals and plants that the traders or hunters must collect. See the card list to get an idea of numbers.

5. Mark out the boundaries of the playing area, and tell the students that this represents a habitat. The Species students must stand inside the playing area and are not allowed to leave. Explain that if they go outside of their habitat they will die. The idea should be that the animals and plants cannot escape. The students playing plants or animals must display their card by pinning it on their shirts or holding it up.

6. Before the game begins, ask the hunters and traders to read their roles to the rest of the class. When the game begins, the hunters and traders must catch (tag) the species in the habitat area. The game continues until the hunters and traders take what they need according to the instructions on their card. This is done by collecting the species cards from other students when they are caught or tagged.

Use concept

7. When the games is over, reflect on what happened.

Use the following questions to guide your discussion. Some suggestions for answers have been provided for your assistance.

- Why do you think the hunters/traders collect animals and plants? *To earn money for school fees, to feed their family, for their business, for a cultural celebration.*
- In real life who do you think would buy or trade the animals and plants represented in this game? *Tourists, local businesses, people overseas, locals.*
- If the trees represented in the game were the homes of the cuscus (a nocturnal animal related to the possum), what would happen to the cuscus? *They would find it hard to find a home.*
- If this amount of collecting/hunting happened in the same place again tomorrow with the same traders, what would the impact be? *The traders and hunters would not be able to get the same number of animals or plants, because the population has not recovered. The species would disappear.*
- How does trade threaten our biodiversity? How does it threaten animals and plants that are already rare?

Application

8. Introduce the concept of how awareness raising is a good way to bring important issues to the attention of other people so that, hopefully, something positive can be done about these issues.

Creating posters is a good way to raise awareness in the community. Ask students to suggest a plant or animal that may be a target of illegal trade in their community or country. It might help to ask students if they know what things tourists like to buy that are made from animals or plants. Encourage the students to make posters that promote messages about not buying or selling endangered species. For example, consider the following messages:

- Protect our rare species: take only photographs, leave only footprints!
- Take rare coconut crabs off the menu!
- Attention, tourists: please don't buy our rare clam shells
- Protect the green snail
- Cassowaries don't fly. Please don't make them!
- Turtles need their shells more than you do!

If you think it is appropriate, you can display students' posters in the community, e.g. in a local tourist market. Be sure to do some research and ask permission first.

Extension

If you have access to your country's Environment Department or quarantine service, invite a guest speaker to your class to talk about CITES and how it is used to fight trade in endangered species.

Cards for the game

The numbers below are for a class of 45 students. You will need to adjust the numbers according to your class size. The important thing is to make sure that you will have a few plants or animals remaining to create a discussion on how the trade has affected the population.

Make the following cards to conduct a game of 'Wildlife for Sale'.

Hunter/Traders cards:

I make jewellery for the local tourist shop.
I need to collect **five** turtle shells to earn $800.

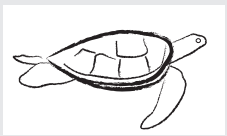
I own a business that catches fish found on coral reefs, such as clownfish. These fish are sent overseas to people who collect them. I am asked to collect **four** clownfish. I will be paid $200.

I make bags (bilums) that are made from cuscus/possum. I need to get **five** cuscus/possums to earn $300 to pay for school fees.

I log a particular tree that is popular locally and overseas to make furniture. I earn good money selling the timber and I am asked to log **six** trees.

I collect coconut crabs and sell them to tourists and local restaurants to put on their menu. If I colllect **six** coconut crabs, I will earn $160.

Species cards:

Turtles  x 7

Clownfish  x 7

Cuscus/possums  x 7

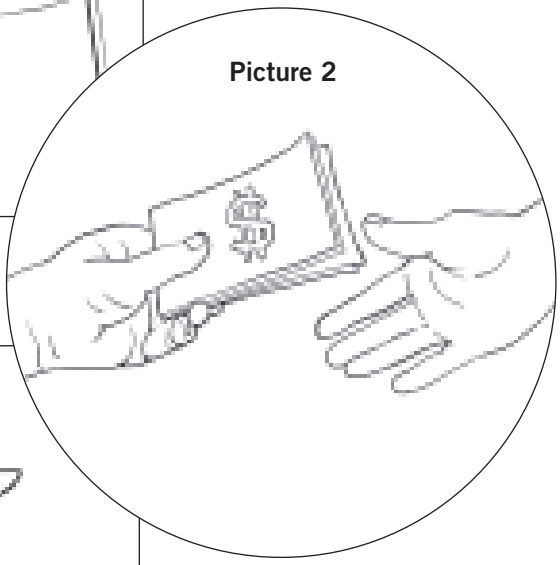
Trees  x 9

Coconut crabs  x 10

Wildlife Trade

Picture 1

Picture 2



Picture 3

Picture 4

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

Topic

5

Waste and Pollution

Background Reading

Pollution refers to any material or substance that is produced by human activities and released into the environment with potentially harmful effects. Pollution includes waste materials that may be released into the environment accidentally or on purpose. Sometimes pollution problems are easy to see, for example, oil spills, an overflowing rubbish dump or plastic washed up on the beach. But many of the most serious pollution problems are not so easy to see; they are things such as pesticides or other ***toxic*** chemicals in the water or soil. Many people believe that the most serious causes of pollution are big industries, factories or mines. While industry can be an important source of pollution, the majority of pollution comes from the activities of regular people living and working in their communities. Litter, poorly designed toilets or lack of toilets, ***domesticated*** animals (e.g. pigs), and household detergents and chemicals used in gardens and agriculture all add up. These sources of pollution are much 'closer to home' than most big industries, and they are often the main sources of pollution in Pacific Island countries. This means that everyone (including you and me) has a role to play in reducing the amount of pollution entering the environment.

Types and sources of pollution

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 pollution,** which comes from a clearly identifiable source, such as a factory pipe, mining dump site or pit toilet (bush toilet)
- **Non-point source (or diffuse) pollution,** which comes from a broad area, such as weed killers or fertilisers spread out over a crop or garden, oil and grease building up and washing from roads. Diffuse pollution is much harder to identify and treat.

The following table further describes types and sources of pollution

Pollution	Sources
Disease-causing organisms (bacteria, viruses and protozoa)	• Human wastes, through waste water or seepage from toilets or septic tanks • Wastes from animals such as pigs and cattle
Nutrient pollution (phosphates and nitrates)	• Human wastes, through waste water or seepage from toilets or septic tanks • Wastes from animals such as pigs and cattle • Fertiliser run-off from agriculture and gardens • Detergents from cleaning or washing
Solid wastes	• Waste products or rubbish, such as plastic packaging and plastic bags, tin cans, glass, building materials, car parts etc.
Toxic wastes	• Heavy metals in batteries • Pesticides and herbicides used in gardens and agriculture • Medical wastes • Heavy metals such as lead, zinc, cadmium and mercury may be a by-product of industry or found in run-off from roads
Chemical pollutants	• Oil and other petroleum products that are dumped or spilled • Industrial wastes from manufacturing processes or mining
Sedimentation (silt)	• Erosion of stream banks • Water run-off from cleared land • Sand and gravel mining in streams

Persistent Organic Pollutants (POPs) and their impact on biodiversity

Persistent Organic Pollutants (POPs) are an environmental and health threat to animals and plants in our oceans and on land and also to humans. POPs are human-made chemicals that are carried by air and water. They are released into the environment by human activities such as using insecticides, burning plastics and other household waste, and from wastes produced by some factories. The persistent compounds are not broken down when absorbed by plants or animals. This allows them to accumulate (build up) in animals where they are passed on from one ***organism*** to another when they are eaten. For example, if you were to eat 10 fish that each had 1 POP ***molecule*** in its body, you would accumulate 10 POP molecules in your body. Naturally, the same would happen if you were a shark or other ***predator*** of fish.

POPs are among the most dangerous of all the pollution that is created. They are highly toxic, causing death, disease, and birth problems among humans and animals. Specific effects can include cancer, liver damage allergies, reproductive problems and lowering of the immune system, not only in animals and humans that have been in contact with POPs but also in their babies. POPs do not easily dissolve in water, but they are absorbed in fatty tissue. Fish, predatory birds, mammals and humans generally absorb the greatest concentrations of POPs.

How pollution is impacting on our diverse environments on the coastal regions

Located downstream from land, the sea receives many of the human-made pollutants via run-off or through direct dumping. These pollutants include sewage, persistent organic pollutants (POPs), heavy metals, fertilisers, pesticides, litter and even large amounts of ***sediments***. Each of these pollutants impact upon and contribute to the degradation or destruction of marine habitats and their biodiversity.

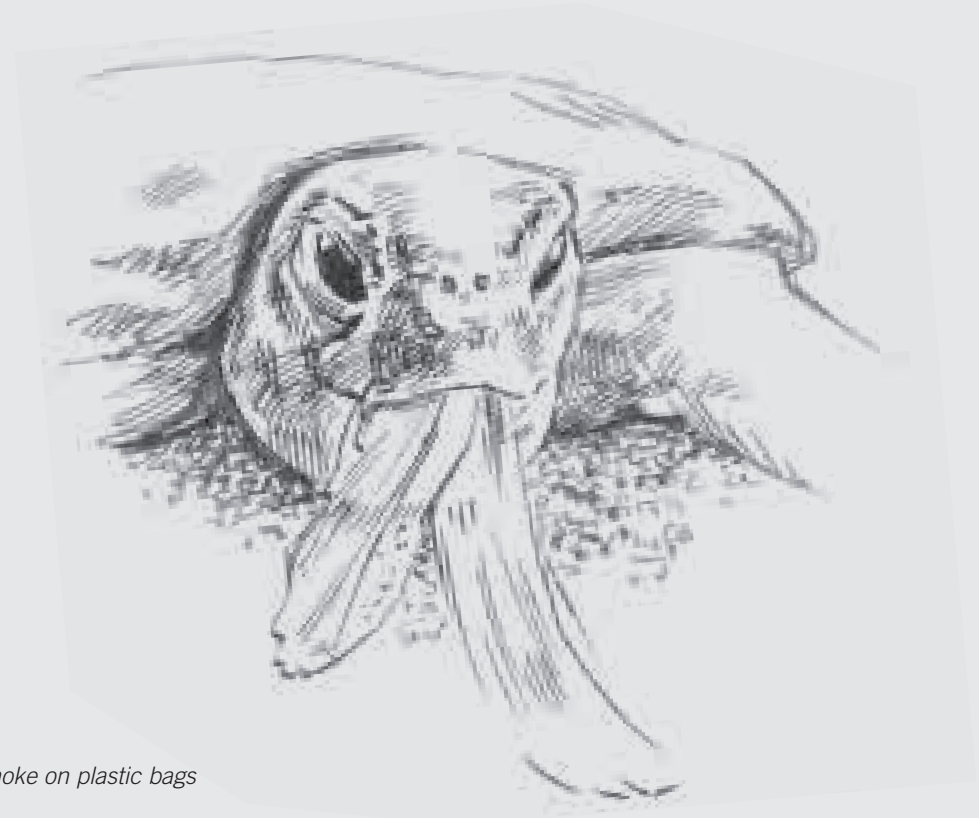
In Pacific Island countries, many wastes are not recycled or properly disposed of and may be dumped in bush, mangroves or a stream. In Fiji, Tonga, and Vanuatu, for example, such unregulated disposal of wastes threatens mangrove forests and nearby marine areas such as seagrass environments.

The case study below looks at plastic and how it is even more deadly than we thought it could be. The case study on p. 124 looks at one specific ***ecosystem***, the seagrass beds, and how pollution can affect the plants and animals there.

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 100 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.



Turtles can choke on plastic bags

Case Study:

Seagrasses: An Important Feature of the Marine Environment

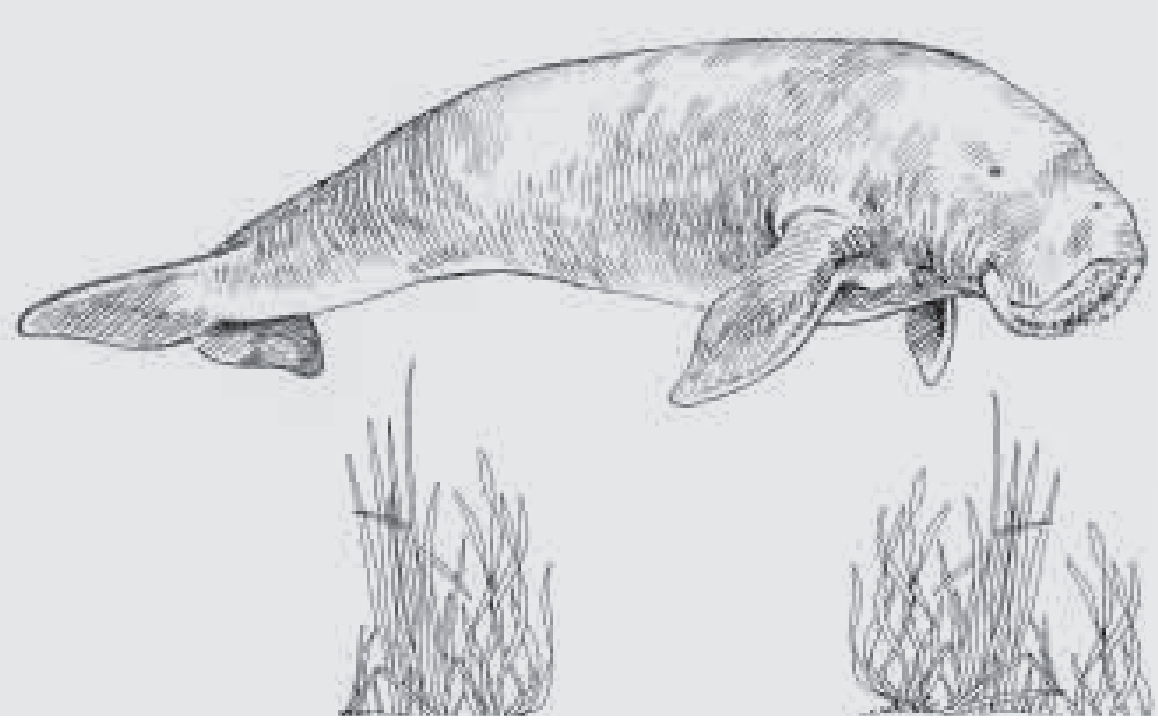
Seagrasses are a very important feature of the environment. They keep the water clean and healthy, they recycle nutrients, and they provide shelter for marine animals and food for fish. Seagrasses also look after many diverse and very small organisms called epiphytes (plants) and epifauna (animals),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



Activity 5
Story of a River

Suggested Timing

Teacher preparation time:
30 minutes
Lesson time: 45–90 minutes

Subject Areas

Language Studies, Arts, Health, Science, Social Science

Glossary Words

Pollution, POPs, non-biodegradable, biodegradable, domesticated, urban, organism, molecule, predator, toxic, sediment, ecosystem

Materials

- 4 empty bottles
- A transparent container or big bowl (more then 2 litre capacity)
- 1 bottle of cola (full) or cold black coffee
- 1 bottle of milk and coffee or tea
- 1 bottle of green cordial
- 1 bottle of yellow cordial
- Soap

Four cards with the following titles:

- (1) Mr Watson, the Logger
- (2) Ms Gina, the Farmer
- (3) Ms Siwa, the Villager
- (4) Mr Fremie, the Factory Manager

Teachers' notes:

If you do not live near a river or your island has no rivers you can still use the 'Story of a River' in this book as a guide to write your own story. The story could be about the mangroves or the landscape and how pollution builds up.

When you are doing the 'Story of a River' simulation with your class, make sure they understand that the substances you are tipping into the river are only representations of the pollution, not the real stuff. At the end of the simulation make sure you dispose of the water responsibly, e.g. pour it onto a garden bed. Make sure the students are aware that you are disposing of it properly.

Activity summary

Students will investigate sources of waste and pollution in their area and be able to understand its effect on the food chain and its impact on biodiversity. They will then be able to develop a storybook that illustrates their understanding of the issues, and suggest actions that could be done locally to address the problems with pollution.

Outcomes

Students will be able to:

- Identify ways in which humans pollute the environment and explain the effects of pollutants on biodiversity.

Tuning in

1. Show students the picture of a dead fish floating next to rubbish and pollution (see p. 126). Ask the students what they think has happened to the fish. Conduct a discussion to develop a definition of 'pollution'. Ask the students: Where does pollution come from? (What are the sources of pollution?). Make a list of sources on the blackboard.

Developing understanding

Story of a River

Present the following demonstration to the class to develop students' understanding of the sources and effects of pollution.

2. Prepare the following substances in any type of container:

- Mix coffee and milk to represent 'mud'
- Put the bathing soap into a container and pour in some water. Leave to dissolve and give a shake. It represents 'detergent'
- Fill a third container with green cordial/juice to represent 'pesticide'
- Fill another container with yellow cordial/juice to represent 'waste water'
- Fill another with cola to represent 'oil or fuel'
- Prepare one larger transparent (see-through) 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 'Story of a River':

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

Imagine what your river is like in its most healthy and untouched condition 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 images. 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 water container and describe how it represents the clear healthy water from their river that they imagined at the beginning of its journey. 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. The first thing that it passes by is a place where a logging company has been working close to your river. The logs have been cut down and taken away to a timber mill to be made into woodchips and then paper. Unfortunately, the logging company has cleared a very large area and re-planting hasn't yet occurred. The soil is exposed and uncovered. What will happen when heavy rains return to the hillside?"

Choose a volunteer from the audience who has answered a question and ask them to play the role of 'Mr Watson, the Logger.' Explain that Mr Watson has not been very responsible in the management of his logging operation. Ask him to add half a bottle of muddy water to the river. Tell the students that this represents 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. Very shortly after leaving 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 moving amongst the various crops, making sure they will produce a good yield. Various chemicals are being added to the gardens. When it starts to rain, the water washes over the soil and plants and takes chemicals with it into your river. What types of chemicals are added to 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 has not been very responsible in the application of fertilisers and pesticides to her crops. Ask her to add half a bottle of green liquid (representing pesticide) 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. The houses are along the banks of the river and people are going about their daily business, washing, cooking, and tending 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, waste water 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 been very responsible in how she has looked after her pigs and has allowed water from their pen to run into the river. The toilet is also right on the riverbank. 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 be careful because the liquid smells bad (block your nose). 'Ms Siwa' then returns to her seat. Now explain that *everyone* in the village also contributes to pollution because rubbish and litter has not been disposed of properly. Ask every student in the class to take a small piece of paper and place it into the river.

8. Read aloud the next section of the story:

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

Encourage the students to answer questions about other forms of river pollution such as factory wastes, sewage, rubbish and oil from vehicles etc. Choose a volunteer from the audience who has answered the questions and ask them to play the role of Mr Fremie, the Factory Manager. Explain that Mr Fremie has not been very responsible in the management of his factory 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:

"Your river now flows out into the sea. The substances that are contained in its muddied waters tell their own story. The water disperses and moves across fringing coral reefs where many types of marine creatures live. These include many types of fish, crabs, shellfish, corals, starfish and sea turtles. These creatures have no choice but to attempt to live and survive in this water.

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?"

10. Ask students to close their eyes and return to their vision of the healthy river in the highlands, and conclude by seeking further discussion on the 'Story of a River'.

- Is this story realistic? Why?
- Who do you think is to blame for causing the pollution?
- Did this story challenge your views on the causes of pollution? Look back at the list of sources of pollution that students helped create. Ask the students what needs to be added to their list.
- Who is responsible for fixing the problems in this river?

Use concept

Pollution survey

11. Find a location near the school where you can take the class to conduct a pollution survey. Choose somewhere you can allow the students to safely walk along by themselves for about 100 m. The bank of a creek, drain or along the beach would be ideal, but other locations would also be fine.

12. Before going out of the classroom to conduct the survey, ask your students to draw the table below in their exercise books to be used as a survey sheet.

Survey sheet sample

See, hear or smell	Describe in detail	Source

13. Out at the survey site, ask the students to walk through the chosen location (as individuals, pair or small groups). Tell students they must take notice of their surroundings, not only with their eyes, but with their ears and noses as well. Using their survey sheet, students should write down as many types of pollution that they can see, hear and smell.

    The students should also write down a description of the pollution, e.g. its colour and smell. They should also write down where they think the pollution came from (source).

14. Re-group back in 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, effects and possible actions to solve pollution problems.

Application

15. Ask the class to consider what actions they could take to reduce the problem of pollution. Reflect on the actions that students identified in the tables created earlier. As a class, choose one action and set about doing it as a class project. The projects could include the following, or refer to 'Getting Involved' section starting on p. 184 for project ideas.

- Organise a clean-up day to remove rubbish from the beach, river, bush or some other location
- Establish a school compost heap so that organic waste does not need to be thrown away
- Create awareness-raising materials about pollution, e.g. signs, posters, newspaper articles or a radio program.

Pollution	**Causes**	**Effects**	**Actions**
Describe the pollution, e.g. plastic bags	*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?*

Topic

6

Brown tree snake

Invasive and Introduced Species?

Background Reading

Invasive animals and plants are those that have been introduced by humans into an environment in which they did not originally live and then are able to establish themselves and reproduce without the help of people. Invasive species can cause environmental and economic harm, or harm to human health.

Invasive species cause changes to ecosystems and sometimes, as a result, wipe out other species that are native or naturally found in an area. They are a threat, causing species to become ***endangered*** and also causing the ***extinction*** of many species. For example, rats are an introduced species in the Pacific Islands and ***prey*** on native animals, such as birds and their eggs, for food. The water hyacinth is an introduced water plant and is a major problem in many Pacific freshwater areas. It grows quickly, completely covering waterways and causing many local plants and animals to lose their habitat.

Other examples of invasive plant species include the kasis, also known as the 'conflict tree', introduced to Vanuatu and the 'big lif rop' (*Merremia peltata*), which is a creeping vine now found in many Pacific Island countries.

Hitching a ride with humans

Ever since humans have had the ability to travel between countries and islands, various plants and animals have moved with them. Some of the animals travelling with people have been deliberate introductions, while others have been accidental.

Our ancestors deliberately moved various plants and animals from island to island. These species were resources that were valued for food. Deliberately introduced species include the pig, taro, sweet potatoes and even the northern common cuscus (possum) which was moved to new islands around New Britain, New Ireland and the Solomon Islands many years ago. The earliest days of transport and settlement of islands in the

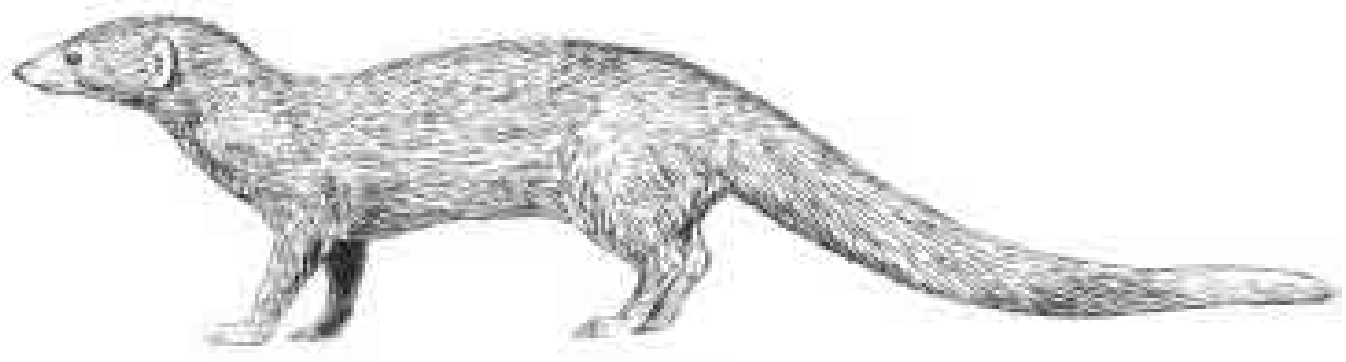
Pacific also saw the accidental introduction of the Pacific rat, *Rattus exulans*, which was able to hide on the giant canoes during long journeys.

Movements of species have continued into modern times and still include deliberate and accidental introductions. For instance, the conflict tree was introduced to Vanuatu for use in agriculture. The plant improved the soil conditions, it was good for cattle feed and it was thought to be a good source of wood for cooking. The creeping vine, 'big lif rop', is thought to have been introduced to many Pacific Islands during World War II by the American army to be used for camouflage.

The Indian mongoose, originally from Southern Asia (India), was introduced to many countries around the world and now occurs on islands or mainlands elsewhere in Asia, Africa, Europe, North America, South America and Oceania. In the Pacific region it is found in Hawaii, Fiji and Japan. The Indian mongoose was introduced to control rat numbers, especially in sugar cane growing areas.

Another reason for people to introduce a species into a new area is because the species reminds them of their previous home. British colonisers and other immigrants to Australia and New Zealand brought many species of plants and animals to remind them of their homes. In Australia, ***imported*** animals now make up more than 10% of land mammal diversity.

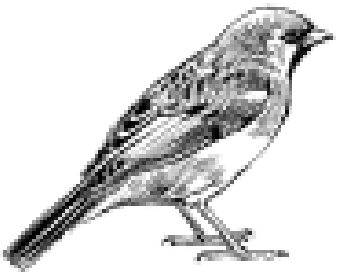
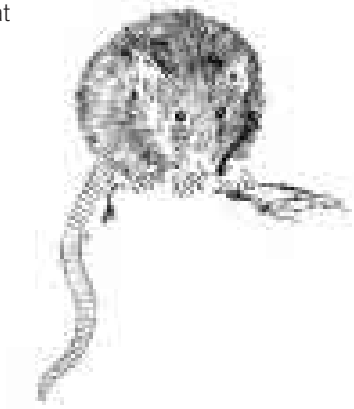
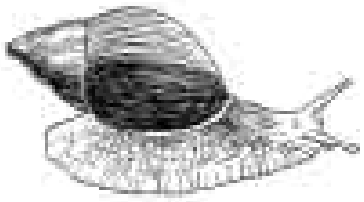
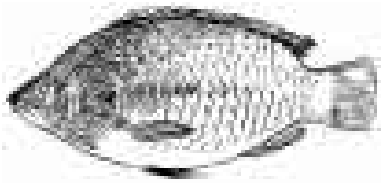
Accidental introductions often include species that like to live in and around people and our houses, allowing them to hide in cargo on ships or planes. Rats, cockroaches and Indonesian house geckos (the ones that make a chirping noise) have been transported in this way. Many accidentally introduced weeds are transported as seeds in soil stuck to machinary or in contaminated agricultural supplies. Fire ants have also been accidentially introduced when their nests have been undetected in machinery. One of the most well-known biological disasters in the Pacific was the accidental introduction of the brown tree snake into Guam following World War II. It was hidden in cargo on a ship and was able to make Guam its home where it had no predators. The brown tree snake is native to the Solomon Islands.



The Indian mongoose was introduced to Fiji

Famous faces: some common invasive species

You may recognise some of these introduced invasive species which are a common sight in many Pacific Island countries.

Cane toad 	Indian mynah 	European sparrow 
Pig 	Rat 	Giant African snail 
Tilapia 	Water hyacinth 	Coffee bush 
Creeping vine 	African tulip 	Draw a picture of an introduced species from your local area

What impacts do invasive species have on biodiversity?

Whatever the reason for introducing an invasive species, these species have created major problems for native plants and animals. The introduced species may become a problem for several reasons:

- The introduced species do not have to live with their usual ***predators*** or enemies that keep their populations under control
- The native animals and plants may not have any defences against the new invaders; their normal ways of escaping from predators may not work
- The introduced species may be very good at competing for resources, e.g. for space to grow, and the native species may lack the strategies to compete with them

Introduced predators commonly cause the extinction of species that have no ways of defending themselves or escaping. The Indian mongoose, is an example of this. It was introduced to many countries, including Fiji, as a way to control rats which were a pest to agricultural crops such as sugar cane fields. The mongoose was responsible for the extinction of two bird species in Fiji, both of them ground nesters. In Fiji, the barred-wing rail was described as common in 1875; in 1883, the mongoose was introduced, and within a few years the rail was extinct (see picture of a rail on p.113). Apart from the removal of native birds, it's believed that the mongoose is largely responsible for the removal of the two biggest skinks (a type of lizard), from the two largest Fijian islands, Viti Levu and Vanua Levu.

Rats accompanied the first humans into the Pacific Islands and had a devastating impact on smaller species of birds. The accidental introduction of the brown tree snake into Guam saw a devastating impact on the native wildlife. The brown tree snake feeds on birds. The Guam birds had no experience with snakes and were easy prey. This predatory brown tree snake has eliminated ten of the eleven native bird species from the forests of Guam. The massive decline of Guam's bird populations has had a series of impacts, including a huge infestation of spiders and other insects in bush areas of Guam.

Introduced species gain advantages over native species if their natural enemies are absent. They can then out-compete native species for food and space. For example, the 'big lif rop vine' (creeping vine) that was introduced to many Pacific Island countries during World War II covers whole forests. It is very good at competing for light, and grows over the top of other plants, starving them of the energy that they need from the Sun. Logging or building roads opens clearings in the rainforest canopy, and allows the invasive creeping vine quickly grow in the space, preventing native plants from growing.

Another major pest found in the Pacific is the bird known as the Indian mynah. This bird may have been introduced in the 1970s. It is fast becoming the most common species on many islands, where it replaces local native birds. Commonly seen on cattle farms, the Indian mynah is now an agricultural pest and reduces biodiversity by competing for nesting hollows, and destroying chicks and eggs.

Prevention is better than cure

Once an invasive species has become established, it is usually very difficult to eradicate or remove it. The cost of controlling or eradicating an invasive species may run into the tens of millions of dollars, and even then efforts might not be successful. For this reason it is much better to ensure that invasive species are not introduced or spread from island to island.

Governments of Pacific Island countries employ a ***quarantine*** service, whose job includes protecting each country from the introduction of invasive species and diseases. Quarantine inspectors look at shipping cargo and luggage that arrives on planes. Heavy fines may be handed out to people who deliberately bring a new species to a country where it doesn't belong. The quarantine service usually helps to prevent invasive species moving into a country, however, movement of species between separate islands within a country can also be a problem. For example, the Indian mongoose is not found on the Fijian Island of Taveuni. Taveuni is a refuge for species of bird, snake and

frog that disappeared elsewhere after the arrival of the mongoose. Mongooses have already spread across the neighbouring island of Vanua Levu, where they have caused several species to become extinct. Less than 10 km of ocean separates Vanua Levu from Taveuni, which means local people must take action to prevent the further spread of the mongoose and the loss of more native Fijian animals.

Everyone can take some simple steps to help stop the spread of invasive species:

- Never carry living plants or animals to another country
- Avoid carrying plant or animals from one island to another. If you are transporting food or mats, make sure that seeds, insects or other animals are not travelling with you.
- Inspect boats and luggage for any animals that may be trying to get a free trip to a new island
- Be aware of the invasive species that live around your own island and community so that you can do your part to stop them from spreading
- If you see any new plants or animals that do not belong in your area contact your Environment Department or quarantine service for advice.

Activity 6
Deadly Invaders

Suggested Timing

Teacher preparation time:
15 minutes
Lesson time: 90 minutes

Subject Areas

Social Science, Science, Physical Education, Language Studies

Glossary Words

Invasive, introduced species, native, endangered, extinct, prey, import, predators, quarantine

Materials

- Marker pens and paper
- Coconuts or something to mark out the playing area

Activity summary

Students will learn the difference between native, introduced and invasive species, and play a fun game to explore the impacts that introduced brown tree snakes had on native birds in Guam. Students will apply the concepts learned through creative writing.

Outcomes

Students will be able to:

- Define the term 'invasive' and give examples of invasive species and the impact they have on biodiversity.

Tuning in

1. Introduce the concept of what an introduced species is compared to a native species.
2. Challenge the students to think about which species in their local area are introduced and which are native. Explain the following: *When people move to a new place they often bring new animals or plants with them. These plants or animals might be very useful, but can cause problems if they get out of control.*

Divide students into small groups and together brainstorm and write their answers to the following questions:

- Do you think all the plants and animals in your area are native?
- Make a list of the animals and plants that are not originally from the area (introduced) and those that are native.
- Where did the introduced animals and plants originally come from and how did they get to their current location? *Use the background reading to assist the students.*

Ask the groups to present their ideas, and create an overall list of introduced species and native species.

Developing understanding

3. Introduce the story about the brown tree snake in Guam.

> The **brown tree snake** is native to the Solomon Islands. It was introduced to Guam in the late 1940s during World War II. Adult brown tree snakes may reach 2.5 m in length. They have mild venom, but are not considered dangerous, except to small children. Since their introduction to Guam, the brown tree snake has caused the extinction of almost all of Guam's forest birds. Nine species are extinct and the others are soon to follow. The possible spread of the brown tree snake to neighbouring islands is an ongoing concern in Guam.

Brown tree snake role-play (Solomon Islands)

4. Take the students outside to a place where they can run around (a sports field is ideal) and mark out a boundary to the area where you will play the role-play game. To set the scene, explain to the students that the boundary of the area represents an island in the Solomon Islands where brown tree snakes are native. Choose four or five students to play the role of brown tree snakes. Tell the rest of the students that they are native birds in the Solomon Islands.

The object of the game is for the brown tree snakes to tag (eat) the native birds. The birds are allowed to run away to avoid the snakes, but can only move within the playing area. When the birds are tagged, they must leave the playing area. However, the teacher can select birds to send back into the game. This represents the birds breeding. Play the game until everyone has had plenty of fun or is too tired to continue.

Link the game to the real-life situation in the Solomon Islands by discussing the following questions:

- What did the birds in the game do when they were being chased by a snake? What do you think real birds would do in the Solomon Islands? *Birds in the Solomon Islands recognise brown tree snakes and have behaviours to avoid being eaten by them; they would fly away if approached by a snake, and build nests which are hard for snakes to find.*
- Why couldn't the snakes get rid of all the birds? *In the Solomon Islands, although snakes eat some birds, the birds keep breeding so they are able to maintain their populations.*

Brown tree snake role play (Guam)

5. Play the game again. This time explain that the playing area represents an island in Guam. Tell the students that they now represent native birds in Guam, a place where brown tree snakes are not native, but were introduced. Ask the students in the playing area to flap their wings and show everyone how much fun it is to live on an island with no predators. Explain to the birds that they do not fly away from predators and if they are threatened they must hide or 'freeze'. Then send in the four or five students to represent the introduction of the invasive brown tree snake. The snakes must tag (eat) the birds. Even if you send some of the birds back into the playing area they will quickly be caught because they cannot run away. The game ends when there are no more birds.

Link the game to the real-life situation in Guam by discussing the following questions:

- Why was it so easy for the snakes to eat the birds in Guam? Why didn't the birds in Guam try to escape from the snakes? *Birds in Guam did not recognise brown tree snakes as predators, or tried to avoid being eaten using behaviours that did not work against brown tree snakes.*
- What happened to the population of birds in the game and in Guam? *In the game, the birds were wiped out (they became extinct). In real life, the same thing happened to many species of birds (nine have already disappeared forever).*
- Why did the birds in Guam become extinct? *The brown tree snakes ate them quicker than they could breed.*

Explain that in real life there are some species of bird in Guam that have been able to avoid the brown tree snake some of the time. This has ensured that the snakes didn't run out of food when many of the birds they preyed on became extinct.

Use concept

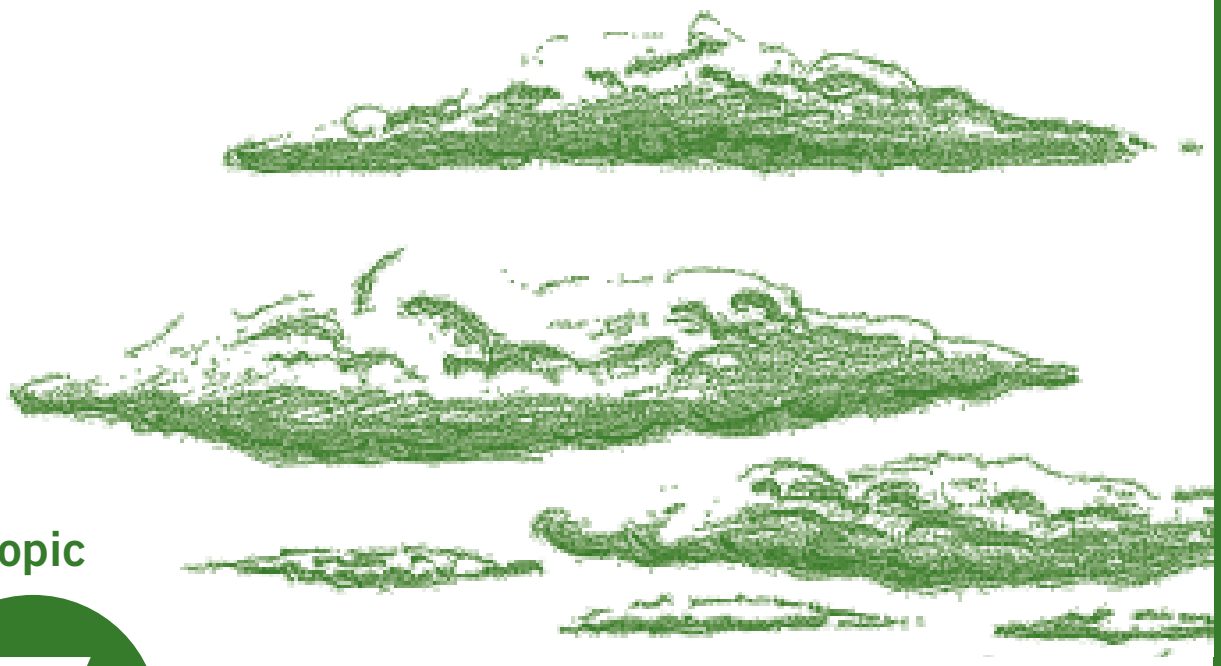
Write a 'press release' about invasive species. A press release is a short written article that you could send to a journalist if you wanted them to write a story in a newspaper, or a segment for radio or TV. Ask the students to write a short press release about the harmful effects of invasive species. The press release should be written so that it attracts the interest of the journalist, so it should use 'colourful' language and be interesting. The press release could include:

- An explanation of what 'native', 'introduced' and 'invasive' mean
- Descriptions of introduced or invasive species from your community, island or country
- An explanation of why invasive species can be a problem
- Suggestions for what people should do to stop the spread of invasive species.

Reflection

Ask the students to write a creative story about invasive species from the point of view of either the brown tree snake or the fruit dove in Guam. For example, a story could be called 'Attack of the Tree Snakes by the last surviving Fruit Dove'.

Alternatively, research and write a story about invasive species that occur in your community, island or country.



Topic

7

Climate Change

Background Reading

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

What is 'climate'?

Climate is 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 are characterised by different climatic conditions or weather patterns. For example, it is generally cold in New Zealand during the winter season but warmer in the summer. Further north in the Pacific we usually separate the seasons into the wet season, which we know of as having a lot of rain, and the dry season, where we may not experience rain for many days and up to months.

What is 'weather'?

The term 'weather' refers to the daily changes in temperature, wind and/or rainfall of an area. It may be sunny today and raining tomorrow. Weather is not the same everywhere. It may be hot and sunny in one part of the world but freezing and snowy in another.

How does the Earth naturally control its climate?

Our planet is constantly changing, but the Earth has a way of balancing and controlling the climate. There are many different things that can affect the climate of our planet, however, one of the most important is the Earth's atmosphere. The atmosphere is made up of the gases that surround us, including the air we breathe. The atmosphere

is a wonderful thing, and does a lot more than just provide us with oxygen. The atmosphere also acts like a greenhouse, which keeps us from freezing to death.

Greenhouses are made of glass and are designed to hold heat inside so that plants can grow. For example, in places too cold to grow tomatoes, they can be grown inside a greenhouse. Our planet's atmosphere traps energy just like a greenhouse. Heat from the Sun can enter the Earth's atmosphere. Some of the heat is able to escape but not all of it can easily find its way out again.

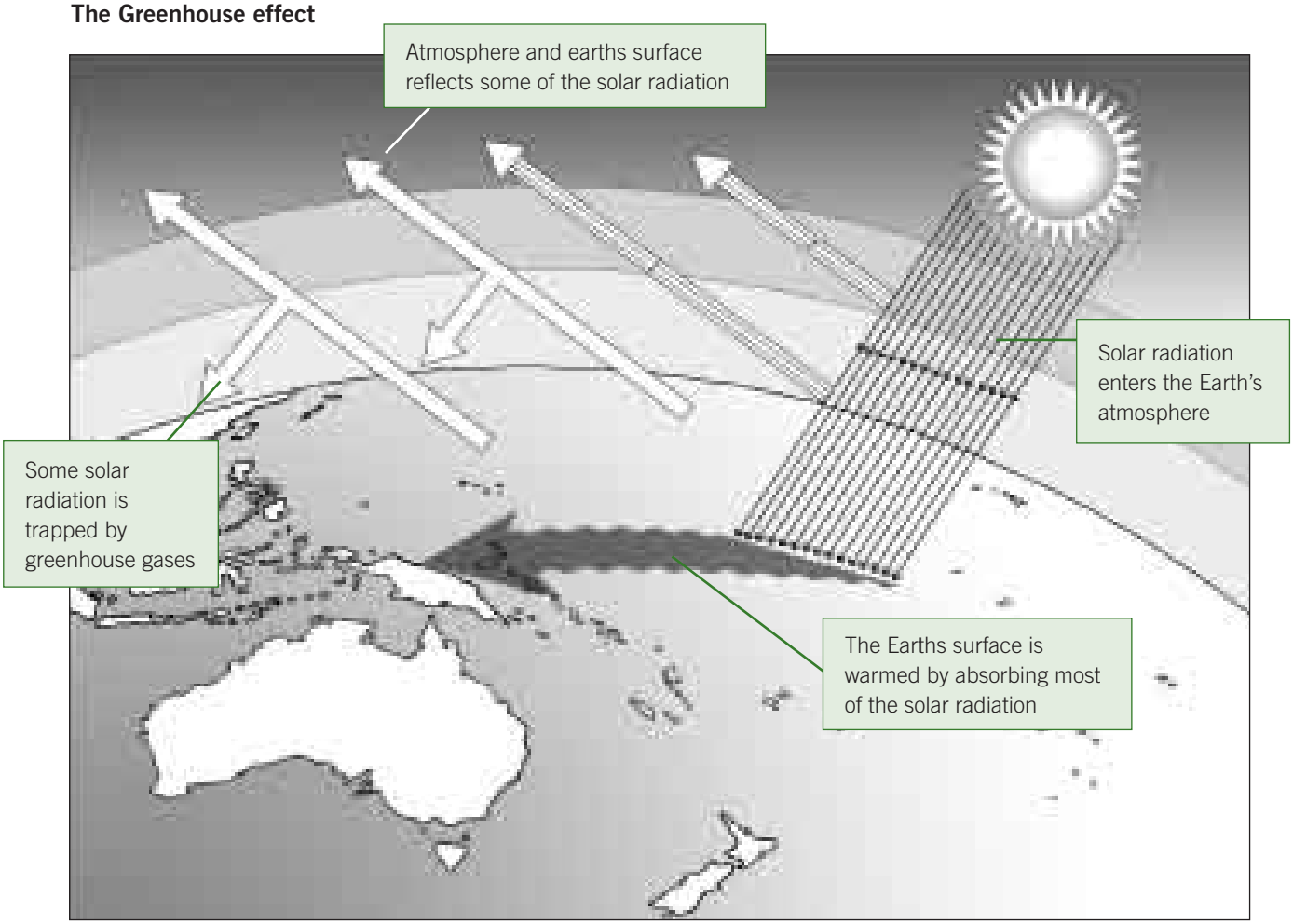
This greenhouse system warms the planet and allows humans, other animals and plants to live on the Earth. However, the Earth does not have a layer of glass over it! Instead, there are tiny, invisible particles in our atmosphere, called greenhouse gases, which absorb the heat. Greenhouse gases are made up of gases such as water vapour, methane, ozone, nitrous oxide and carbon dioxide. There may not be much of some of these gases in our atmosphere, but they can have a big impact. If Earth did not have these gases, the average temperature at the surface of the Earth would be zero degrees, making it very difficult for life to exist. However, too many greenhouse gases can cause the temperature to increase out of control. Such is the case on the planet Venus where there are many greenhouse gases and the average temperature at the surface is more than 457 degrees Celsius!

Why is the climate changing?

When more greenhouse gases are released into the atmosphere, it causes the temperature of the Earth to increase, which causes changes to weather patterns around the world. This is referred to as global warming or climate change.

People are concerned because temperatures are warming up very rapidly. This is happening because humans are currently adding more greenhouse gases to our atmosphere.

The Greenhouse effect



Why are the Pacific Islands so vulnerable to climate change?

The Pacific region is made up of 22 small-island developing states and territories, many of which are low-lying atolls with limited land space and human and financial resources.

We depend on our limited natural resources for our very existence. Fishing, tourism and agriculture dominate the economies of the Pacific Islands and these sectors all stand to be affected by changes in the climate.

Pacific Islands are already at risk from natural hazards such as cyclones, storm surges, droughts and flooding. Scientists are predicting that climate change will see such extreme events happen both more frequently and more intensely.

- In Fiji, half of the population live within 60 kilometres of the shore with 90% of villages located on the coast. Sea-level rise may threaten village livelihoods and traditional settlement patterns, as people may have to move away from their customary land to higher ground.
- On Upolu Island, Samoa, 70% of churches and 60% of schools are located on coastal lowland.
- Many of our island people rely on fisheries as a source of food and income. Coral reef and mangrove habitats are threatened by warming ocean temperatures and sea-level rise.

WWF South Pacific Programme

How are we adding more greenhouse gases to the atmosphere?

The most common greenhouse gas that humans are adding to the atmosphere is carbon dioxide. Carbon dioxide occurs naturally in the world and is a very important gas that keeps our Earth healthy. However, when we add more carbon dioxide, it makes the layer of greenhouse gases thicker. This makes it harder for heat to escape and, in turn, this makes the Earth warmer. It's like wrapping the planet up in a blanket. We release carbon dioxide whenever we cut down forest, or burn oil, coal and other ***fossil fuels*** such as when we use electricity or use petrol when we drive cars and boats.

Currently we are seeing that the Earth's weather is getting warmer and we know that the Earth will continue to warm as the amount of greenhouse gases increases. But what we do not know is how this will affect people, plants and animals. Some areas will become considerably hotter or cooler or wetter or drier than others. Some places might have stronger storms or more severe droughts. All these changes can affect the way people live their lives and the way ***ecosystems*** work. A warmer atmosphere may create more storms and more extreme weather events and so the Pacific Islands are likely to be more vulnerable to cyclones and other severe storm conditions. The ice caps at the poles (the Arctic and Antarctica) have already begun to melt, resulting in a rise in sea levels around the world. Already we are seeing the effects of sea-level rise in the Pacific. People in Tuvalu are seeking to immigrate to New Zealand as their land is disappearing under the sea, and the people on Carteres Island (a small island off Bougainville) have had to relocate to the mainland of Bougainville because of rising sea levels. Kiribati will also be affected because the islands are very close to sea level.

How is climate change affecting biodiversity?

Climate affects all of the animals and plants that live in an area in some way. When the climate begins to change, all living things have to change their lifestyles in order to survive. Many ***species*** of plants, animals and micro-organisms may not have enough time to adapt to suit their new climate. These organisms may become ***extinct***.

For instance, with climate change we are likely to see changes in temperature and rainfall patterns. This may lead to changes in a plant's growing

seasons and/or its rates of photosynthesis, a process essential for a plant's survival as it converts the Sun's energy into food. These changes could affect the ability of plants to reproduce or do well in the habitats that they have adapted to.

Entire ecosystems may change with global warming. Tropical forest areas could warm up, dry out or experience forest fires and may even become deserts. Warmer temperatures may cause entire ecosystems to disappear. An example is the highlands of PNG where plants and animals that are adapted to very cold temperatures live on the tops of the mountains. When the weather warms, the suitable habitat for these species will disappear, and since they can't go further up the mountain to find colder conditions (because they are already at the top), they will most likely die out and be replaced by plants and animals that once lived further down the mountain. Since the development of an ecosystem has generally been a very slow process, taking many thousands of years, many species will be likely to have problems adapting to rapid climate change and may become extinct.

What do we know about climate and its relationship with biodiversity?

- Climate determines how much water is available and also the range of temperatures, both of which are important influences on life's basic processes.
- Climate is a key factor affecting where individual species of plants and animals can live, grow and reproduce.
- Changes in climatic factors such as temperature and rainfall may directly affect the distribution, life cycles, ***habitat*** use and structure (in the case of some plants) of individual species.

In new conditions caused by climate change there are likely to be winners and losers. In such altered ecosystems, exotic and introduced species are likely to do well, while rare and specialised species may become extinct.

Climate change may also indirectly affect species and ecosystems by altering important factors such as:

- How often we get fires: climate change may make them more frequent and more intense.
- Spread of diseases and impact on human health: for example, with warmer temperatures predicted, malaria mosquitoes will spread to areas that have previously been too cold for them to survive. Also, air pollution is likely to get worse with climate change, so chest infections are more likely to increase. Warmer temperatures would also increase the incidence of algal blooms. This would see conditions that are good for the spread of cholera. This problem would also be made worse by the lack of water available in some areas.
- Water flows in rivers and wetlands: with a hotter climate we may have less water available in our rivers.
- The number of extreme climatic events, such as floods, hail, tropical cyclones and drought.
- The ocean's temperature may also increase, impacting on the survival of our coral reefs, marine animals and plants.

These events, along with other human activities, will reduce the ability of our biodiversity to adapt to climate change. Obvious impacts of climate change on biodiversity may include changes in the flowering times of native plants, changes to the arrival and departure times of some bird species during migration, a movement away from usual areas by native animals, a decline in trees due to lack of water, a decline in fish species and a greater spread of weeds and pests.

How do we see the signs of the impact of climate change?

Some signs in our environment may include disappearing wetlands, greater coastal erosion and coral death due to coral bleaching. The case study on the opposite page looks at how the effects of climate change would impact on our coral reefs:

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 the hard substance known as calcium carbonate, which is the building blocks of the reef. Each coral polyp has microscopic algae that lives inside them, and helps the coral create sugars (food) using energy from the Sun. When the temperature rises, the corals are forced to spit out the algae. This turns the corals white in colour 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.

Close-up of coral

Activity 7
Global Warming: A Hot Issue

Teachers' notes:

Climate change is probably the biggest threat to biodiversity and humanity that we will experience in our lifetime. It is very important that you read the background reading so that you can fully explain the concept to students and answer their questions.

Suggested Timing

Teacher preparation time: 30 minutes (plus time to make or organise the ice)
Lesson time: 90 minutes

Glossary Words

fossil fuel, species, ecosystem, habitat, wilting

Subject Areas

Social Science, Science, Maths

Materials

- Two small thermometers or two small seedlings in a small pot (no larger than 5 cm diameter)
- One large clear glass jar
- 1 plastic box or bucket
- 1 brick or piece of wood the size of a brick that will sit inside the plastic box or bucket
- 1 ruler
- Large piece of ice or several ice cubes
- Water
- Blu Tack or sticky tape
- World map or drawing of the world including the Arctic and Antarctica
- Case study on coral bleaching (above)

Activity summary

In two demonstrations, students will learn how the greenhouse effect works, be able to explain why the climate is changing and understand how climate change will impact on biodiversity.

Outcomes

Students will be able to:

- Investigate the causes of climate change and climate change's impact on biodiversity.

Tuning in

1. Before you begin the activity ask the students how much they know about different types of weather and climate. Explain the difference in weather and climate: *Weather means the daily descriptions of what is happening, i.e. sunny and hot today, raining and cold tomorrow. Climate describes the long term variations of an area, for example, in New Zealand, there is a winter, which is very cold, and a summer, which is warm.* Ask students to explain what the weather and climate is like in their area. You could expect to see answers such as: *We have a wet and dry season, where the wet season has a lot of rain and is very humid and the dry season usually has a lot of sunny and warm days.*

   Ask students if they have ever heard of a greenhouse effect. Explain the greenhouse effect using information from the background readings. Draw the diagram of the greenhouse effect on the blackboard and ask students to copy it into their books. Ask the students if they think the greenhouse effect could have an effect on their lives. Ask them to provide reasons for their answers.

Developing understanding

Global Warming Experiment

2. Discuss how in our daily activities we might add to the amount of greenhouse gases in the atmosphere. Ask students if they are aware of what we do that does this. Assist students using information from the background reading.
3. Explain that an increase in greenhouse gases will cause temperatures to rise and climate to change. Ask students if they understand why. Tell the students that they are going to undertake an experiment which aims to simulate the greenhouse effect.
4. Place two thermometers or two small seedlings side by side on the same kind of surface outdoors. If using the seedlings you should start this activity in the morning, leaving the seedlings for several hours, to see the effects in the afternoon.
5. Explain to the students that the glass jar will represent a greenhouse gas layer that is very thick because of the increase in gases released into the atmosphere. Ask for a volunteer to then cover one of the thermometers with the large jar. If you are using seedlings, cover one of them; note, this would have been done in the morning.
6. If using a thermometer, you do not need to begin this activity in the morning like with the seedlings. Record the readings from each thermometer at the beginning of the experiment, again after 30 minutes and again after one hour. If you are using seedlings describe their appearance after 3 hours and again at the end of school.
7. Discuss the results. What were the differences in temperatures shown on the thermometers or indicated by the seedlings between the greenhouse and non-greenhouse tests? Note that the seedlings indicate temperature by the level of ***wilting***.
8. Discuss how the increased thickness or concentration of greenhouse gases causes the Earth to become warmer. In the case of the seedling, the extra heat caused it to wilt more in comparison to the other seedling. Discuss the sorts of impacts that an increased temperature would have on the students and their surrounding environment. Refer to background reading to assist students.

Use concept

Sea Level Rise – Practical Demonstration

9. When you are satisfied that students understand the concept of the greenhouse effect, use the following demonstration to show how climate change can affect our world. If you have a world map point to the Poles and ask the students if they know what the environment is like in these areas. If your students have difficulty with this, lead them with clues such as: *These areas are further away from the Sun. We are in an area that is close to the Sun…here we are hot…so there would be…* You should get answers such as cold and dark. Use their answers to expand on what the areas are like, e.g. that they are mostly covered in snow and ice.

   Explain to the students that we are going to see whether an increase in a few degrees (which is what scientists predict will be the effect of climate change) can cause much damage to the world.

10. Conduct the experiment:

- Put a piece of wood or stone into the bucket or plastic box. Fix a ruler to the inside of the box with sticky tape or Blu Tack.
- Put the ice on the block of wood or brick. This represents ice, just the like the ice and glaciers that cover land in the far south and far north of our planet.
- Ask a student to pour water into the bucket until the level is just below the top of the block. Get another student to record the level of water on the ruler. Leave the box to warm up to room temperature, and all the ice has melted. This should only take about 10 minutes.

11. Tell students to draw a diagram of the experiment and the table (below) in their notebooks. Record the level of the water after the ice has melted.

12. After the students have completed the measurements and entered it into their notebooks, you could generate a discussion with the following questions:

- *What causes ice to melt?*
- *Why did the water level rise in the bucket?*
- *With global warming, we are expecting the icebergs and ice sheets covering land at the Poles to melt. If the ice melted at the Poles, causing the sea level to rise, how would it affect your coast?*
- *Make a list of possible effects to your community (or a coastal community you know) if the sea was to rise by 1 metre.*

Reflection

Ask students to imagine the impacts on their lives if the coral reefs found on their coast were to disappear because of global warming. Hand out the coral reef bleaching case study for students to read through. Ask students either to write a written assignment or design a series of drawings that relate to the following:

- *Why are coral reefs important?*
- *The effects of global warming on coral reefs*
- *The impacts on people of loosing coral reefs*
- *How do you feel about the threat to coral reefs?*
- *What do you and your family do that may contribute to this climate change problem?*
- *Can you think of ways to reduce your impact? (Aim to have 5 to 10 things you can do)*

	Level before	**Level after**	**Change in level**
Land ice box			

Assist students to identify actions that they can take to save the planet from global warming, for example:

- **Buy local foods**: when you buy products that have come from overseas there has been a huge amount of fossil fuels used to fly or ship the products to your country.
- **Walk or use buses to get to school**
- **Turn off the lights and fans when you leave a room**: if you leave the lights on you are wasting fossil fuels and releasing greenhouse gases into the air.
- **Don't buy food packed in plastics**: these add to the pollution problem and are usually made overseas and shipped to your country. Factories use a lot of fossil fuels when they make these products.

4 Taking Action for Biodiversity

"I am only one, but I am one.
I cannot do everything, but I can do something.
And I will not let what I cannot do interfere with what I can do."

Edward Everett Hale

MODULE 4

Module Introduction

Taking Action for Biodiversity?

The damage being done to the number and variety of plants and animals in the world around us is largely due to the impacts of human activities. This is a sad thought but it is also a hopeful one, because when we realise we have the power to cause impacts we also recognise that we have the power to make positive changes for our natural environment.

One of the greatest challenges we face in protecting biodiversity is how to balance the needs of the present, without putting at risk the needs of future generations.

The best way to look after our environment is to choose sustainable practices over non-sustainable ones. This module looks at a variety of practices that are currently being used in the Pacific and encourages students to think critically about them. It aims to lead students to be able to critically analyse practices in case studies, as well as those they see around them, in the hope that they will be better prepared to make sustainable choices in their lives both now and into the future.

This module aims to do more than teach awareness about the environment: it aims to develop students' values, attitudes and skills to take action for conserving biodiversity. This action needs to involve all members of the community working together. Students should be encouraged to make lifestyle choices that have positive impacts on the environment.

There are many levels under which people are working to make positive impacts on the environment and biodiversity. Changes can be made by individuals, organisations or governments. Students will be introduced to a variety of conservation organisations and legal concepts that they may not have previously been aware of. By looking at the aims, visions and missions of others, students will be able to relate their own conservation efforts to what is happening globally.

This module has six Topics that cover:

1. Resource Management
2. Sustainable Practices
3. Laws that Protect Biodiversity
4. Biodiversity Conservation Organisations
5. Environmental Issues Facing the Pacific
6. Personal Action to Protect Biodiversity.

This module also has a 'Getting involved' section that has six 'Schools' Action Projects'. These projects are designed to give students the opportunity to apply the skills and knowledge they have gained to projects in their own school or community. The action projects presented are:

- Replanting
- Litter Education
- Making compost
- Sup Sup Garden
- Bring your own Bag
- Clean Up Day.

By conducting these projects in your schools and encouraging your students to take a community-level approach to biodiversity issues, students are helped to make connections between what they have learned about biodiversity and how they can directly help protect it.

Activity Details Summary: Module 4, Taking Action for Biodiversity

Topic	Activity Name	Activity summary	Outcome	Subject Areas	Timing
Resource management	Activity 1 – Resource Management Mobile	This activity will help students to understand the new terms 'resource' and 'resource management' by giving them an opportunity to define the terms and find examples. Students will be able to show their understanding in a mobile that highlights examples of both 'good' and 'bad' management of resources from their local area.	Explain what Resource Management is and how wise resource management protects Biodiversity and Identify local examples.	Social Science, Science, Language Studies	Teacher preparation time: 40 minutes Lesson time: 90 minutes
Sustainable practices	Activity 2 – Providing for the future	In this activity students will reflect on stories of sustainable and non-sustainable practices. Students will have the opportunity to analyse and think critically about case studies and reflect on practices in their own communities. By completing the Reflection Table, students will develop organisational and summary skills	Research an international example of sustainable practices and discuss their suitability in the local context.	Social Science, Science, Language Studies	Teacher preparation time: 40 minutes for reading/research and story preparation if needed. Lesson time: 45 minutes + 45 minutes (extension activity)
Laws that protect biodiversity	Activity 3 – Looking at Laws	This activity will help the students to identify laws that are in place in their country. They will gain an understanding of why we need these laws and what governments and local leaders are doing to protect our plants, animals and their habitats.	Identify laws that protect Biodiversity (plants, animals and habitats) and make further suggestions for laws with reasons.	Language Studies, Social Science	Teacher preparation time: 40 minutes for reading Lesson time: 90 minutes
Biodiversity conservation organisations	Activity 4 – Looking after Biodiversity	This activity provides an opportunity for students to learn from and about people working in the conservation field. Where possible, firsthand information can be provided by guest speakers, however, it will also be useful for students to learn about some different organisations through the profiles provided in the background reading section.	Identify various organisations and people that are responsible for looking after biodiversity and become familiar with the roles and activities of these organisations or individuals.	Social Science, Language Studies, Art	Information from organisations to be collected/sent for in the weeks prior to the task. Teacher preparation time: 40 minutes reading time Lesson time: 45 minutes
Environmental issues facing the Pacific	Activity 5 – Investigating Issues	This activity will lead students to identify and understand various environmental issues particularly those relevant to their local area. Students will have the opportunity to develop and use their critical thinking skills in order to talk about possible solutions to the identified problems.	Identify and investigate some local environmental issues and suggest strategies to address the issues	Social Science, Language Studies, Science, Art	Teacher preparation time: 60 minutes reading and gathering resources relevant to their local area if available. Lesson time: 60 minutes
Personal action to protect biodiversity	Activity 6 – Personal Pledge	In this activity students get the opportunity to analyse the contribution they personally make to biodiversity decline and consider the options that they can take to minimise the effect that they have as individuals.	Analyse their individual role in contributing to environmental impacts and devise personal actions for conservation.	Social Science, Language Studies,	Teacher preparation time: 45 minutes Lesson time: 45 minutes to determine the pledge. Ongoing monitoring.

Topic

1

Field worker recording data

Resource Management

Background Reading

This activity introduces the students to the concept of 'resource management'. In order to clearly understand what resource management is, we must first have a working knowledge of what the term ***resource*** means.

A resource is 'anything of value and importance for use'. This definition is very broad. In this unit on biodiversity, we will be using this term to refer to resources we make use of from the natural world around us (not including those made by people). The following is a list of resources, with those from the natural world highlighted:

car	**water**	**soil**	**fish**
classroom	broom	candles	detergent
firewood	**coconuts**	ladder	**reef**

Resource management can then be defined as the 'control and administration of anything of use to us from the world around us'. Wise resource management means looking after our resources so that they can be sustained for the future. This means using resources in a way that will also allow future generations to benefit from the resources.

Examples of resources and wise management techniques.

Resource	Wise management techniques
Coral reefs	• Restricting fishing practices, e.g. not using explosives • Not walking on the reef or damaging it in any other way • Establishing Marine Protected Areas • Establishing tabu areas to 'rest' the resource
Forests	• Clearing only small areas • Selective wood removal and replanting • Replanting cleared areas with 'native' type mix of species • Restricting forestry practices to exclude poor practices, such as clear-felling large areas and areas near waterways
Water	• Keeping waterways clear of rubbish and other wastes • Not wasting water by letting taps run when not in use

Local resource management

Some marine resource management techniques used in the Pacific are good examples of how resource management can be put into action. The management techniques used focus on encouraging local communities to take responsibility for looking after their own marine resources.

Marine resources that are available to communities in the Pacific include the fish and shellfish that make up a large part of our diets. Because these resources are so important to us, we have to make sure they are taken care of in a sustainable manner so they are available to us (and our children) into the future.

In many Pacific communities, important marine species have been managed through the use of customary rules or rules made by the village communities themselves. After the rules have been decided on, they can then be enforced by the community through their own system of authority. Government and non-government organisations (NGOs) can provide support in enforcing the rules that look after resources. The use of locally created rules and laws allows the community to take an active part in monitoring and managing their own resources. This can be very empowering and effective.

Some examples of ***traditional*** or ***customary*** rules that help to care for our marine resources include:

- Creating a tabu area, fish reserve or conservation area
- Enforcing a 'No Fishing' period (a time of the year when fishing or collecting is not allowed)
- Creating a tabu or ban on taking a particular species that is becoming rare or threatened
- Banning the use of destructive fishing methods (such as using explosives or poisons)
- Banning littering in the marine environment (including creeks and rivers that flow into the sea)
- Banning the removal of live or dead coral.

Case Study:
Arnavon Islands Marine Protected Area

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. This meant that neither group could use the islands directly but all would benefit.

By establishing a Marine Protected Area (MPA), 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 islands of Arnavon 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.

Activity 1:
Resource Management Mobile

Teachers' notes:

If access to the various materials needed for the mobile is difficult, this task can be modified to be a poster or diagram. It is important to display the students' work as this creates interest and pride in the topic.

Suggested Timing

Teacher preparation time: 40 minutes
Lesson time: 90 minutes

Subject Areas

Social Science, Science, Language Studies

Glossary Words

Resource, resource management, sustainably, good practice, bad practice, traditional, customary, terrestrial

Materials

- Marker pens
- Colouring pencils
- Cardboard or stiff paper
- String
- One-metre sticks (one per pair)

Activity summary

This activity will help students to understand the new terms 'resource' and 'resource management' by giving them an opportunity to define the terms and find examples. Students will be able to show their understanding in a mobile that highlights examples of both 'good' and 'bad' management of resources from their local area.

Outcomes

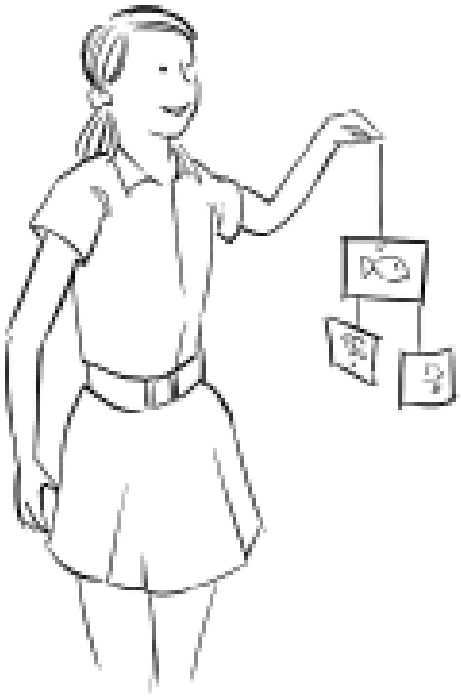
Students will be able to:

Explain what resource management is and how wise resource management protects biodiversity and identify local examples.

Tuning in

1. Introduce students to the terms 'resource' and 'resource management'. Use the background reading information to assist you to introduce the terms accurately. Discuss these ideas with the students.

2. Ask students to identify and suggest examples of 'resources' from the natural world in their local area, and write these on the blackboard. Some examples could include: water, soil, birds, fish, crabs, coconut, bamboo, timber, firewood and pandanus.



Developing understanding

3. Discuss the ideas of 'good resource management' and 'bad resource management' with the students. Include the ideas that 'good' management is 'sustainable' and 'bad' management is 'unsustainable'. Give students examples by using the, 'Resources and wise management techniques' table on p. 150 to give the students some ideas. This table identifies good resource management, what would bad management of the same resource include?

Further explain the concept by using the following example involving the collection of green snails in Vanuatu. Green snails were collected by the local people in such large numbers that there were not enough left to reproduce. This meant that the populations declined and now green snails are no longer found in many reefs around Vanuatu. Remember to make clear that 'sustainable' means that the practice is able to continue without significant impact on the natural balance of the ecosystem. Ask the students if they think the collection of green snails was sustainable or not and, therefore, was it good or bad resource management?

Practise skills

4. Using the examples of resources identified earlier and working in pairs, ask students to construct a 'mobile' of local resources and an example of 'good' and 'bad' management. Instructions for making the mobile are as follows:

   a. Each pair of students needs to collect a one-metre long stick to tie their resource pictures to.

   b. Each student in the pair is to draw two separate pictures of resources from the class list.

   c. Attach the pictures by a piece of string to the stick, spacing them evenly along the stick.

   d. For each of the resources pictured, the students in the pair need to think of a short way of expressing a 'good' and a 'bad'

management technique. Write the 'good' technique in green marker pen and the 'bad' technique in red marker pen.

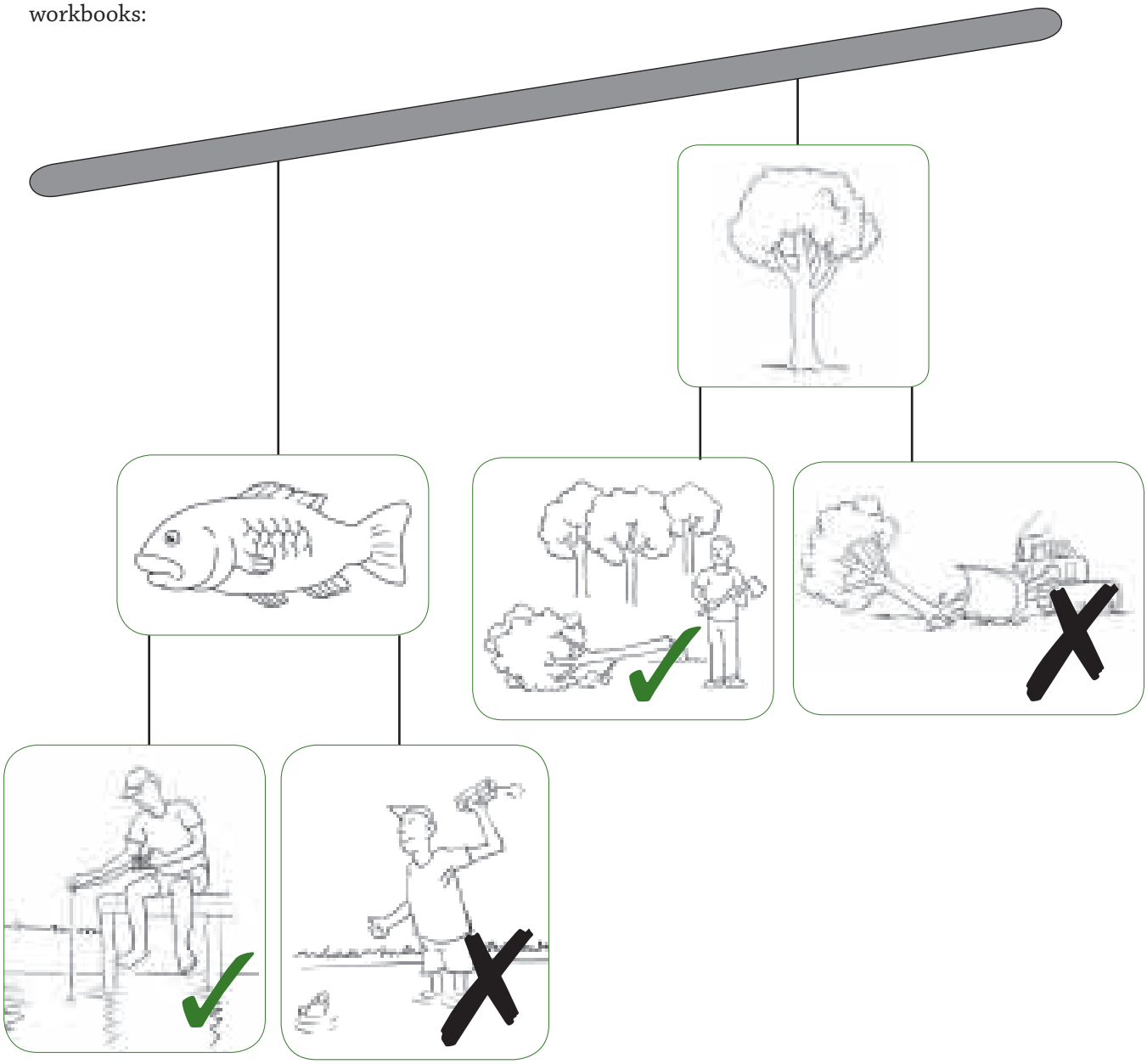
e. Attach the two management techniques – one to each corner – to the resource picture.

Reflection

Display the mobiles in the room to remind the students of our resources and how they are managed.

Ask students to look at all of the mobiles and then answer the following questions in their journals/ workbooks:

1. What have you learnt about good and bad resource management?
2. What are the impacts of bad resource management?
3. What examples of good resource management in your local area did the class think of? (Use examples from the work of other students, not just your own.)



Topic

2

A common species of sponge harvested for use as bath sponge

Sustainable Practices

Background Reading

It is important to remember that the Earth is a finite system. We have limited supplies of water, minerals, land and ***fossil fuels***. For example, there will never be any more water on the Earth and in our atmosphere than there was a million years ago. Our water simply cycles around, but it is the same water, so it is very important not to pollute it. We only have a limited area of land on which we can grow our food and build our houses, so we must take good care of it. There are also limited amounts of minerals and fossil fuels in our ground, so once we mine them and use them up, they are gone. Using our resources ***sustainably*** can unsure that they are not 'used up' and in the process we do not damage the environment that sustains us.

Sustainable use of a resource means using it at a rate that meets the needs of the present generation without making it difficult for future generations to meet their needs.

As the world's human population grows, sustainable use of resources becomes more important and more difficult to manage. More people means more land is required for housing, farming, roads, schools, shops and disposal of wastes. The land that is being turned into human ***habitat*** is being taken away from animal and plant habitats. This results in smaller areas being available for the native plants and animals of an area, which leads to smaller populations of fewer types of species – this is loss of biodiversity.

In their efforts to reduce loss of biodiversity, many countries are encouraging sustainable resource management practices. The case studies in the next pages provide some examples of sustainable and ***non-sustainable*** practices.

Case Study 1:
Agroforestry

Gwendolyn Pitakaka is from Sasamuqa village in Choisuel, Solomon Islands. She is a mother of three children and a farmer. She manages several hectares of ***agroforest*** on her family land, which consists of a small, narrow valley. Gwendolyn has planted the agroforest to produce useful materials and as an example to her children. The forest is being developed in stages. The agroforest occupies the slopes of the small valley and the ridge-top. This is steep land with some natural bush that has been left in the agroforest. Gwendolyn has left a local tree that produces plenty of large leaves and she uses these leaves for ***mulch.*** The slopes were once planted with coconut and most of these have been left standing because they produce useful products. The coconut trees make a tall canopy over the agroforest.

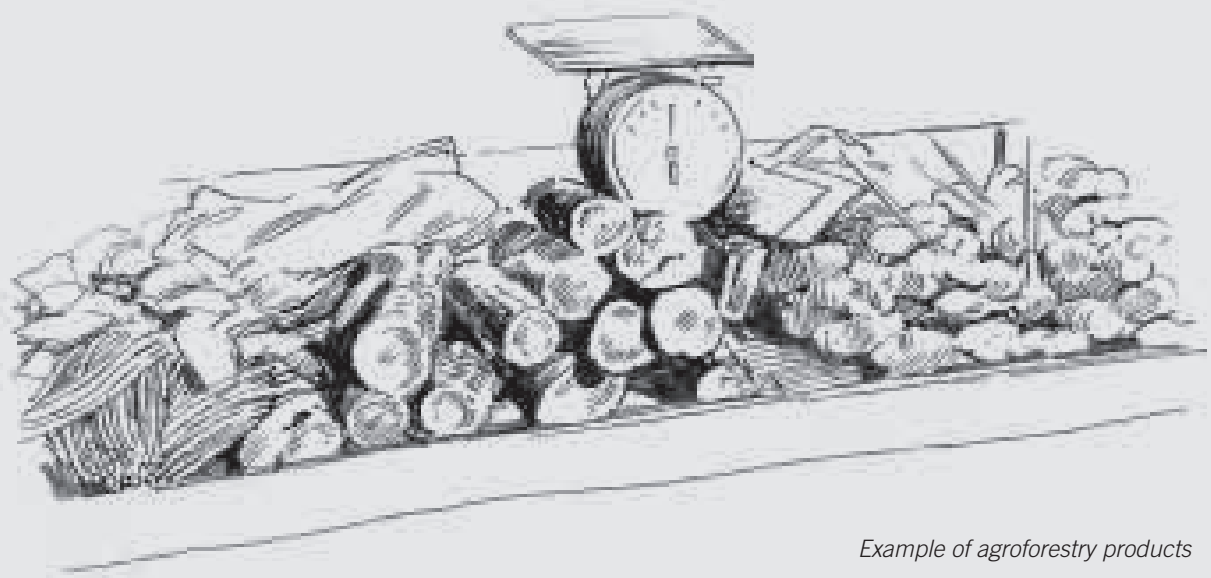
In the agroforest Gwendolyn has planted:

- a collection of nuts, including varieties from other provinces of the Solomon Islands
- local bush fruit trees
- a local tree known as 'sandpapers' which has edible leaves and fruit
- mango, guava and betel-nut trees.

One of Gwendolyn's brothers has planted a hillside with the valuable timber, teak. He has planted other areas below coconuts with 'bunie', a local timber tree. When mature, this can be felled and milled into planks that can be sold as building material.

The success of Gwendolyn's agroforest will be thanks in a large part to the fact that this method of 'farming' and 'forestry' together copies a more natural ecosystem. Many native birds, bats, insects and spiders make their home in the forest. At no time will the land be stripped bare of all vegetation and there are no large areas of only one type of plant, which would encourage pest insects and diseases to invade the crops. Many people in rural areas of the Pacific set up their gardens in similar ways and we should be encouraged to continue using our land in this way instead of planting out whole areas with only one thing.

Source: Agroforestry: Growing Income for Solomon Islands Farmers, 2004



Example of agroforestry products

Compare the idea of agroforestry with the next story about large-scale forestry.

Case Study 2:
Large-scale Logging

Logging companies remove trees for timber in a way that we refer to as 'large-scale logging'. This means that they remove most or all of the trees in a large area of forest. This type of tree removal is poor practice because it can have far-reaching effects on the forest plants and animals, as well as the people living in the area.

When an area is clear-felled (all or most of the trees are removed), it leaves the land bare and makes the area prone to erosion. This means that the best soil which is in the top layer, is washed away and the land becomes infertile. The washed away soil also creates problem because it washes into rivers and oceans, making them dirty with the soil ***sediments***.

In Olive Village in the western part of the Solomon Islands, a logging company called Earthmovers has been operating. The poor practices of large-scale logging by this company have ruined the water in the area. This has happened because when the trees are removed in an area, the soil washes away into the rivers and then onto the reefs. The people of Olive Village are suffering because they have no clean water and the number of shellfish and fish in the mangroves and reefs has declined.

The bare soil left after all the trees have been removed cannot be used for agriculture because it is too infertile. Loya cane and other bush materials for building houses have also disappeared. The practices of Earthmovers is unsustainable, which means that the future generations of Olive Village and other areas where these practices occur will not have access to healthy natural resources from their environment for use in their lives.

Case Study 3:
Aquaculture

An example of sustainable use of our marine resources can be seen in the practices of sponge aquaculture. Sponges are a commercial item and can be sold to make money for a village, but if the harvesting is not managed all the sponges will disappear. If well managed, ***aquaculture*** ensures there will always be enough sponges.

Coscinoderma matthewsi is a common bath sponge species of the Pacific Islands. It grows on reef slopes and is widespread in areas such as the Western Province of Solomon Islands. Sponges have the ability to repair themselves when they are damaged and it is this property that sponge farmers use in sponge aquaculture.

The farmers select a 'mother' sponge, which is large enough to recover from harvesting. They remove the outer 5 cm of the sponge then leave the mother alone to recover. The mother can be harvested again when it has grown back its outer layer. The removed piece of sponge is cut into 5 cm squares and threaded onto nylon line. The nylon lines are attached to ropes. One end of the rope has weights attached and the other has floats. The ropes are positioned in the salt water so that the floats sit 5 m below the surface. Under the water, the cuttings of sponge begin to grow and after a year or so they have reached a marketable size. At this time they are harvested and prepared for export.

The thing that makes sponge aquaculture sustainable is that farmers do not simply take the sponges but grow them while leaving the mother sponges to recover for use later on. Compare this to the story of over-harvesting in Vanuatu.

Case Study 4:
Over-harvesting

There are many examples of over-harvesting of our marine resources. We can probably all think of an example of a fish or shell that used to be plentiful and now is either completely lost or very rare because too many of them have been taken.

This is what has happened to ***trochus*** in many of the reefs of Vanuatu. The trochus shells are a commercial item, used in button-making, and the meat of the trochus is eaten by the local people. These two factors have put too much pressure on the populations of trochus around Epi Island, Vanuatu.

Trochus shell had been collected as a source of food for many generations but in the late 1940s a market became available for the shells to be harvested for button manufacture following the arrival of commercial buyers in Port Vila. This was a much needed source of income for rural populations and many people wanted to collect trochus and sell the shells. To make buttons, the trochus shells cannot be too big or they become brittle, so many small, young trochus were harvested. During the 1980s button factories were built in Port Vila creating new demand for trochus. Unfortunately, the harvesting was not managed because people did not understand what would happen if too many trochus were taken. In fact, they did not know how many was too many until it was too late.

So many trochus were harvested that those that were left were too spread out to be able to breed and produce more. This has led to widespread loss of trochus in many places. No trochus means no income from the button industry but, more importantly, a significant traditional food source has been lost.

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

A diver harvesting trochus

Activity 2:
Providing for the Future

Suggested Timing

Teacher preparation time: 40 minutes for reading/research and story preparation if needed
Lesson time: 45 minutes + 45 minutes (extension activity)

Subject Areas

Social Science, Science, Language Studies

Glossary Words

Sustainability, sustainable practice, aquaculture, agroforestry, canopy, trochus, habitat, mulch, erosion, infertile, sediments, fossil fuel

Materials

- Case studies of sustainable and non-sustainable practice (see pp.155–157). Stories from newspaper and magazine articles could be used, where possible to provide a wider range of examples.

Activity summary

In this activity students will reflect on stories of sustainable and non-sustainable practices. Students will have the opportunity to analyse and think critically about case studies and reflect on practices in their own communities. By completing a reflection table, students will develop organisational and summary skills.

Outcomes

Students will be able to:

- Research an international example of sustainable practices and discuss their suitability in the local context.

Tuning in

Ask the students to explain the difference between 'sustainable' and 'unsustainable'.

It is highly recommended that you undertake 'Activity 1: Resource Management Mobile' (p. 151) to introduce this activity. Explain the terms 'sustainable' and 'unsustainable', referring back to the 'good' (sustainable) and 'bad' (unsustainable) management techniques on the students' mobiles from Activity 1.

Developing understanding

Read two of the case studies to the students: either Agroforestry/Large-scale Logging, or Aquaculture/Over-harvesting. The case studies may need to be simplified for younger students.

Ask some focus questions about each case study when you finish. For example:

- What do you think will happen to the resource over time?
- Will the resource be there for future generations?
- Why? (That is, how is the resource declining or being maintained?)

Practise skills

Ask students to draw up the following reflection table in their books:

What did the people do? (the practice)	What happened to the resource?	Describe what you expect the resource to be like in 50 years

Using the table, ask students to complete a summary of the practices they have heard about in the stories.

Application

When they have completed the table for the stories, as a class discuss some local practices and where they would fit into the table. Ask students to add three local practices to their table. They may need guidance with this, as it is sometimes difficult to be critical of the things we do.

Extension

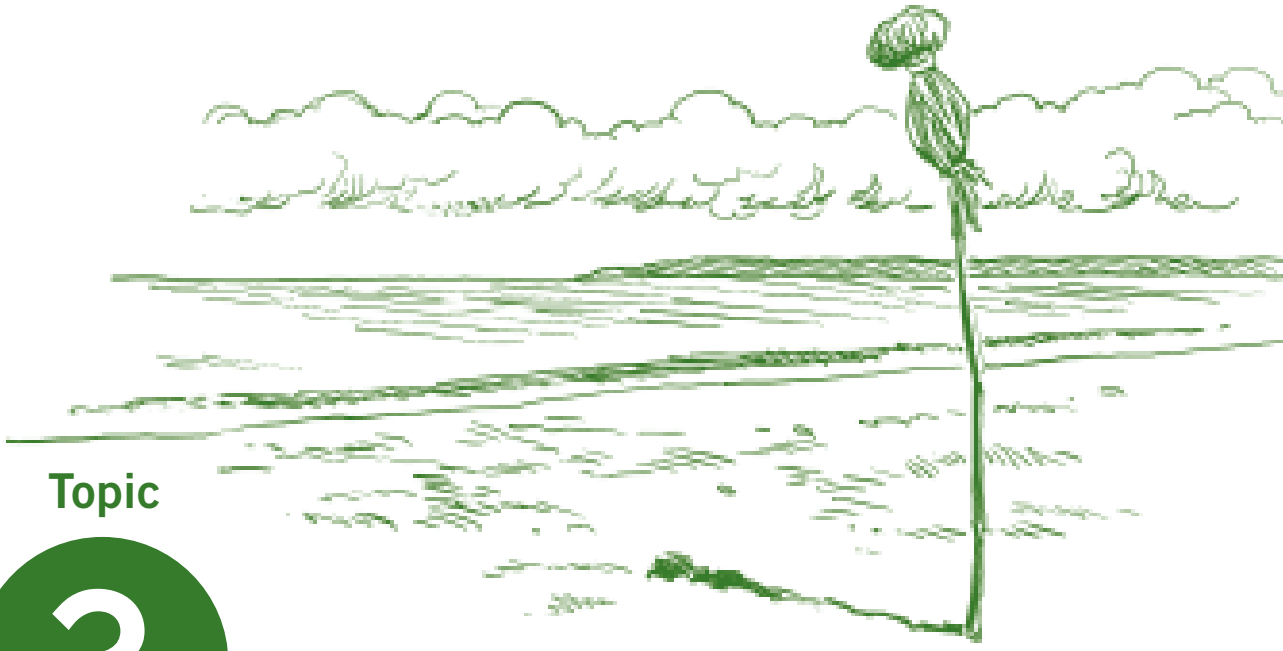
Writing Task: Unsustainable to Sustainable.

Ask the students to select and think about a local practice that they think is unsustainable. Write about the practice including the following:

- What is the practice?
- Why do we do it?
- How is it unsustainable?
- How could we change our practice to become sustainable?

Make the length of the piece appropriate to the level of the students.

Display the written work around the room for students to read in their own time or when they have finished their work. You may be familiar with the 'Read the Room' concept or participate in DEAR (Drop Everything And Read); if so, you can use the written work for this.



A sign that an area has been declared tabu

Topic

3

Laws that Protect Biodiversity

Background Reading

Laws and conventions addressing environmental issues can be found at local, national, regional and international levels. It is important that students have an awareness and understanding of these laws, so that the laws are respected and hence more effective in conserving the Pacific's unique environments. It is through these laws and conventions that the people of the Pacific have the rights to protect their resources.

All laws and, on occasion, conventions are subject to change; those who have the power to make laws can also alter or remove laws. There are a number of levels of laws, so there are a number of different people responsible for the laws in a particular area.

Local laws

At a local level, laws may be put in place by the chiefs and elders of a community. Laws dealing with the protection of the environment in a local area may be put in place as part of the chiefs' duty to care for the community and their land. These laws are not passed by the government but may be put in place through a process of discussion at a community meeting. A Council of Chiefs in an area may be responsible for agreeing on laws that each individual chief will be responsible for overseeing in their own community.

Examples of local laws

1. Declaring a tabu area where fishing is not permitted.
2. Declaring a 'No Fishing' period after someone of a high rank from the community dies.
3. A local ban on the use of destructive fishing methods such as using explosives.
4. Establishing bans on the cutting of mangroves.
5. Adhering to custom tabus including those related to not eating or killing the special spirit animals of your tribe.

6. ***Customary*** land ownership, which allows only members of a particular tribe to use a piece of land.

7. Declaring a tabu area for hunting.

These laws help to protect our biodiversity because they control the ***pressures*** being put on different environments and ensure that resources are not being used up. Where customary law and culture are strong, local laws tend to be respected by people and are highly effective. Respect for and keeping of with local law is associated with a community's sense of ownership and understanding of the law and community support for a customary system of law. If laws are not followed and respected they cannot be effective. For this reason, most laws have consequences if you break them.

For example, if a Vanuatuan village is planning for an important event in the future, the Chief may create a law that restricts the use of any marine resource until that day. People in the village are banned from harvesting any marine resource for that set time. This ban is shown by placing a namele leaf at the site. The penalty for breaking such a law may lead to fines of pigs with coil tusks; the tusks need to be worth between 20,000 Vt – 50,000 Vt (up to $500 Australian). Traditionally, if the person who broke the law can't get a pig of that value then they would have to ask relatives or a neighbouring village for assistance.

National laws

Most of our Pacific countries have acts within our laws that protect various parts of the natural environment, such as the Wildlife Protection Act, the Environment Act and the Fisheries Act. These acts and their associated laws are put into place by our governments and are designed to protect, conserve and manage the variety of natural resources that we own.

Examples of national laws

1. Under the Wildlife Protection Acts of many Pacific countries, it is against the law to export certain animals and plants without a specific permit to do so, e.g. dolphin.
2. Under the Environment Acts in many places it is illegal to dump waste in a manner that will result in environmental pollution.
3. Under many different Fisheries Acts the activities of commercial fishing are controlled so avoid over-fishing.

National laws are important, but they sometimes fail to be effective because of a lack of community awareness of the law, or a lack of enforcement. For example, a national law may be passed to protect the natural bush on the side of a river from being removed. If the government agency responsible does not have the staff or resources to visit affected rivers, and investigate and enforce penalties on people who have broken the law, then it is likely that the law won't be followed and will not be effective. Unfortunately, this is the case with many national environmental laws in Pacific countries.

Regional laws

Like-minded countries that share a concern about a certain issue may agree to work together or to make a commitment to each other to take action. For example, many countries have made a commitment through the U.N. *Convention on Biological Diversity* to create policies and laws within their own countries to ensure that their biodiversity is protected. There are many examples of international and regional conventions that require the member countries to take appropriate measures to protect the environments, animals and plants of their own country.

The conventions are legally binding on the member countries and they must comply even by changing their national laws, if necessary. Conventions are usually enforced by international pressure, so by not following the rules of a convention a country could find itself without the support of other countries in the area, or without access to funding support.

Examples of conventions in the Pacific:

1. *Convention for the Protection of the Natural Resources and Environment of the South Pacific Region, Noumea, 1986* – This convention is the most significant convention in operation in the South Pacific because of the broad duties it places on its member countries to protect the marine and land environments. It covers pollution control, nuclear testing, seabed activities, airborne pollution, storage and disposal of toxic and dangerous substances, mining, coastal erosion, protecting rare and threatened flora and fauna, and preserving fragile ecosystems.

2. *Convention on Conservation of Nature in the South Pacific, Apia, 1976* – This convention is concerned with the creation of protected areas and national parks, as well as restricting the use of these areas for commercial profit.

3. *Convention for the Prohibition of Fishing with Long Driftnets in the South Pacific, Wellington, 1989* – Under this convention each country must ban the use of driftnets by any citizen or vessel covered under the country's laws.

4. *Convention of International Trade in Endangered Species of Wild Fauna and Flora (CITES), Washington, 1973* – This convention is concerned with ensuring that trade in wild animals and plants does not threaten their survival. To find out more about CITES see boxed text 'Laws to protect animals and plants involved in trade' on p. 116.

International and regional conventions can be effective in guiding the development of national laws and policy. However, they are also limited by the capacity of the country to put them into action. International donors such as the United Nations often provide funds and training to developing countries to increase their ability to meet their obligations under the conventions that they have agreed to.

Politicians have a role in making Laws

Convention on Biological Diversity

The Biodiversity Convention is an international agreement that was signed by 157 countries at the International Environmental Summit in Rio de Janeiro, Brazil, in June 1992.

- the conservation of biodiversity
- the sustainable use of its components
- the fair and equitable sharing of benefits arising from the use of genetic resources.

Parties to the Convention must agree to undertake measures relating to:

- in situ (in its original place) and ex situ (away from the natural habitat) conservation
- sustainable use of biodiversity
- incentives to encourage conservation and sustainable use
- improved public understanding of biodiversity and the need for its conservation
- access to and transfer of relevant technologies
- the provision of financial resources to encourage developing countries to implement the Convention provisions.

Activity 3
Looking at Laws

Suggested Timing
Teacher preparation time: 40 minutes for reading
Lesson time: 90 minutes

Subject Areas
Language Studies, Social Science

Glossary Words
Law-making, laws, consequence, draft law, customary

Materials
- Paper
- Marker pens
- Coloured pencils

Teachers' notes:

Students who have access to non-government organisations and government offices that deal with policies, laws and regulations could be asked to conduct research and collect laws and regulations on plant and animal protection.

The students' research could be used to begin the class discussion on biodiversity laws and regulations.

Activity summary

This activity will help students to identify laws that are in place in their country. They will gain an understanding of why we need these laws and what governments and local leaders are doing to protect our plants, animals and their habitats.

Outcomes

Students will be able to:

- Identify laws that protect Biodiversity (plants, animals and habitats) and make further suggestions for laws, with supporting reasons.

Tuning in

Start the activity by running a short introductory activity. Tell the students that there are many rules and laws in our lives. Rules exist in games and sports, at home and at school, and we even have rules when we play with our friends.

1. As a class, create a list of games that students know such as naughts and crosses, snakes and ladders, or an outside game such as soccer or hopscotch. In pairs, ask your students to record the rules for one of the games. Each pair should draw a picture of what might happen when one of the rules is not followed.

2. Ask students to write captions for their drawings that explain the possible reasons for games having rules. Possible responses include the following.

- *So it is fair for everyone.*
- *So that everyone has fun.*
- *So that nobody gets hurt.*

Explain to the student that the rules, which the whole of society must live by, are called laws.

Developing understanding

1. Read to the class the example provided below, 'Poison Rope Fishing', or choose a topical article from your local newspaper.

2. Divide the class into small groups. Give students a list of people who might be affected by or interested in a solution to the problem of poison rope fishing (e.g. fisherman, chief, villagers, local council member, environmental activist, wildlife protection officer, etc.).

3. Have each group choose a different individual from the list above and work out:

- Their view about the issue
- Arguments or reasons to support their view
- A law or laws that provide a solution to the problem.

Have one student from the group record the groups findings.

4. When each group is ready, ask them to present their findings to the rest of the class. Ask them to give reasons for their opinions about the need for the law and how it would work. Also have them consider the practicalities of introducing the law or solution.

5. Record each groups' suggestions on the blackboard. Then as a whole class, vote for the best solution from the list.

Poison Rope Fishing

A local resident described a developing problem in our community. The resident, who declined 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!"

Use concept

Have students work individually or in small groups to draft a law, in detail, that will provide a solution to the problem of poison rope fishing. Make the law as clear and simple as possible. When drafting the law, ask students to think about and write down answers to the following questions:

- What is the title of the law?
- What are the details of the law? What will it achieve, and how will it achieve this?
- Why do you think this law is necessary? How does this law help to support the protection of local biodiversity? What are the issues/problems it will address?
- What will be the consequences of breaking the law?
- Who will be responsible for enforcing this law?

Application

Ask the students to think about and write down other laws that could be used to help protect biodiversity in their local area. Encourage students to think about actions that cause damage to biodiversity in their country such as logging of forests, over-fishing, trade in wildlife and pollution by big companies etc., and create a law that may help to prevent or reduce this damage.

Extension

If you have the time, you can carry out a role-play that demonstrates how governments or chiefs consider proposed laws. Use one of the laws suggested by the students and consider it through a mock parliament or community meeting. You will need to research the process in your own country if you do not already know it. Encourage students to debate the proposed law and help them understand how proposals for laws are considered by parliament or by chiefs.

Green Peace campaigners protesting about unsustainable forest clearing in PNG

Topic

4

Biodiversity Conservation Organisations

Background Reading

The job of protecting biodiversity is something we all must take responsibility for if we are to ensure a sustainable future for our children and grandchildren. We all take responsibility in different ways, but some people devote much of their lives to protecting biodiversity through their choice of study and career.

There are many people and organisations that are doing great work, both in the Pacific and around the world, on the protection of biodiversity and conservation of the environment. It is important for students to know about these organisations as a resource for projects they may wish to become involved in at some time in their lives but also as an opportunity for a choice of career in the environmental sector. The following profiles provide some background to a few of the more prominent environmental organisations or non-government organisations (NGOs) in the Pacific.

Profile: National Trust of Fiji

The National Trust of Fiji is an organisation devoted to conservation of the resources that belong to the people of Fiji. It was created in 1970 by the N*ational Trust of Fiji Act* to provide for the protection of Fiji's natural, cultural and national heritage. Its primary purposes are the preservation of historic and natural resources, the promotion of and increase in value of amenities to those resources, conservation of flora and fauna, and the provision of access to the historic and natural resources for the public.

Goals

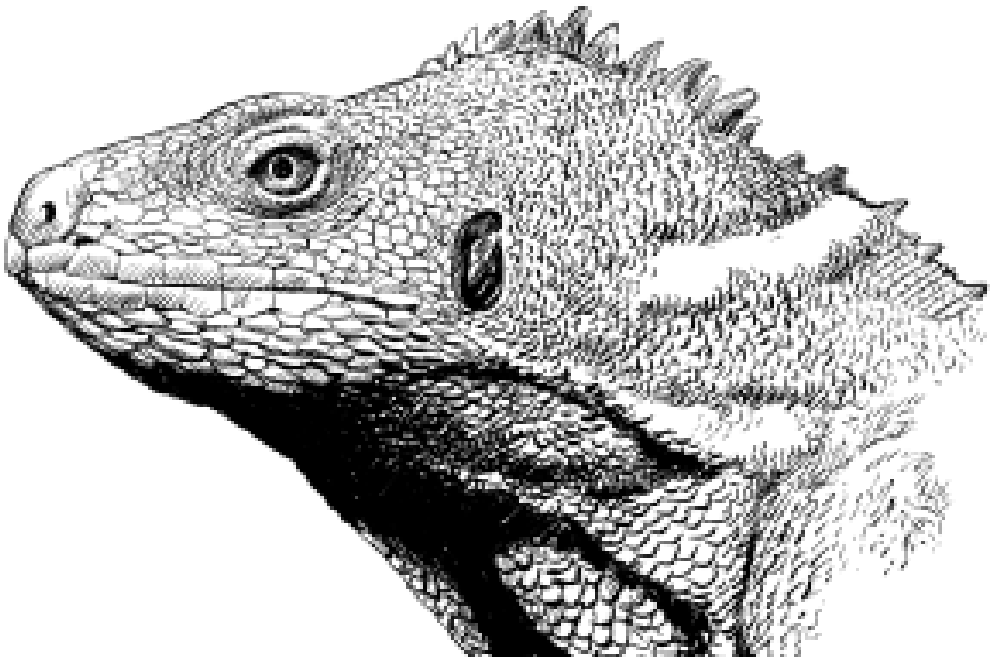
- The National Trust aims to be the leading institution in the protection of Fiji's heritage, including sites of natural, cultural, and scientific significance and outstanding beauty, while carrying out research and management of areas containing rare and endangered species of flora and fauna.

Objectives

- Several key policy objectives of the Trust are: cultural and natural heritage protection; heritage awareness; local community involvement; capacity building, policy frameworks for integration of heritage conservation into development policies, and partnerships.

Work done by the National Trust of Fiji

- The National Trust of Fiji administers six national parks designated as areas of outstanding national beauty. This includes the following:
  - Koroyanitu National Park, Nadi Area, Viti Levu
  - Sigatoka Sandunes National Park, Viti Levu
  - Bouma National Park, Taveuni, Northern Islands
  - Lovoni Trail, Ovalau, Lomaiviti Group
  - Nausori Highlands, Nadi Area, Viti Levu
  - Colo-i-Suva Forest Reserve, Suva, Viti Levu
- The Trust is also responsible for the conservation of the Fijian crested iguana. This includes the management and protection of the Crested Iguana Sanctuary of Yadua Taba.



Profile: World Wide Fund for Nature

The World Wide Fund for Nature is a non-governmental conservation organisation serving countries around the world including the Pacific Island countries. It was established in the Pacific in 1990 in an attempt to work effectively in the region. It is managed from a regional base in Suva, Fiji. It organises conservation field projects, policy reviews and campaigns in different Pacific Island countries. Country program offices have been established in the Cook Islands, Fiji, Solomon Islands and Papua New Guinea.

Vision

The general vision is that the ecological processes and biodiversity of the Pacific's islands and oceans are conserved and managed in a sustainable manner so that future generations are assured natural resources to meet their needs and sustain their lives.

Goal

To support Pacific Island people to conserve and sustainably manage our natural inheritance for present and future generations.

World Wide Fund for Nature's Mission: Living in Harmony with Nature

- Conserving the world's biodiversity
- Ensuring that the use of natural resources is sustainable
- Promoting reduction of pollution and wasteful consumption

What World Wide Fund for Nature does

- Climate Change program
- Forests program
- Freshwater program
- Marine program
- Species program
- Sustainability program

Examples of work done in the Pacific

Forest conservation

World Wide Fund for Nature organises legal and technical advice to customary landowners who wish to challenge logging agreements or companies. It also promotes sustainable choices to large-scale logging and big plantations, assisting communities with land to establish projects that combine conservation and income generation through tourism, furniture making and small-scale timber production.

Marine conservation

World Wide Fund for Nature helps local communities and governments develop better ways to manage marine resources that are close to the coast.

For example, World Wide Fund for Nature, Solomon Islands, concentrated its efforts on community-based conservation work with Gizo Island and Tetepare Island communities. This involved establishing marine protected areas (MPAs), and the Tetepare Descendants' Association (TDA) initiated a community-based Turtle Conservation and Monitoring Program.

Profile: IUCN/World Conservation Union

Source: *www.iucn.org*

The World Conservation Union is the world's largest conservation network. The Union brings together 83 States, 110 government agencies, more than 800 non-governmental organisations (NGOs) and some 10,000 scientists and experts from 181 countries in a unique worldwide partnership.

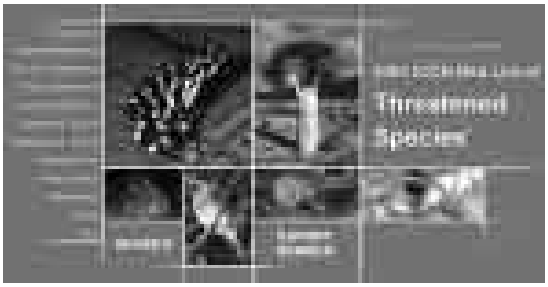
Mission

The Union's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

Work done by the World Conservation Union

The priority of the Union's current program (2005–2008) is to build recognition of the many ways in which human lives and livelihoods, especially of the poor, depend on the sustainable management of natural resources.

- Monitoring the state of the world's species through the IUCN Red List of Threatened Species
- Contributing to and supporting the Millennium Ecosystem Assessment
- Convening multi stakeholder events such as the World Parks Congress in 2003
- Disseminating the Union's knowledge and expertise through the World Conservation Bookstore
- Giving policy advice and technical support to governments, UN organisations, international conventions and other groupings such as the G8 and G7
- Assessing all new sites nominated for natural World Heritage Site listing
- Contributing technical assistance to prepare national biodiversity strategies and action plans
- Providing technical support for drafting environmental laws and natural resource management strategies
- Through the Water and Nature Initiative, working with 80 partners in a five-year global action plan in 10 water basins
- Through the Forest for Life Strategy, promoting wise management through guidelines for fire prevention and community management of forest resources
- Working with the corporate sector on energy and biodiversity, and mining and protected areas
- Facilitating Parks for Peace between countries in areas of conflict



Profile: Greenpeace

Source: *www.greenpeace.org.au*

Greenpeace is an independent organisation campaigning to ensure a just, peaceful, sustainable environment for future generations.

Our core values

Non-violent direct action

Greenpeace uses non-violent direct action to confront industry and force it to abandon destructive practices, raise awareness, create urgency and apply pressure for change. We also use other campaigning methods to help industry help itself, by developing safe and profitable alternatives to destructive processes.

Independence

We refuse money from governments or corporations, leaving us wholly independent, free to protect the earth and expose environmental crimes. Voluntary donations by individuals are the backbone of Greenpeace fundraising.

Bearing witness

We follow the Quaker tradition of bearing witness. Our peaceful protests raise awareness and bring public opinion to bear on decision-makers.

Communication

Greenpeace has always sought the best way to reach the widest audience and communicate our most urgent message – the environment needs action. Our first crew included two journalists and a photographer. Today our ships are equipped with technology to beam instant satellite images around the world and our websites allow millions of activists to take action online.

Greenpeace Australia Pacific campaigns to:

- stop climate change
- promote sustainable fishing
- say no to genetically engineered foods
- protect ancient forests
- save the whales
- end the nuclear threat
- create a peaceful future
- save deep sea life.

Profile: Conservation International

Source: *www.conservation.org*

Values

CI's work is inspired by the core values that have been with them since day one: passion, respect, integrity, optimism, and courage.

- CI is **passionate** about nature and cherishes the diversity of life from the sea bottoms to the mountain peaks.
- CI **respects** and trusts each other, and they embrace the diversity of our cultures, talents and experiences.
- CI makes every decision with **integrity** and is accountable for the choices they make.
- CI is **optimistic** that life on Earth can be preserved and that with their partners they will witness unprecedented successes in conservation.
- CI has the **courage** to take bold action in the face of naysayers and critics, to persevere through challenging times, and pursue their vision tirelessly and with enthusiasm.

Strategy

CI are innovative problem-solvers. Their work is based on cutting-edge science, comprehensive partnerships and concern for human well-being. With these three principles guiding them, they safeguard valuable species, preserve the most important landscapes and seascapes, and support communities that care for and rely on Earth's natural resources. To reach these goals, they focus on three strategies: dedicating themselves to innovation, raising awareness about conservation, and maintaining business-like effectiveness.

The Future for Life Campaign aims to reach concrete, measurable targets. The campaign goals are to:

- Save species in the most biologically diverse and irreplaceable regions of the world, which contribute to the vital balance of all living things.
- Conserve landscapes and seascapes – from tropical forests to crucial coastal habitats – to support human well-being, biological diversity and natural resource preservation.
- Empower local communities to ensure that responsible and effective use of natural resources happens around the world, for the benefit of local people.
- Develop innovative methods to address issues such as climate change, human well-being and corporate best practices.
- Raise awareness of a conservation ethic and build a shared mindset in governments, development institutions, corporations, partner organisations and local communities.
- Guarantee effectiveness by developing a robust organisational infrastructure to support CI's work at home, in the field and around the world.

Where are Conservation International?

In the Pacific region, CI has offices in:

- New Caledonia
- Papua New Guinea
- Solomon Islands
- Philipines
- Samoa.

Activity 4
Looking After Biodiversity

Teachers' notes:

The extent to which your class can be involved in this activity will depend on your location. Rural classes without access to organisations or guests can still make use of the information in the profiles. It may be possible to send away for information, however this will need to be organised in advance.

Suggested Timing

Information from organisations to be collected/requested for in the weeks prior to the task.
Teacher preparation time: 40 minutes reading time
Lesson time: 45 minutes

Subject Areas

Social Science, Language Studies, Art

Glossary Words

National Trust, goal, vision, strategy, values, conservation organisations

Materials

- Organisational profiles – one for each group (see background reading)
- Exercise book or paper for writing questions
- Paper to use for posters (posters can be A4 or larger)
- Materials to create posters - coloured pencils, paint, magazines for collage or photographs
- Copies of worksheet (p. 174) if you conduct the 'show and tell' session or invite a guest speaker

Activity summary

This activity provides an opportunity for students to learn from and about people working in the conservation field. Where possible, firsthand information can be provided by guest speakers, however, it will also be useful for students to learn about some different organisations through the profiles provided in the background reading section.

Outcomes

Students will be able to:

- Identify various organisations and people that are responsible for looking after biodiversity and become familiar with the roles and activities of these organisations or individuals.

Tuning in

1. To begin this activity explain to the students that some people are employed by the government or other organisations that work to protect the environment. Discuss the following questions with the class:

- Why do you think people are employed to do these jobs?
- Why would people want to do this kind of work?
- What sort of work do you think these people are employed to do?

Discuss the idea that some people may choose a job that relates to the issue they care about. Then explain that in this activity they will be investigating some organisations that work towards conserving the environment and protecting biodiversity.

Developing understanding

2. Encourage your class in their groups to develop a set of research questions to use to find out about their organisation and present on their poster. These questions could include things like:

- Where does this organisation work?
- What kinds of biodiversity does it look after?
- What kinds of activities does it carry out?
- Who works for the organisation?
- Why is the biodiversity the organisation cares for important?

Pass out the organisation profiles (one profile per pair*) and explain the activity.

*You may like to create some of your own organisation profiles to add to those already provided. Try to write about local organisations that are in your area so your students can become familiar with them. Once the profiles are created, they can be kept and used when you run the activity in the future.

Give the students time to read their organisation profiles. Then tell them that each group will work together to create a 'Looking After Biodiversity' promotional poster or a job profile for this organisation to explain or highlight how this organisation and the people that work for it protect biodiversity.

3. Ask students to use their organisation profiles to try to find out the answers to the questions. (They might need to do a little extra research to find all the answers, if possible.)

Practise skills

4. Give the students the opportunity to create their 'Looking After Biodiversity' promotional poster. This can be done using a variety of materials (see materials list), with accompanying text.

5. Display the posters around the room and encourage the students to share their research with the rest of the class. This could be done as a 'show and tell' session where each group stands with their poster and they imagine that they work for the conservation organisation and informally talk about it and what they 'do'. This could be done in one lesson or you could have one group present each morning over a week.

6. In some areas, this activity could be extended to inviting a guest speaker from one of the conservation organisations to present to the class.

   Assist the guest speaker to make a relevant presentation by informing them what your class would like to know about. Prepare the class by developing ideas for questions that the students can ask the guest. During the presentation students can fill out the worksheet provided on p. 174.

   The worksheet on the next page, could also be filled out by students during the 'show and tell' session. Students could take notes on the displays, materials or information given by the teacher to fill in the worksheet on biodiversity laws and regulations.

Reflection

Have the students write a short reflective piece in their exercise books or journals using the following as starter:

'The organisation I found most interesting is…….. because……..'

Invite students to discuss and share their thoughts with the class.

Worksheet: Looking after Biodiversity

Who am I?

Where do I work?

What kinds of biodiversity do I look after?

The biodiversity I look after is important because……

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

Topic

5

Environmental Issues Facing the Pacific

Background Reading

The Pacific Islands face many environmental problems; some are local issues and others are the result of global problems shared with other nations around the world.

A number of factors contribute to the particular types of problems we are facing in the Pacific today. Many of our communities exist on small islands, where our increasing populations put greater pressure on our limited ***resources***. Poor management of natural resources in the past and today is leading to their reduction. For example, unplanned development in many areas has led to land clearing, ***habitat*** loss and ***pollution*** problems.

Some global environmental problems are largely caused by the activities of developed countries that use enormous quantities of resources and create pollution, such as greenhouse gases that impact on the entire planet. However, it is developing countries and small islands in particular who are vulnerable to these environmental problems.

We have a growing pressure to be part of a globalised ***cash economy***, which is creating demands to use our environments and resources in new ways. The greenhouse effect and global warming has a particularly serious impact on islands, where coastal communities, coral reefs and freshwater supplies are vulnerable to sea-level rise, and changes in temperature, rainfall and frequency of extreme weather events such as cyclones.

It is important for students to become aware of the particular issues being faced in the place where they live. Young people have the energy and the foresight to be a driving force behind the changes that need to be made in order to address these issues. It is the young people who will inherit the environment of the future and live with the consequences of the decisions that are made today.

Common environmental problems in the Pacific

Further information about each of the issues below can be found in Module 3, 'Biodiversity: Understanding the Threats'.

Reduction in the quality and availability of water

Water is essential for life, both for humans and the other living things with which we share the Earth. People require clean water every day for drinking, cooking, washing, bathing and agriculture. However, water ***ecosystems*** also support an enormous diversity of plant and animal life, many of which we also depend upon for food.

Human activities can reduce the quality of water by introducing pollutants, or alter the availability of water by diverting it for agricultural use. They might plant certain crops (such as oil Palm), which reduces the amount of run off.

Common causes of water ***pollution*** in the Pacific include human waste, agricultural run off, industrial waste and rubbish. Human wastes may carry disease-causing micro-organisms, such as bacteria and viruses. These may enter water when bush toilets are too close to a river or water supply. Serious diseases such as cholera, typhoid and diarrhoea can be passed on in this way.

Nutrient pollution is another serious threat to rivers, wetlands and reefs of the Pacific. Nutrients are found in fertilisers, detergents, and human and animal wastes. They impact waterways by causing increased growth of water plants and algae, which can take over from other organisms. Nutrient pollution is one of the most serious threats to coral reefs.

Rubbish is also a problem in the environment. Some rubbish, such as batteries, contain chemicals harmful to living things in aquatic environments. Other rubbish, such as plastic bags, take a long time to break down and may harm fish and turtles, which can become entangled in them or accidentally eat them.

Erosion

When land is cleared it becomes susceptible to ***erosion***. The underlying soil may become exposed, and in heavy rain it can be washed away. This reduces soil fertility and causes problems for waterways that receive the muddy water. The soil may eventually end up on our reefs where it can smother the coral and introduce extra nutrients that promote the growth of algae.

Deforestation (the loss of our forests)

Deforestation is increasing worldwide as demand for timber and timber products rises. Increasing demand for land for various different kinds of development is also contributing to forest clearing. Larger populations require more land for farming, agriculture and urban areas. The loss of our forests impacts on the plant and animal species that live there, and our ability to make use of these valuable resources.

Other issues associated with deforestation include:

- Increased soil erosion and reduced productivity
- Loss of wild plant and animal foods, medicines and building materials
- Loss of cultural history and traditional sites
- Loss of opportunities for economic development through sustainable (selective) logging
- Loss of opportunities to develop tourism
- Reduction in water quality.

Over-harvesting of particular species

Over-harvesting refers to taking too many individuals of an animal or plant species from nature for use. If too many of a species are taken, then the remaining individuals may be unable to reproduce and the population will decline. Over a period of time this can lead to ***extinction***. This can also have flow-on effects through an ecosystem.

For example, if the numbers of a ***predator*** decreases then it may cause a rise in the number of the prey species that the predator normally feeds upon. A drop in the availability of prey can also cause a decline in the number of predators. Over-harvesting of predators or prey leads to other changes that we may not fully understand.

Sadly, there are many examples of over-harvesting of Pacific wildlife that have lead to serious declines. Examples include marine turtles, cuscus, birds of paradise, giant clams, green snail, fruit bats, pigeons, ***trochus***, coconut crabs, megapodes and conch shells.

Activity 5
Investigating Issues

Suggested Timing

Teacher preparation time: 60 minutes reading and gathering resources relevant to local area if available
Lesson time: 60 minutes

Subject Areas

Social Science, Language Studies, Science, Art

Glossary Words

Cash economy ecosystem, resource, habitat, deforestation, extinction, over-harvesting, pollution, erosion, deforestation, predator

Materials

- Poster paper
- Cardboard
- Marker pens
- Glue
- Pictures from magazines
- Costumes (if the educational performance is completed)

Activity summary

This activity will lead students to identify and understand various environmental issues, particularly those relevant to their local area. Students will have the opportunity to develop and use their critical thinking skills in order to talk about possible solutions to the identified problems.

Outcomes

Students will be able to:

- Identify and investigate some local environmental issues and suggest strategies to address the issues.

Tuning in

1. Begin this activity by leading the students in a discussion about any environmental issues that they know of either locally or globally. They may need some help to start this – use the information provided in the background reading section. List their answers on the board.

Developing understanding

2. Break students into groups of three or four and ask each group to choose an environmental issue to work on from the suggestions gathered during the tuning in session.

Issues could include:

- Deforestation (the loss of our forests)
- Over-harvesting of particular species
- Water pollution
- Soil erosion
- Damage to reefs
- Poor rubbish disposal
- Increasing human populations.

3. In their groups, ask the students to write down answers to the following:
   a. What are the causes of the environmental issue?
   b. Where is it a problem?
   c. Why should we be concerned about it?
   d. What can we do about it?

Practise skills

4. When the groups are ready, ask them to share their ideas with the whole class. Provide assistance to each group by encouraging students to offer additional suggestions and ideas.

5. When you are comfortable the groups have enough information, ask them to develop an education campaign consisting of:
   a. an educational poster
   b. a slogan or jingle about the issue. (A

Tell your students that, before designing their posters or jingle, they should decide who their audience is. For example, they could 'target' a particular age range (peers, parents, young children or older people in the community) or a particular interest group (farmers, churchgoers, fisherman, mothers, government officers or tourists). They should also decide what their message is and whether they need examples to illustrate their message. Explain that by doing these things first they'll find it easier to come up with an interesting and effective campaign.

Before the students begin, ask them to think about characteristics that make educational posters and slogans effective. Among other things they should:

- Have a clear message or story
- Relate the message or story to something relevant or important to the audience
- Be attractive, clever and interesting (the poster) and be catchy and fun (the jingle) to grab peoples attention
- Connect to people's values and what they care about.

Application

6. Place the posters around the school as part of an education campaign to teach others about these issues.

7. Each group can also teach the class their jingle or rhyme as a way of promoting awareness about the issue.

8. Have each student stand up and tell the class something they learnt from one of the posters or jingles.

Extension

If time permits, help the students to script and prepare a short play or a speech about the environmental issues covered and perform it to other classes in the school. Have the play include the promotional jingles so other classes can sing/chant them too.

Topic

6

Personal Action to Protect Biodiversity

Background Reading

Recent studies have suggested that 60% of the ***ecosystems*** that support life on Earth will be severely damaged by 2050 if we continue living as we do now. There has never been a more urgent time to start making changes to the way we use the environment to ensure it can still provide for us in the future. Maintaining biodiversity is a very important part of keeping ecosystems healthy.

The daily choices that we make in our lives have an effect on the environment and on biodiversity. Some of these choices have direct links to biodiversity; others are indirect, but are no less important.

Catching fish, cutting wood, hunting, and disposing of rubbish are all directly linked to biodiversity. When we do these activities we need to consider the long-term impacts of our actions. For example, we can choose to fish with destructive methods, such as using poison or smashing coral, or we can use other more gentle methods that catch fish but don't destroy fish habitats. We can choose to throw our rubbish in a river or we can make the effort to dispose of it in a less harmful way, such as in a rubbish pit or bin.

Our indirect impacts on the environment include what we decide to buy or use, and what activities we support in the community. For example, we can choose to buy products that are locally made and don't come with excess packaging, because these products lead to extra waste. The products and services that we use are often connected with environmental impacts, therefore, it is important to understand these connections so we can make informed decisions. Choosing to avoid products or services that create environmental impacts can be very powerful. When multiplied, the power of many peoples' individual choices can put pressure on companies and governments to become more environmentally aware.

We can also make a positive difference to the environment by deciding to become involved in the decisions that are made in our communities.

We can speak to our community leaders, chiefs, government representatives or the media to offer suggestions and voice our concerns about environmental protection.

People have a lot of power to change and destroy environments, but people also have the power to protect and conserve the environment and biodiversity.

Some environmental problems might seem too big for us to take on by ourselves, but the collective power of many individuals acting together should not be underestimated – it can change the world. 'Think Global, Act Local' has become the catch cry of environmentalists and concerned citizens from across the world. Our own communities or our school grounds are a great place to take up the challenge of biodiversity conservation and securing a better future for everyone.

Many people and organisations from around the world are trying to conserve biodiversity and look after the environment. However, there is still a long way to go. What can you and your students do to help protect biodiversity?

1. **Reduce, reuse and recycle.** Try to reduce the amount of materials that you buy that will become waste. Packaging, such as plastics, can be reduced by purchasing local produce from markets and by saying no to plastic bags when you go to the store. Many items can be reused many times, which reduces waste and saves money. Plastic drink bottles, jars, bottles and plastic bags can be reused. Try to ***recycle*** things such as glass, aluminum or paper. Some larger towns have places where you can take them.

2. **Make compost.** About two-thirds of ***urban*** rubbish is made up of things that will rot away naturally in the garden. This is called ***organic*** or ***biodegradable*** waste. You can make a ***compost*** heap where you can throw all your organic waste – fruit and vegetable matter, garden scraps and fallen leaves, but not meat or fat scraps. The compost will rot down and form very fertile soil, which can be put on the garden to improve the growth of plants such as vegetables.

3. **Look after your water.** Every living thing needs clean and healthy water, therefore, we must make sure water is protected. Never dispose of your rubbish in the river, and don't wash your clothes or car close to the river. Instead cart the water away to prevent detergents from entering the river. Never empty paint, oils or other chemicals into rivers, and make sure your bush toilets or animal pens are built far enough away so that your waste does not get into waterways.

4. **Don't clear too much bush.** When your family is clearing land for gardens or houses, encourage them to keep some patches of bush as wildlife habitats and to leave old trees standing, especially those with hollows suitable for nesting animals. Try to reuse old garden sites where possible, instead of clearing new ones. Places such as mangroves, wetlands, reefs, rainforests and grassland are delicate habitats and provide important homes for ***native*** animals, so try to leave some of these places around your community undisturbed.

5. **Fish responsibly.** Don't use destructive fishing methods such as those that use poisons, poison ropes or explosives. These methods also kill other ***organisms*** from the ecosystem, including the coral reef building organisms. Fishing methods that involve smashing coral in order to scare the fish out of their hiding places or to collect shellfish have long-lasting damaging effects on reefs.

6. **Dispose of your rubbish responsibly.** Make sure any rubbish that cannot be recycled or composted is disposed of properly. In the villages this means buried in a safe area that won't harm the environment, humans or wildlife. Crushing cans, tins and bottles reduces the space they need and makes disposal easier. Do not burn your rubbish as it can release harmful chemicals. Never throw rubbish into the river or the sea as this causes harm to the water supply and reefs. Separate toxic waste, e.g. batteries, for special disposal.

7. **Control your pets.** Roaming pets can cause problems for native animals. Dogs bother and even kill native animals, and cats are efficient hunters and kill birds and lizards. Don't let the number of pets you have get out of control. If possible, ***de-sex*** your pets so they don't have unwanted babies. Did you know that in its lifetime it is possible for one cat to have more then 100 kittens?

8. **Talk to your grandparent or another elder in your community.** They can teach you a lot about your local environment. They may know a lot about native plants and animals, as well as ***traditional*** medicines and custom stories about plants and animals that live in your area. Traditional knowledge about biodiversity may be lost if young people do not have opportunities to learn from their families. Make sure that you follow rules put in place by chiefs or local authorities to protect wildlife.

Cats are good hunters and kill many birds and lizards

Activity 6
Personal Pledge

Suggested Timing

Teacher preparation time: 45 minutes
Lesson time: 45 minutes to determine the pledge. Ongoing monitoring.

Subject Areas

Social Science, Language Studies,

Glossary Words

Ecosystem, recycle, compost, de-sex, habitat, pledge, urbanisation/ urban, organic, biodegradable, organism, traditional

Materials

- Paper and pens
- Butchers' paper or blackboard
- Pledge sheets

Teachers' notes:

If you would like to get involved in a project to help protect biodiversity, there are a number of suggestions for schools' action projects in the Getting Involved, section at the end of this module, see p. 184.

Activity summary

In this activity students get the opportunity to analyse the contribution they personally make to biodiversity decline and consider the options that they can take to minimise the effect that they have as individuals.

Outcomes

Students will be able to:

- Analyse their individual role in contributing to environmental impacts and devise personal actions for conservation.

Tuning in

1. Challenge students to reflect on their past behaviour towards the environment, however, be careful not to make them feel ashamed or singled out. Ask students to raise their hand if they have ever thrown their rubbish on the ground or out of a bus window. (Also raise your own hand if you have ever done this.)

Repeat this exercise by asking other questions such as:

- Have you ever burned plastic wastes or tyres?
- Have you ever thrown rubbish in a river?
- Have you ever broken coral to catch fish or shellfish?

2. Hold a class discussion about the results of your class survey. How do these behaviours impact on the environment? Who is responsible for these impacts? Why do we do these things if we know they are bad?

Developing understanding

3. Divide the class into groups of four or five. Ask the students to discuss and write down a list of ways in which they or other people impact on their environment.

4. Ask a representative from each group to report back to the class about the ideas their group came up with. List all ideas on the board or butchers' paper.

Use concept

5. From the list of impacts on the board ask each student to choose one they think they can do something about reducing. Then introduce students to the concept of making a 'pledge'. A pledge is a promise to yourself to take personal action or make a change in your life. Hand out copies of the pledge sheets or ask students to copy the pledge sheet onto a piece of paper, then give students time to fill them out. Assist students to identify a pledge that is achievable and specific; discourage pledges that are too general, such as 'I will look after the environment' and encourage specific pledges such as 'I will not throw my rubbish on the ground.' When they have completed the sheets, collect them and keep them in a safe place.

Explain to the students that they need to make a commitment to the change they have identified. The idea is that this learning will go beyond the classroom and have no time constraints – the best scenario is that the students make a behaviour change that they can continue throughout their lives. Regular feedback will be necessary to check on how the students are going in their aim to change their behaviours.

Reflection

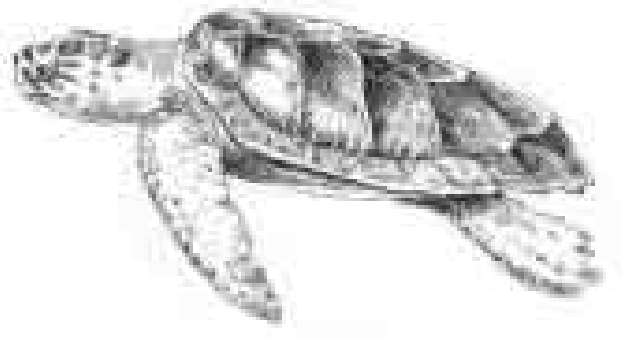
After one or two weeks, hand the pledge sheets back to the students and give them some time to reflect on their pledge and whether or not they achieved it. Set the students a writing exercise to reflect on their pledge. They should answer the following questions:

- How did I feel when I read my pledge?
- What were some of the difficulties in achieving my pledge?
- How did I feel when other people around me continued with the behaviour that I wanted to change?
- How will I keep my pledge in the future?

Allow students to keep their pledges at school or take them home. Schedule regular monthly feedback sessions for a while or whenever you feel it's a good time to remind students about their pledge. During these sessions ask the students to assess what is stopping them achieving their aim if they haven't been able to do it, and try to adjust that way they are going about achieving change in order to make it happen. It is a great idea to complete a pledge sheet yourself and report back to the students about your success and difficulties as well.

You might like to encourage your class to decide on a shared pledge, i.e. something that you will all try to do together, e.g. no students will bring their lunch or other things to school in a plastic bag, or as a class we will try to reduce the amount of rubbish we create. Determine a plan to help you achieve this.

Pledge Sheet



My Pledge to the Environment and Biodiversity.

I promise that I will try to reduce my impacts on _____

_____

_____

_____

_____

_____

_____

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by trying to:

1. _____
2. _____
3. _____

Signed _____

Print your name _____

Getting Involved

Hands on for biodiversity

Your students have now tried a number of biodiversity activities and learned about ways individuals, organisations and governments in the region are helping to protect biodiversity. They're ready to apply the skills and knowledge they've gained to action projects in their own community.

This section provides a detailed guide for six 'Schools' Action Projects' that your students can become involved with. It also includes ideas for many other simple and effective schools' action projects that your students can easily develop and undertake by themselves.

Planning an action project

There are dozens of different types of projects that your students might be interested in that will help them to learn more about biodiversity and, at the same time, address a local or national problem. Some projects might focus on teaching others about environmental issues. Some might help to actually improve the environment, such as a re-planting projects or a clean up day.

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

Choose a topic for your project to focus on

You and your students can get some ideas about environmental issues through information supplied in this resource, particularly Module 3, 'Biodiversity: Understanding the Threats' or by collecting information from newspapers or other media, interviewing community members and parents, or contacting organisations and government agencies that focus on environmental issues. You can also encourage students to explore their community and identify problems firsthand.

Encourage students

When planning the action project, encourage student ownership and initiative. The more students are involved in the project, the more they will get out of it. As much as possible, allow students to make their own decisions. It is also important to help students to appreciate the value of their work. Students need to know that their project, no matter how small, is valuable.

Set a goal

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 the action project? Set goals that can be accomplished. Do not take on projects that are beyond the available resources and time.

Think about timing

What is the timeline for the project, such as the approximate start date and ending dates? Can it fit into your school term or school year. Does it fit in with other plans?

Map it out

Before getting started, think about the specific steps or tasks that need to be accomplished to help meet the objectives of the project.

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 materials if required.

Promotion

Think of ways to promote and generate support for your project, from within your school or the wider community. Conflict can sometimes occur when students interact with community members or parents who don't agree with a specific activity or who don't feel that action projects are an appropriate educational approach. In many cases you can prevent this by discussing projects with parents, school members and community members and by explaining how environmental projects enhance the children's learning.

Evaluation

How will you know if the project has been a success? And that the students' knowledge has increased? Taking time to evaluate a project helps students to understand what they've accomplished and allows them to recognise how their project has assisted their personal growth. Don't just evaluate at the end: encourage specific methods for monitoring success as the project develops.

Source: Adapted with permission from WWF, Windows on the Wild: Biodiversity Basics. Educator's Guide to Exploring the Web of Life.

Action projects can make a big difference – not only to the environment but also to your students. By taking action and contributing to a school or community project, your students can feel a sense of accomplishment and satisfaction.

We have included suggestions and guides for six Schools' Action Projects in this section.

- Schools' Action Project #1 - Re-planting Project
- Schools' Action Project #2 - Litter Education
- Schools' Action Project #3 - Creating Compost
- Schools' Action Project #4 - Sup Sup Garden
- Schools' Action Project #5 – Reusable Shopping Bags
- Schools' Action Project #6 - Clean Up Day

Ideas for projects can come from many sources, including your own interests and experiences. The action projects are just examples of the many things you could get involved in.

Here are a few more suggestions of possible projects:

Develop and perform a play for the community – A play about a biodiversity 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 on biodiversity 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, with a specific target audience or media.

Do a school waste audit – Conduct ongoing surveys of the school's waste and document the results. Present the results to your school administration along with ways to reduce waste.

Organise a 'Biodiversity Day' – Organising a community event focused on biodiversity can help raise awareness about local, national and global issues. Team your school up with an environmental organisation and others to help coordinate a Biodiversity Day. The International Day of Biodiversity is celebrated worldwide on 22 May.

Participate in decision making – Students can learn a lot about the environment and learn citizenship skills by getting involved in issues faced by the local community. Students should study an issue from all perspectives and develop an opinion. They may need to contact organisations, request information, write letters, conduct surveys, circulate petitions, build coalitions with other schools or groups, and make presentations.

RiverCare – Educate landowners and homeowners in your area about reducing impacts on waterways. Suggestions to improve the health of local creeks and waterways could include reducing the use of fertilisers and pesticides, planting a buffer zone of local plants along a creek bank, and cleaning up rubbish.

Remove an introduced plant species – Removing invasive and introduced plant species gives native species of plants and animals a chance to reclaim their former habitat. Contact your local environmental or agricultural organisation or government department for information about introduced and native plants in your area.

Survey the community about an issue – Students can find out how a community feels about an environmental issue by surveying people about their thoughts and points of view . The survey can also lay the groundwork for future action projects by identifying issues that people are most concerned about.

Start a school energy patrol – Saving energy conserves natural resources. Students can save energy at school by turning off lights and turning off computers or photocopiers when they're not in use. An energy patrol can remind students and teachers to conserve energy.

Test your local water – Water testing can be the first step towards discovering local water problems, so that people can decide what action is needed to solve those problems. Test water at several locations and compare the results to water quality standards. Some environmental organisations or government agencies can offer access to simple test kits and provide training for teachers on how to use them.

Schools' Action Project #1

Re-planting Project

There are many areas in our Pacific Islands that have been deforested. This can occur for a number of reasons and leads to many problems. To find out more about the effects of ***deforestation*** see the case study 'Large-scale Logging' in Module 4, Topic 2, p. 156.

Some areas are more prone than others to the negative effects of land clearing. For example, in very steep hilled areas, land clearing is more likely to cause major landslips and erosion.

River banks cleared of vegetation can create ***sedimentation***, when particles of soil wash into the water. This can cause problems for the river as well the marine area that the river flows into. Excessive sediments can kill marine plants and animals by smothering them or cutting off their access to light if the water becomes to muddy.

Coastal areas suffer too from loss of trees, such as when mangroves are cleared. When the coastal region has been cleared, the bare ground has no protection against our tropical storms or cyclones and will wash away.

The task: To carry out replanting in your area.

In New Zealand, 'Arbor Day' is celebrated on the 5 June which is also World Environment Day. This could be a good day to set aside for your planting. Arbor Day is an event that encourages tree planting and care and is celebrated in a number of countries. Check if there is an Arbor Day or Tree Day celebrated in your country

Before you begin

- You will need to have a source of seedlings or cuttings of native plants and trees to plant. When you are re-planting to help improve biodiversity 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 p. 188 for details.
- The class may need to start a plant nursery or collect cuttings prior to the planting day. See 'Tips for growing local seeds' on p. 189. A good source of native plant seedlings could be your

local forestry department. The time required for this will vary depending on what seeds you have put in and how fast they grow.

- It is important that the site you choose for planting is protected. Consider what or who might ruin your planting. Small trees and shrubs are easily killed by people walking or driving over them. Seek an appropriate agreement with your community if your area is accessed by others. Also consider roaming domestic animals and whether or not they are likely to eat your young plants after you have planted them. Your re-planting could be on your school grounds or in a nearby area such as a river bank.
- Select and prepare your site. Many sites will be infested with weeds and these will need to be cleared and monitored so they do not take over the area and your plants have space and light to grow. Do not clear back to bare ground if possible, and be very 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.

The job

- Get support and help if possible from your local community
- Plant the seedlings and cuttings with enough space between them so that they can grow (consider how they grow in the wild).
- 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.
- If necessary, rope or fence off the area and stake the plants.

Follow up

- Check the plants regularly and give them water when needed.
- When the planting has been successful, i.e. you can see significant growth, ask the community members who helped you to have a picnic near the area to say thank you and to celebrate your re-planting area.

Why Local Plants?

Local plants means the trees, shrubs and other plants that grow in the natural bush where you live and 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 the food-plants of the larvae of many different insects, which in turn are the food of 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.

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 contribute to the conservation of biodiversity by providing habitat and food for local wildlife.

In the months or weeks leading up to your re-planting project, keep a look out for plants that are producing seeds. Try to make sure the seeds are mature before you pick them, and when you are storing, try to keep them dry. An old envelope is a good thing to store seeds in; 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

1. Fill seed containers (old ice cream, butter or egg containers work well) with a light mix of soil and sand. Push down the soil mix firmly and gently. The mix should be about 1 cm from the top of the container. Water the mix.
2. Sow the seed. For fine seed, mix with fine sand and lightly sprinkle to spread seed evenly over the mix. Medium and large seeds can be sown by hand, spreading evenly and pressing seeds down into the mix.
3. Cover the seed with a thin layer of soil mix. Try hard to spread the soil evenly. A good guide is to cover the seeds with soil mix to a depth two to three times the size of the seed.
4. Water with a fine spray.
5. Write labels for each container, with plant name (common and local language) and sowing date.
6. 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 planted out into small individual pots. For this you will need a pencil-sized stick to help remove the seedlings from the tray.

1. 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.
2. Make a hole in the mix large enough for the seedling root system.
3. Gently remove the seedling from the tray with the stick, holding on to the leaves, not the stem. Try to disturb the roots as little as possible.
4. Place into the new pot, keeping the roots straight with your stick.
5. Push the mix around the plant firmly and water thoroughly.
6. Label the plant with its common name and local language name if you know it, and the date of planting.
7. Place in a partly shaded, sheltered spot and water regularly.
8. After a few weeks, move the plants gradually into a more exposed spot where they get some sun and rain.
9. After a few months, the plants will be ready to transplant into the ground.

Schools' Action Project #2

Litter Education

When it rains, where does the water that flows along the streets and down drains go? Many people in urban communities are not aware that the water in the drains goes underground in pipes and eventually empties into the sea. 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 and it also ends up in the sea.

People in rural areas also have problems with litter. Many people leave wrappers or plastic bags on the ground. Wind and rain mean that next time they look around, the litter is not there. But where does it go? Our litter does not just disappear; it gets blown or washed into our rivers and the sea.

Both urban and rural people need to be educated about littering. Here are two projects you can do. Choose the one that is most suitable to your area.

Part 1: Urban area drain stencilling

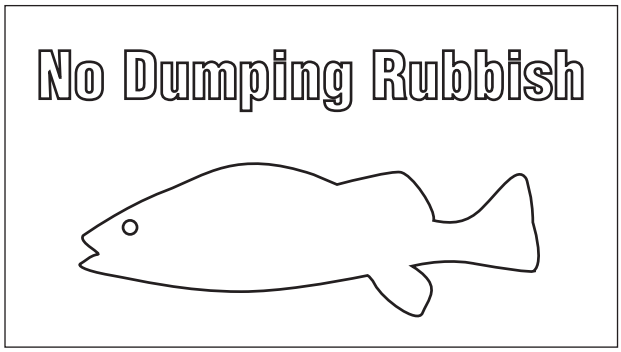
Drain stencilling can be a very effective way of educating people as they walk around the town or city. If your city has concrete drain covers, they provide an opportunity to inform people about the dangers of throwing their rubbish on the ground. Contact your local council to seek permission to carry out drain stenciling.

Materials

- Poster paper/thin cardboard
- Razor blades or a craft knife (take care when using a sharp instrument)
- Spray paint

Think of some short, catchy messages to tell people not to throw rubbish on the ground because it will wash into the drain and from there go into the sea. Make the slogans in your local language or pidgin so they are easily read even by people whose English is not very good. Try to think of a simple picture or symbol too.

Draw your slogan onto the cardboard in thick lettering, for example:



Cut along the lines to create a stencil. Cut out symbols, such as a fish shape or a drink bottle.

Lay the stencil very flat on the drain cover. You may need to hold it down with some rocks.

Very evenly and smoothly, spay paint over the stencil; be careful not to go over the edges of the cardboard. Remove the stencil carefully so you can use it again on another drain. Alternatively you could also paint the stencil using a brush. Rather then brushing try to dab the paint on; this will prevent you from using too much paint and ensure the stencil stays clear.

Part 2: Wall mural

A mural is an artwork painted on a permanent surface, such as a wall or 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. In rural areas we do not have the concrete drains to use as a place to put our message but we may have other places we can use to inform our 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.

Materials

- Exterior paints in various colours
- Spray can of sealer (if available)

1. 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.

2. On a large piece of paper, design a great picture of our reefs or forest to go with your slogan.
3. Draw an even grid over your design.
4. Draw another grid onto your mural wall to help you place the picture on the large surface in the correct proportions.
5. Draw the mural on the wall in pencil or chalk first.
6. Paint your mural and slogan neatly and clearly on the wall.
7. If available, spray the finished mural with clear sealer once it is dry. This will help protect the picture from fading and peeling in the weather.
8. 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.

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

Schools' Action Project #3

Creating Compost

Organic waste comes from animal and plant material. These wastes can be broken down into soil by the action of bacteria and returned to the garden. In most Pacific Island countries, organic wastes make up about 65% of the waste we throw away.

Making compost is a great way to safely get rid of our food and garden wastes without losing the nutrients that are stored in them. Dumping or burning 'green wastes' such as vegetable peelings and off-cuts, grass clippings and leaves is the same as throwing away packets of chips, noodles or sugar with some still left in the bag.

Compost is nature's way of breaking down organic material into usable pieces for plants and animals. This cycle of life is an important part of biodiversity.

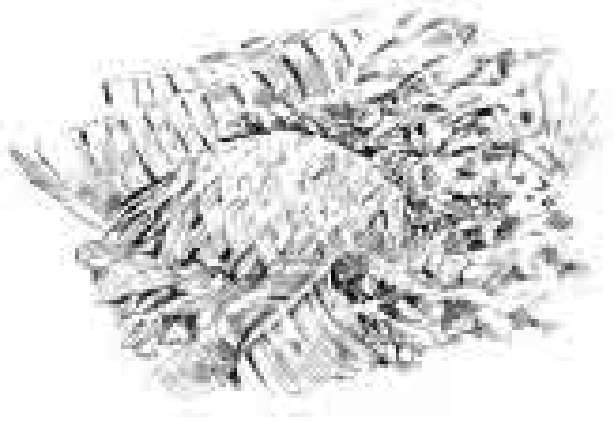
Compost not only reduces what is considered waste, it is also a very useful way to recycle organic material to make an environmentally friendly alternative to artificial fertilisers. Using compost instead of having to buy artificial fertilisers can help save you money. By selling compost for use by other gardeners or by providing composting services, you may be able to raise some funds for your school.

Before you begin

Organise for your students to bring a supply of household organic waste (e.g. vegetable scraps) for this activity.

- Read and discuss 'Nine simple steps to make compost' on p. 194.
- Select an appropriate site for the compost heap. The site must be convenient, have access to water and be located where it will not attract unwanted pests to your school.

Common household organic waste in the Pacific



The job

- Lay out the materials that have been collected for the heap and ensure that there are also sufficient leaves or dry yard wastes. Examine each material and decide if it is dry yard waste or green vegetable waste. Place these into two piles. Dispose of any item that should not be placed in a compost heap.
- Use a bush knife or spade to chop up the coarse leaves and yard waste into small pieces.
- Lay cardboard boxes underneath the heap. Explain that this will help to protect the groundwater from any liquid that drains or 'leaches' through the compost. Sometimes this can include substances that are not good for the soil.
- Create a 'frame' to contain the compost heap. This could be made with cardboard boxes or wire, old tyres or wood.
- Make the compost heap in layers as described in the nine steps on the next page.
- The compost is ready when the soil looks dark, has a clean smell and doesn't contain any identifiable vegetable scraps

Follow up

- Every two to three weeks you will need to remove the cover and mix the remaining compost. After adding water if the mix is too dry, replace the cover.

- It is important to monitor the moisture in the compost heap. If it is too dry it will compost very slowly, and if it is too wet it will get smelly.
- Now that you have the knowledge and skills required to make a compost heap, what will you do with this knowledge and skills? Make a commitment to start compost heaps at home, or conduct a training workshop to show other people in your community how to compost.

Nine simple steps to make compost

1. Firstly make a base 30 cm high and 2 m wide with coarse plant material such as small stems or coconut husks. This will ensure good air circulation and drainage.
2. Add a 10 cm layer of material that is difficult to decompose, such as dry grass or coarse leaves.
3. Add a 10 cm layer of material that is easily decomposed, such as fruit and vegetable scraps.
4. Add 2 cm of animal manure or old compost.
5. Add a sprinkling of top soil (soil collected from within 10 cm of the ground surface)
6. Very small amounts of ash can be lightly sprinkled onto these layers to accelerate the process of decomposition.

Create a 'frame' to contain the compost heap

7. Repeat all these layers except for the first layer of coarse material, until the heap reaches 1 to 1.5 m high. This can be done over time and may take several weeks.
8. Monitor the moisture level of the compost. It should be damp but not wet. If it is too dry, add water. If it is too wet, remove the cover when it is sunny and replace the cover to protect it from getting water-logged in the rain.
9. The heap should be covered to protect it against evaporation and heavy rain as this will wash away all the nutrients. Plastic sheets, thatch or banana leaves are suitable for this.

Source: Steps modified from 'Composting in the Tropics', HDRA - the organic organisation

Use banana leaves to cover your compost

Schools' Action Project #4

Sup Sup Garden

What is a sup sup garden?

Traditional bush gardens are usually located at varying distances from villages and are usually visited two or three times a week. Root crops grown in bush garden form the dietary staple of Pacific people and can be stored for a few weeks.

'Sup sup garden' refers to a small family garden, grown beside homes, that grows leafy greens. These gardens provide instant vegetables that can be cooked in a pot to make 'soup'. Sup sup gardens mostly use compost materials to add fertility to the soil. In the Solomon Islands, sup sup gardens were started to encourage people living in town to grow fresh food around their house to keep their diet healthy.

Growing a sup sup garden in your school is a great way for students to learn how to grow, harvest and prepare fresh food as well as get a better understanding of how the natural world sustains us. Sup sup garden projects also help to develop co-operative behaviour as all work can be done as part of a small group.

Having a sup sup garden also has benefits for biodiversity:

- By providing the necessary fruit and vegetables locally, the families are reducing their reliance on commercially grown food, which often uses non-sustainable methods, pesticides and herbicides.
- By using area that has already been cleared for housing, we are reducing the need for further land clearing to grow food.
- By growing food next to our homes, we are reducing the use of another resource – the fuel to transport fruit and vegetables to and from the market.

- By making use of compost, we are increasing the fertility of the land near our homes and therefore adding value to a resource.

Materials

- Compost: lawn cuttings, sawdust, fruit wastes, leaves, wood shavings, coconut husks, rotting logs (see Schools' Action Project #3: Creating Compost for instructions)
- Manure
- Some soil
- Water
- Fruit and vegetable seeds and seedlings

Before you begin

- You will need to have some of the plants grown to seedling size. Talk to a local gardener for advice on when to plant various types of vegetables, if you are unsure.
- Select a site for your sup sup garden. When selecting a site you need to consider the amount of sunlight and shade your garden will get, access and availability of water, and risk of your garden getting damaged by people.
- Prepare your plot by digging over the ground if necessary and adding composted material (see Schools' Action Project #3)
- If necessary, build a fence to keep out roaming animals or students.

The job

- Plant out the sup sup garden with your seeds and seedlings remembering to leave enough space to walk between the plants in order to collect the fruit and vegetables. Mix up the different types of vegetables to make it harder for insects and disease to attack the one type that they like.

Follow up

- Students will need to regularly work in the sup sup garden to:
  - Water the plants
  - Weed around the plants
  - Collect the fruit and vegetables when they are ready.
- The fruit and vegetables grown in the school sup sup garden could be distributed amongst the students, eaten as part of school lunches or sold at the local market to raise funds for other school projects.
- Encourage students to make their own sup sup garden at home.

Some tips to assist you

Scarecrows

Birds can be scared away from your sup sup garden by hanging plastics or cassette tapes in the garden.

Plants

Some insects and animals use their nose to find your plants. Strong-smelling plants planted nearby or used as a fence around the sup sup garden help scare away insects from eating the leaves and fruits and protect the plants.

Wood ash

Insects cannot walk in wood ash. Sprinkling some on the cabbages and other plants' leaves will help prevent them from eating their leaves.

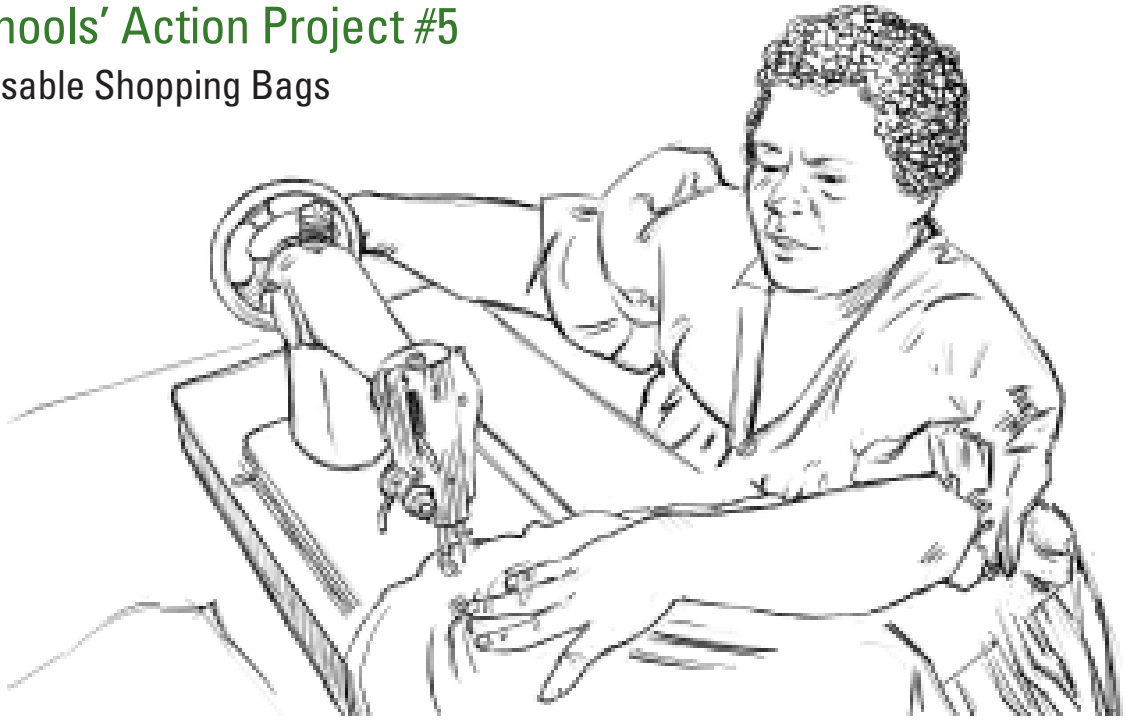
Chillies

Students can make a spray with chillies. Chillies have a strong taste, which can burn insects. Mix a handful of squashed red chillies with water in a one litre container. Leave this overnight and sprinkle it on the crops. Use it when you see lots of crawling insects on plants. You may need to use it twice a week.

Source: tips from Honiara Supsup Garden. BAONSA BUK

Schools' Action Project #5

Reusable Shopping Bags



Ni-Vanuatu woman using her sewing machine

Pollution from plastics has been an ongoing problem in our environment for a long time. Most plastic bags do not break down quickly. Estimates for the time it takes them to decompose range from 20 to 1,000 years. It also takes a lot of energy to produce them. There is a better way – reusable, fabric shopping bags.

Many places around the world are trying different ways to reduce the number of plastic shopping bags that are used by shoppers, for example, in Kenya shoppers must pay for the plastic bags they use and in Canada plastic bags have been banned. Closer to home, Samoa has banned non-biodegradable shopping bags and all shopping bags used must be able to break down within six months.

Some places offer reusable bags for sale instead; that way you only pay once but you can use them many, many times.

Before you begin

- Get the help of a women's group with sewing machines.
- Buy some large lengths of fabric – bright island prints look great (you may need to do some fundraising to cover this start-up cost) – or ask for donations of leftover fabric from your community. You can also use old flour or rice bags.
- Ask the women to sew up simple square shopping bags with handles. The bag size should be about 40 cm by 60 cm.

Alternatively, you could ask women from your local community to come into your school and teach students about traditional ways of making baskets or billums. This can be done in your art or cultural classes. Students will be learning a new skill, learning about their traditional culture and helping to reduce waste in the local community, all at the same time.

The job

- Conduct an education campaign about the problems of plastic bags. See Module 3, Topic 5, 'Case Study: Dirty Plastics' on p. 123, to find out more about the problems of plastics.
- The campaign could include student presentations at village or town meetings, posters at the local supermarket or store, and

talking with supermarket staff or storekeepers. You will need to encourage shoppers to buy cloth bags or use baskets. Ask the shop workers to offer the cloth bags for sale and promote the use of traditional baskets with customers instead of just giving plastic bags all the time.

- Sell or give away your cloth bags or promote traditional baskets wherever plastic bags are being used. Set up a stall outside the supermarket or at the market and promote them to storekeepers and shop owners to provide to their customers. Students could also buy or make their own bag or traditional basket to give to their mothers and aunties as gifts for Mother's Day.

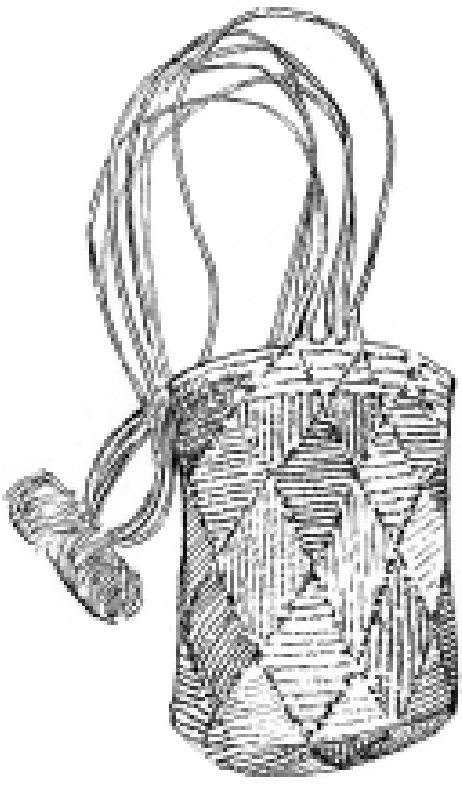
Follow up

- To see if your project is working, watch for shoppers using your cloth bags or traditional baskets more to carry shopping. You could even conduct a survey before and after by sitting outside the shop for a certain length of time and counting how many people have reusable bags and how many have plastic. If it is a very busy shop, have the students work in pairs. Hopefully, you will see less plastic and more reusable bags after you campaign.

Other ways for students to help minimise plastic bag use in your community could be to:

- Encourage store owners to keep cardboard boxes and cartons that their stock comes in and use them for packing shopping rather then plastic bags. They will save money because they don't have to buy bags.
- Encourage shoppers to use these cartons or cardboard boxes for carrying shopping. These can be taken home, squashed down and added to their gardens or compost where they will rot. They can also be burned and won't give off the same bad chemicals as plastic does.
- Encourage customers to take their own basket to the store or market. In the Pacific we have many different styles of traditional baskets. These are not only beautiful, practical and environmentally friendly because they are made from natural materials, they are also a great way to promote and be proud of our traditional culture.

Billum from Papua New Guinea



Basket from Vanuatu

Schools' Action Project #6:
Clean Up Day

We all produce waste so we are all part of the waste problem. But we can also be part of the solution. Of all the environmental issues we face today, waste is one each of us can (and should) do something about. It's all about making wise choices.

The choices we make every day affect the amount and types of waste we produce. When we rethink the way we live, reduce what we buy, reuse things instead of getting new ones, recycle and compost, we not only make less waste, we also save valuable natural resources and energy, and create less pollution.

Tips for reducing waste at your school

Students in a school can make a difference. Students and teachers can organise themselves and work together to manage their waste.

Students can

- Put out separate rubbish bins for different kinds of rubbish, for example, one for organic wastes, one for aluminum cans, one for soft drink bottles and one for plastic bags. Note: Only do this if you can do something with the waste after it is collected – other wise it is a disempowering activity.
- Reuse paper that is only written on one side – establish boxes for recycled paper in classrooms and offices.
- Do a litter survey or rubbish audit. Then map where most of the litter is and consider putting bins in those places.
- Creatively reuse plastic bottles, tyres or other 'waste' by painting them to make colourful garden boundaries.
- Organise a two-hour litter clean-up each week.

- Create a compost heap and learn how to manage it. See 'Schools' Action Project #3' to learn how to make compost.
- Create partnerships with companies that recycle bottles or aluminum cans so that they can have all the recycled bottles and aluminum cans.
- Tell their friends and family members all about proper waste management.

Organise a Clean Up Day in your school or community. Students who take part in such an event will learn firsthand about biodiversity and how the rubbish that is produced effects them. You can conduct it around your school, your community or along a nearby beach.

Encourage students to take responsibility for the waste they produce at home, school and when shopping. It's easy and every little bit helps!

Before you begin

- Involve students in selecting a place that needs cleaning up. You could choose a river or drain as these are places where a great deal of litter collects.
- Promote your Clean Up Day and get the community involved – the more people you have, the easier the clean-up is going to be.
- Discuss with the students how you will organise the tasks, as the students will need to direct and organise the community members who are helping on the day.

The job

- 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 and not everyone is collecting litter in the same place.
- Collect the litter, separate what can be recycled* or reused, and dispose of the remaining waste in a responsible way. Put it out for collection if you are in an urban area with a rubbish collection service. If you are in a rural area, you will need to dig a deep hole and bury the rubbish in an unused area. 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.
- Promote the event and use it 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.

Follow up

- Thank the community by giving appropriate gifts from your area or holding a picnic lunch at the school.
- Now that your community has been 'cleaned up', develop a Waste Reduction Plan with your students to identify ways they can reduce, reuse, recycle and refuse waste and put these ideas into action so that you can maintain your clean community.
- Make a commitment to conduct regular Clean Up Days.

5 Biodiversity in Culture

"Biodiversity includes the vast array of human beliefs, knowledge, traditions, customs, and languages that create the framework for society. Cultural diversity and biological diversity go hand in hand in hand."

Vandana Shiva

Module Introduction

Biodiversity in Culture

The diversity of human culture is an important part of biodiversity. All humans belong to a single species (*Homo sapiens*), but within our species are thousands of different cultures. Scientists believe that there is evidence to show that biodiversity and the natural world are almost as important in shaping different people, cultures and customs as they are in influencing the development of different plants and animals.

The Pacific Islands are home to a great diversity of peoples who have unique and rich cultures, languages and customs. These are strongly influenced by biodiversity and the plants and animals that play a part in daily life. Traditional people in the Pacific have a long history of living and working with the natural environment, and a valuable understanding of how to use these natural resources to meet their everyday needs.

The connection between culture and biodiversity becomes obvious when we look closely at traditional cultural practices such as fishing, preparing food and building shelters; the foundation of traditional knowledge such

as the understanding of changing seasons and the influence it has on availability of food; and in the use of natural symbols as forms of cultural identity.

By looking closely at our own culture and its relationship with biodiversity, we not only learn more about the natural environment but also learn to value the vital role that biodiversity plays in shaping who we are.

The goal of this module is for students to be able to identify the connections between biodiversity and human culture, and explore personal heritage and traditional knowledge, innovations and practices that are connected to the natural environment. Using examples from within the student's own culture – whether it is a cultural tradition from their clan, community or country – ensures the lessons are relevant. Thinking about their own culture and how it is related or connects with local biodiversity also helps students to understand how contemporary changes to traditional practices affect biodiversity and how changes in their local biodiversity affect their culture.

This module includes activities that explore significant plants and animals within the student's own community or country and how they might link to the cultural identity of a country. This will help students think about what culture really means and define parts of their own culture.

This module has five Topics that cover:

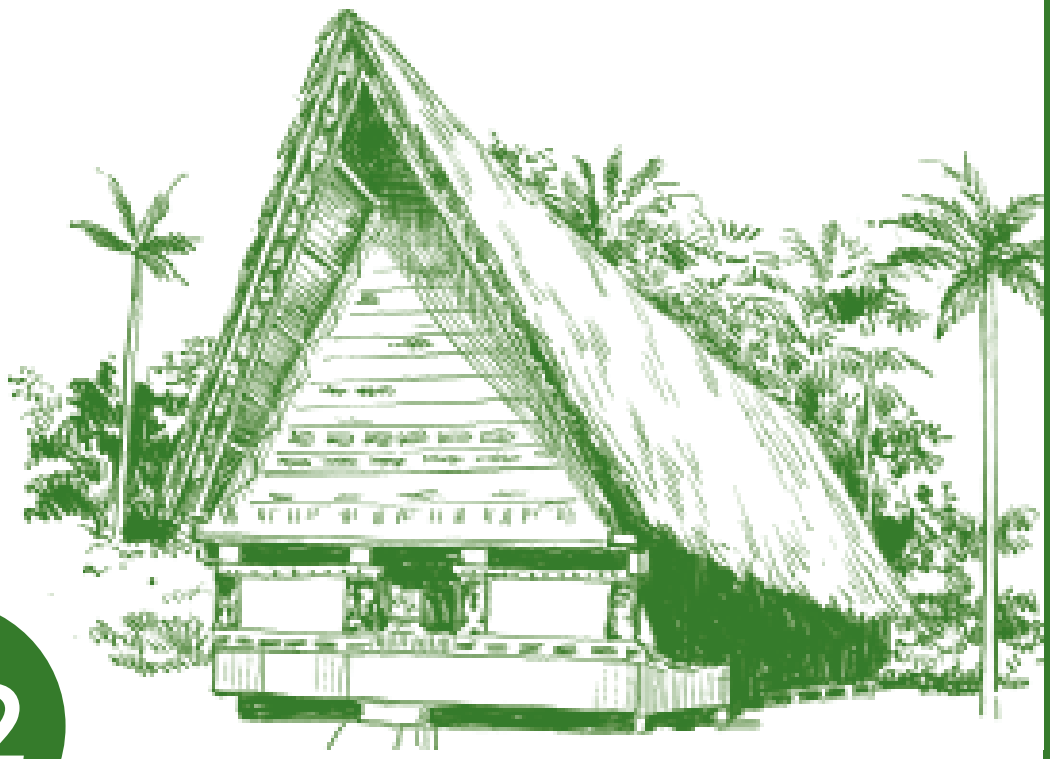
1. Traditional and Contemporary use of Biodiversity Resources
2. Traditional Family Knowledge and Technology Connected to Biodiversity
3. Biodiversity with Special Cultural Significance to Communities
4. National Cultural Identity Linked to Biodiversity
5. Local Biodiversity, Culture and Tradition.

The activities not only define these issues and allow students to understand them in their own context, but they allow students to investigate for themselves why biodiversity is so important to culture.

Man from Tanna Island in Vanuatu in traditional dress made from leaves

Activity Details Summary: Module 5, Biodiversity in Culture

Topic	Activity Name	Activity summary	Outcome	Subject Areas	Timing
Traditional and contemporary use of biodiversity (Traditional Knowledge)	Activity 1 – Old Ways and New Ways	Students will work cooperatively to identify the various ways biodiversity is used traditionally and examine how this has changed in contemporary (modern) society as a result of the introduction of new technology.	Investigate and compare traditional and contemporary ways that people use and manage biodiversity.	Social Science, Language Studies	Teacher preparation time: 20 minutes Lesson time: 60 minutes plus research time
Traditional family knowledge and technology connected to biodiversity (Traditional Knowledge)	Activity 2 – Traditional Family Knowledge	Through research and Developing understanding about their own traditions, students will identify traditional knowledge linked with biodiversity that is very important to their daily lives.	Explore traditional family knowledge and technology that are connected to biodiversity in their society.	Social Science, Language Studies	Teacher preparation time: 20 minutes Lesson time: 90 minutes plus research time
Biodiversity with special cultural significance to communities (Cultural Identity: Related to Nature)	Activity 3 – Significant Plants and Animals	Students will conduct research on plants and animals that are culturally significant to their community.	Research animals and plants that have a special cultural significance to the people of their community (school, family, clan etc.).	Social Science, Education, Language Studies	Teacher preparation time: 20 minutes Lesson time: 90 minutes plus research time
National cultural identity linked to biodiversity	Activity 4 – Biodiversity and National Identity	The students will research national symbols or icons of different Pacific countries and identify the cultural significance of these symbols and how they relate to the country.	Describe how biodiversity contributes to national cultural identity.	Social Science, Language Studies	Teacher preparation time: 20 minutes Lesson time: 60 minutes plus research time
Local biodiversity, culture and tradition	Activity 5 – Nature and Culture Connection	This activity requires students to think about their own culture and compare it with a variety of cultures from other countries or communities within their own country.	Compare elements of their culture, such as rituals, art, traditional farming practices, food storage and spiritual beliefs, with other national cultures.	Social Science, Language Studies	Teacher preparation time: 20 minutes Lesson time: 60 minutes



Traditional mens' house from Palau

Topic

1&2

Traditional Knowledge

Background Reading

South Pacific communities have a long history of living and working with the natural environment, and have a great depth of knowledge about how to use its plentiful resources to meet their everyday needs. This knowledge includes an understanding of what can be collected and eaten, what is poisonous, what can be used as medicines and what can be used for building. Pacific people also have knowledge about how the environment changes from season to season, for example, at what time of year a certain fruit may be collected. This knowledge, which has been gathered over thousands of years through experiences in the environment and passed down from generation to generation, is called ***traditional knowledge***. Traditional knowledge is extremely important and should be recognised for its value, even if you can't find it written in any text book.

Some traditional knowledge is very localised; it may be held by one village, one clan, a family or even an individual person. For example, some people have a detailed knowledge of where and when certain types of fish are found on a local reef. People may also know the specific tree that bats will visit at a certain time of year, and when yams may be ready for harvest in a hard-to-reach place in the bush.

Traditional knowledge may take the form of hunting, fishing, food collecting and gardening techniques, stories, songs, legends, ***cultural values***, beliefs, rituals or community laws, and is often expressed uniquely through local language. For example, songs and legends can be an important way to pass on traditional knowledge. Community laws may be made to protect resources, such as the breeding grounds for turtles at important times of the year.

Traditional knowledge is very practical, particularly in the areas of collecting or growing food, fishing, hunting, and health and environmental management. For instance, in some villages in Vanuatu, people know the right time for yam

harvesting is when a narara tree is in flower. So, to the people of that community, the knowledge of that tree blooming will tell them that it's the right time to start harvesting yam. In some countries, natural signs warn people that breeding seasons have started for birds or crabs and, in turn, it tells the communities when it is best to go hunting or fishing.

Why we should hold on to traditional knowledge

There is concern that traditional knowledge is being lost in the rapidly changing and modernised world. Traditionally, all food and medicine needed for survival was taken from nature and local gardens. With the introduction of trade and the cash economy, people now rely less on collecting and growing food and medicine (to find out more about cash economy verses traditional economy see Module 6, Topic 6, p. 264). Many things can now be purchased. Diets are now changing with the introduction of food from other places. Many people now purchase tinned fish instead of catching fish or buying fresh fish at a local market. Medicinal knowledge is being lost because we are relying more on Western/modern medicine. Similar changes are happening with building materials; people are building with steel, iron and brick rather than with wood, thatch and stone. Hand woven baskets have been replaced by plastic bags in stores.

The change from traditional to modern practices provides some advantages and disadvantages. This is very important to recognise because many people think that modern ways are always better than traditional or old ways, but this is not true. Some modern practices provide very useful services, for example, modern drugs used to treat malaria are much more effective than traditional methods and have saved thousands of lives. However, some modern ways also cause many problems. Plastic bags, for example, take hundreds of years to decompose (break down) in the environment. They pollute our waterways and threaten our marine life, such as turtles. If they are burned, they release toxic chemicals. They also require energy and resources to manufacture and transport (to find out more about the problems with plastic bags see Module 3, Topic 5, p. 121). Woven baskets made from local plant material have none of these disadvantages.

Traditional food, medicine and building materials can be obtained 'free' as long as they are still available in your area and managed properly. Many areas and people in the Pacific still use the resources provided by biodiversity, much the same as they did traditionally. It takes a lot of work to make a fish trap, however, all the materials are available from local plants. Synthetic fishing line or nets, by contrast, can be very expensive to purchase. A tin roof may be very good at keeping out the rain, but it also costs money and this may put pressure on families to obtain the money. Therefore, we see that traditional knowledge and use of biodiversity can provide people with the essentials for life (foods, building materials, etc.) that can be relied upon when money is not available. This traditional knowledge allows people to be 'self-reliant'. If traditional knowledge is lost, people must rely on being able to earn enough money to purchase what they need.

There is currently a growing appreciation of the value of traditional knowledge, not only to those communities using it in their daily lives, but to

Traditionally used or practised	Used or practised in modern times
Medicines taken from native plants	Drugs from a health clinic
Fish traps made with local materials	Synthetic fishing line and steel hooks
Pandanas mats	Synthetic mats and carpets
Thatch roof	Tin roof
Cooking in ground oven	Cooking with gas stove
Wrapping food in banana leaf	Wrapping food in tin foil

modern industry and agriculture as well. Many widely used modern products, such as plant-based medicines and cosmetics, are developed using traditional knowledge.

Traditional knowledge can also be used for managing the environment so that it is kept healthy for future generations. A good example is when a village chief decides to place a ban on taking fish for a period of time or in a specific place using his powers under customary law. This is often called a tabu. This practice is a way that traditional knowledge can be used to conserve biodiversity, and may be more accepted by communities and hence more effective than modern systems of conservation, such as declaring a protected area using the laws made by the national government.

Traditional knowledge: a missing link in schools?

Some people now recognise that traditional knowledge has not been given enough attention in many Pacific Island schools and school curricula. Many schools have been teaching curricula inherited from Western countries prior to independence. Therefore, many of the topics learned by students involve concepts, situations, events or places from foreign countries. Providing students with opportunities to learn traditional knowledge and skills is extremely important in allowing students to develop traditional knowledge and skills. In this way, students will be better prepared to participate in their own culture, society and environment.

This background reading supports the following two activities:

Activity 1 – Old Ways and New Ways

Activity 2 - Traditional Family Knowledge

The following two activities complement each other and work well if they are carried out one after the other. However, they will work equally well if they are conducted independently and you choose to only do one with your class.

Activity 1
Old Ways and New Ways

Suggested Timing

Teacher preparation time: 20 minutes
Lesson time: 60 minutes plus research time

Subject Areas

Social Science, Language Studies

Glossary Words

Traditional, contemporary, indigenous, fallow, holistic

Materials

- Marker pens
- Butchers' Paper (if available)
- Masking tape (if available)

Teachers' notes:

Traditional uses of resources are still very relevant in today's society. A tradition is just a way of doing something that is repeated over time until it becomes a custom. Therefore, a tradition is not something that only happened in the past, but may be continued well into the future. Some societies or communities may even find that contemporary uses of resources are given up for more traditional methods, for example, the practice of organic farming doesn't allow the use of fertilisers and pesticides (contemporary methods of farming) but instead uses traditional knowledge for planting and gardening.

Activity summary

Students will work cooperatively to identify the various ways biodiversity is used traditionally and examine how this has changed in contemporary (modern) society as a result of the introduction of new technology.

Outcomes

Students will be able to:

- Investigate and compare traditional and contemporary ways that people use and manage biodiversity.

Tuning in

1. Ask the students to think about a custom ceremony from their community that involves the use of resources from local biodiversity. Discuss some of the possible changes in the ceremony that may have happened in modern times. For example, do they use the same types of food or costumes for that ceremony as were used in the past? If things have changed, why has this happened?

Write the headings 'traditional' and '***contemporary***' (or 'modern') on the blackboard. Ask the students to think of things associated with the word traditional, in particular what it means to them and their community. Then do the same with 'contemporary'. Write the ideas under the headings. This can be a general discussion to give students an understanding of the differences between the two words before they investigate how biodiversity is used differently in traditional and contemporary situations. (Traditional refers to people living in a way that their ancestors have lived, such as people holding onto their traditions or customs and, for example, using resources in a similar way to their great-grandparents. Contemporary refers to more modern practices and techniques for living, for example, using resources in a way that has been developed only recently).

Developing understanding

2. Divide the students into three different groups. Each group will look at how our uses of biodiversity have changed over time.

Group 1 will look at how people traditionally use biodiversity resources; for example, how did our ancestors or great-great-grandparents use natural resources from our environment? Some of these uses will be still relevant in the present day.

Group 2 will look at how contemporary society currently uses biodiversity.

Group 3 will look at how people might use biodiversity in the future*.

*The group looking at future uses of biodiversity often finds the activity more difficult than the other groups, as it requires imagination about the future. Help this group by asking them to imagine what might change in the future and to describe these changes. For example, what would the community eat if there were no more fish in the reef? What sort of clothes might people wear and what will they be made of? Reassure them that there are no right or wrong answers.

3. Once the students are in their groups. Give each group some butchers' paper (or they can use their notebooks). Write the list below on the blackboard where everyone can see it. Instruct each group to discuss and write down answers to the each item on the list. For example, the 'traditional' group will start by writing types of foods people traditionally eat.
   - Type of food people eat
   - How food is prepared
   - Medicines
   - Building materials
   - Clothes people wear
   - Way of catching fish
   - Way of hunting
   - Weapons
   - Ceremonies
   - Decorations
   - Types of money

4. Ask each group to display their butchers' paper at the front of the room (or use their notebooks) and present their group findings to the whole class. Start with the group looking at the traditional use of biodiversity, then contemporary uses and, finally, possible future uses.

5. Lead a discussion by asking the class to think about the differences and changes in the way people use biodiversity resources traditionally, currently and possibly in the future. The following questions may help the discussion:

   a. What has changed in how biodiversity is used across the three different situations? Is there a pattern in the use of biodiversity resources over time?

   b. Why do you think there are changes in the way people use biodiversity?

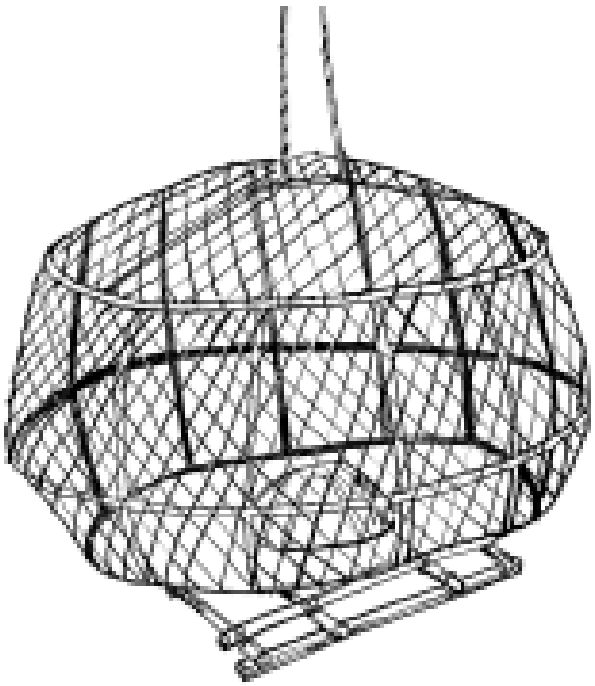
   c. How do you feel about the way things have changed?

Use concept

6. Write down a statement on a piece of paper that says: "Traditional knowledge and use of biodiversity is better than contemporary (modern) ways."

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

8. Present participants with the statement "Traditional knowledge and use of biodiversity is better than contemporary (modern) ways" and tell them that they must consider this and decide if they support it or reject it. If they strongly agree they should stand closest to the strongly agree sign; if they strongly disagree they should stand at the opposite end of the room, next to the strongly disagree sign. They can also choose to stand anywhere on the line between the two opinions, which represents a continuum (e.g. agree to some extent), or in the middle (agree and disagree to the same extent). Note: It is important to tell the participants that there is no right or wrong answer; however, they must think of reasons for their position.



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

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

11. Having considered a range of opinions, encourage the students to change their point of view (where they stand on the line and on the issue). Explain the importance and value of considering a range of ideas and being prepared to change your mind.

Reflection

12. For homework or as an extension activity, ask students to interview an older member of their community about different ways they used or are still using biodiversity traditionally. As a class, compare the response of older people to what students found in their earlier group work.

Activity 2
Traditional Family Knowledge

Suggested Timing

Teacher preparation time: 20 minutes
Lesson time: 90 minutes plus research time

Subject Areas

Social Science, Language Studies

Glossary Words

Ancestors, cultural values, customary, orally

Materials

- Marker pens
- Butchers' paper (if available)
- Stories (see boxed text in activity)
- Coloured pencils
- Paper

Teachers' notes:

Students may not be aware how much of the knowledge they have is 'traditional knowledge'. Generally speaking, if something has been learnt from their parents or family, and they learnt it from their family before them, then it can be considered traditional knowledge. Traditional knowledge is also evident in social norms and everyday culture – 'the way we do things' that people might not even realise is part of traditional knowledge. Use the example of the Burarra people from Australia to explain different signs that signify changes in the environment that are included as traditional knowledge.

Be aware that some traditional knowledge is owned by certain people or groups of people (e.g. women) and it may not be appropriate to share this with the whole class. It also may be the job of a specific person in the community to teach aspects of traditional knowledge. Ensure that the students and the school are aware of and respect these issues.

Activity summary

Through research and developing understanding about their own traditions, students will identify traditional knowledge linked with biodiversity that is very important to their daily lives.

Outcomes

Students will be able to:

- Explore traditional family knowledge and technology that are connected to biodiversity in their society.

Tuning in

1. Ask the class for suggestions about what they think traditional knowledge means. Can they give examples of traditional knowledge that they are familiar with? Write students' ideas on the blackboard.

2. After a brief discussion of the students' ideas, with students' assistance write a class definition of what traditional knowledge means. Do this on the blackboard.

Developing understanding

3. Read the story about Melo and her grandmother (see boxed text at the end of the activity). If possible, get one of the students to read the story aloud while everyone listens.

4. Discuss with the students the following questions related to the story.

   - Where were Melo and grandmother when the storm began?
   - Despite the storm, why did the grandmother assure Melo that they will have a good yam harvest during that year?
   - Why is the narara tree important to the people of Malua Village?

(The grandmother is relying on her traditional knowledge. It tells her that when the narara tree flowers in abundance, it means that there is also going to be a good yam harvest. The conditions suitable for the narara tree to flower well are the same conditions that allow yams to grow large and healthy.)

5. Explain to the students that traditional family knowledge is very important and that communities sometimes depend a lot on this knowledge for their health and survival. Every indigenous community, tribe or family has some important knowledge that can be used for natural resource management such as predicting harvesting, hunting or weather patterns.

6. Set each student the task of researching and recording some traditional knowledge used within their family, clan or village that involves nature or biodiversity. This could be traditional knowledge related to breeding seasons of birds or hunting seasons for different animals, the best time for picking certain fruits, or any other example. Tell the students that they must choose an older person (e.g. a relative or a chief) to interview. They should record their findings in their notebooks. **See Teachers' notes, for a caution regarding respect for privileged information.*

Use concept

7. With the information they have gathered, the students should then write a story about how the particular piece of traditional knowledge was used. The questions below may be useful to guide students in their writing.

- What is the traditional knowledge you researched?
- How is it used?
- Why is it important to the people in the community or family?
- How does it relate or link to biodiversity?
- How has the knowledge been passed on through generations?
- Is it still widely known and used by the family or community?
- What can be done to preserve this traditional knowledge?

Students can also do an illustration of the plant or animal that forms the basis of the traditional family knowledge they have researched and written about. If they have written a story, then the students can do an illustration relating to their story.

Application

8. Collect all the stories the students have written and illustrated and compile them in a book. Illustrate the cover of the book and use a title and the authors' names. That the book can be shared with other classes and even the wider community. The book can be displayed in the classroom as a book for the school on traditional knowledge.

Extension

Traditional Knowledge Calendar

9. To further explore the idea of traditional knowledge in the community, divide the class into groups to work on developing a community calendar based on their traditional knowledge. Explain that within their local community, different times of the year have different patterns of wind, rainfall, and plant and animal life cycles.

10. Put the students into groups and ask them to discuss different environmental patterns and events that their community is familiar with. These patterns and cycles are part of the traditional knowledge people have that links to biodiversity and the natural resources people use from biodiversity. Communities know the best time for planting is when a sign in nature reveals it to them.

11. Ask each group to make a one-year calendar and use their traditional knowledge to list when events or patterns happen within the local biodiversity. The calendar can be based on the different seasons or the months of the year. The activities in the calendar should be based on anything that happens in the community and their local environment that they can relate to some traditional knowledge. This could include signs from nature that signify a natural change or a warning. For instance, in the months November through to April, you might expect cyclones in some places. Traditional knowledge may include signs to reveal whether there will be severe cyclones or no cyclones during these months

or year. If students are not familiar with when events or patterns happen that are linked to local biodiversity then they can ask their older family members at home to help them identify some.

12. Once they have completed their calendars in their groups, display the calendars in the classroom for students to look at as the events in the calendar happen throughout the year. If possible, students can also add or make changes to the calendar throughout the year as they become more familiar with what is happening, and when.

SIGNS

Melo and Her Grandmother

Dark clouds raced across the sky as little Melo and her grandmother packed the taro and bananas they had harvested from their small garden, and started the long journey towards the coast and the little hut at the edge of Malua village on the island of Malekula in Vanuatu. The wind was starting to howl and Melo could just make out the creases on her grandmother's forehead forming crests like the waves she saw every day at the beach. She knew her grandmother well enough to know that this meant something was wrong. The wind grew stronger and it began to rain. Soon flashes of lightning started to light up the sky. Melo could hear thunder rolling in the distance. She was very scared and knew that her grandmother was scared too. Even more disturbing was the knowledge that something was wrong and that her grandmother, in an attempt to protect her, would never confide in her.

A little further down the slope, grandmother suddenly stopped. She stood very still and gazed ahead at something of a crimson colour that had, for a second, been illuminated by a random flash of lightning. Melo had seen it too but brushed it aside as a trick the light was playing on her eyes. She couldn't understand why her grandmother stood fixed to the spot while she was getting drenched to the skin and could even taste salt on the raindrops that dripped from her face and hair. Grandmother pulled her to the side and pointed. "Wait for the lightning," she said. Melo looked in the direction her grandmother was pointing and in that split second there was a flash of lightning and in the distance, illuminated by the light was something that looked like a huge bunch of red roses. Melo was stunned by the beauty of such a sight. She stood very still long after the flash and savoured all she had seen. That split moment seemed to take away all her fear of the thunder and her frustration and she wanted it to last. She was brought back by a tap on the shoulder from her grandmother. "The flowers of the *narara* tree in full bloom and in abundance" she said. "Yes grandmother," Melo replied, "Very beautiful". "You have no idea how beautiful they are, Melo," the grandmother said. "It is a sign, child, a sign of a good yam harvest. That is what I have been waiting to see." Melo felt joy as she saw the crests on her grandmother's forehead subside and the ocean became still. Once again, her grandmother had looked to Mother Nature to find the answers.

Diana Hinge

Seasonal Calendar of the Burarra People

There are hundreds of groups of indigenous people living in Australia, each with its own distinct knowledge and stories. These relate to the conditions in each region: the land, the climate, the habitats, the animals and plants, the landscapes and the waters.

The Burarra ('bur-ah-da') people have lived on their land for about 40,000 years. From their ecological understandings and spiritual relationships with the land, a complex knowledge has developed that includes a detailed knowledge of the natural world and how to live in it.

Burarra people maintain their traditional knowledge, continuously adapting to the changing environments of the modern world. The Burarra people want to preserve their knowledge, traditions and land for future generations. They also want to share this knowledge with others.

One way that indigenous knowledge of the natural world can be organised is in a circular map or 'seasonal calendar' that shows the sequences of events in nature and their relationships.

The Burarra calendar has four seasons, Lugurrma, Barra, Wilma and Jilicha, which are related to the winds that blow at different times of the year.

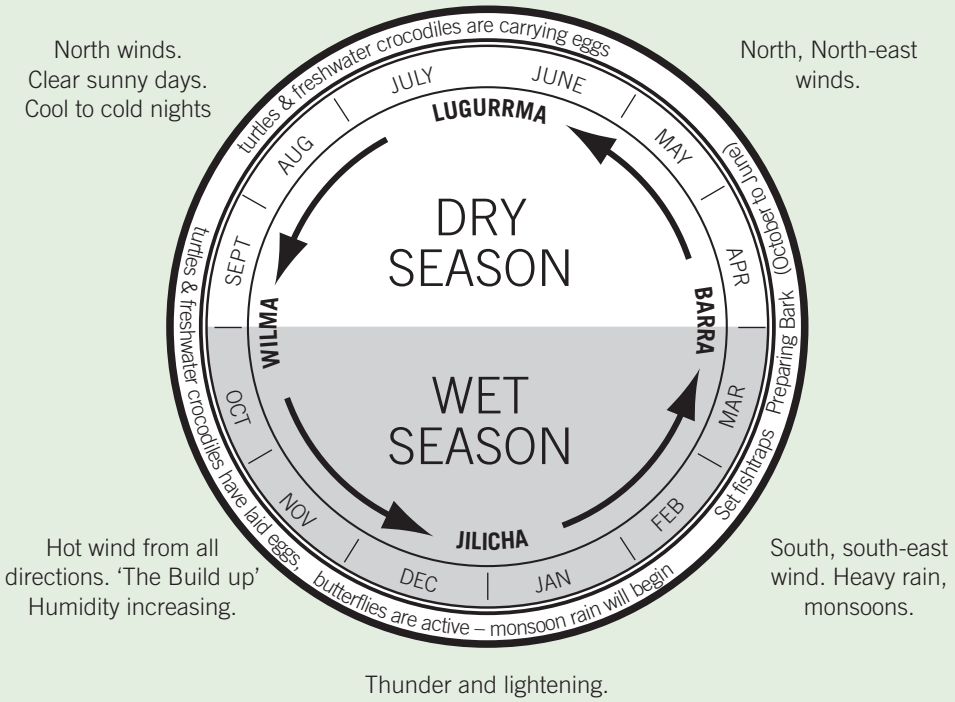
Each season has its own patterns of winds and weather, plant growth and cycles of animal life and death.

Understanding these patterns helps the Burarra people know the right times for activities such as hunting and gathering, burning and ceremonial life.

For example, when the leaves of the yam plant change colour it is time to burn the bush to clear the land for new growth, and when the butterflies become active the monsoon rains will soon begin. The understanding that natural events can be predicted as part of a seasonal cycle enables people to make the best use of resources.

This understanding of the seasonal cycles is central to the lives of Burarra people.

Source: 'Burarra Gathering – Seasonal Calendar', http://burarra.questacon.edu.au/pages/seasonal_calendar.html



Seasonal Calendar of the Burarra People

Kava, an important traditional drink used in Vanuatu, Fiji, Samoa and Tonga

Topic

3&4

Cultural Identity: Related to Nature

Background Reading

The Pacific Islands are home to a great diversity of peoples who have unique and rich ***cultures***, languages and ***customs***. Culture and customs are strongly influenced by the natural environment and the diversity of plants and animals that play a part in our lives. For example, our diets, daily activities (e.g. fishing), building materials and spirituality all involve biodiversity.

Our culture simply refers to how we go about our daily lives, and includes what we eat, how we obtain and prepare food, how we build our houses, our ceremonies, art, songs and how we relate to each other. Some aspects of our culture have not changed for a very long time, however, other aspects of our culture are changing quite quickly. Biodiversity plays an important part in our culture because it is linked to it in many ways. For example, a community has unique ways of gardening, hunting or fishing that were developed to make use of specific plants and animals available in the local area or region. As a result, differences in regional biodiversity contribute to the differences between cultural practices from one area to the next.

Our culture also includes our traditional customs that may have been passed from generation to generation for thousands of years; these include songs, art, ceremonies and spiritual beliefs. These are vitally important to our way of life, particularly for those of us living in rural areas. Many Pacific communities have beliefs that connect them to biodiversity. These connections can be so strong that people closely associate their own identity with a certain animal or plant.

Every culture in the world has traditions, foods, songs, art and games that incorporate local biodiversity. Certain plants and animals that have special significance to customs and culture in a community, region or country often become symbols that represent cultural identity.

The following explores the cultural significance of biodiversity more closely.

Cultural significance through use

Many Pacific Island communities traditional livelihoods are based on ***subsistence farming***, gardening and fishing. The same plants and animals involved in these activities often feature in custom stories that have spiritual significance and may also relate to how we manage our resources. For example, food plants such as yams are often talked about in custom stories in Vanuatu and Papua New Guinea; they play a big part in the ***economy*** and social organisation of people in some areas. These custom stories are a way to explain the important relationship between people and the plants. There are also a number of special ***rituals*** that must be performed in the cycles of planting and harvesting of yams, and these often contribute to good management practices.

Cultural significance through the role it plays in the community

Kava is a good example of a plant that has special cultural significance because of the role it plays. Kava is an important plant in cultures in many Pacific countries and plays a key role in society in Vanuatu, Fiji, Samoa and Tonga. It is drunk in ceremonies meant to honour visitors, unite participants and validate their social identities. There are similarities in the use of kava between the different cultures, but each also has its own traditions.

Tapa is a bark cloth that is made in countries such as Fiji, Samoa and Tonga from the bark of the paper mulberry tree. Traditionally, tapa was used for clothing and bedding but now it has been replaced by other textiles. Tapa is now worn on formal occasions such as weddings and funerals, as well as after the birth of a new baby. It is also dyed and printed with traditional patterns and is often used for decorating homes.

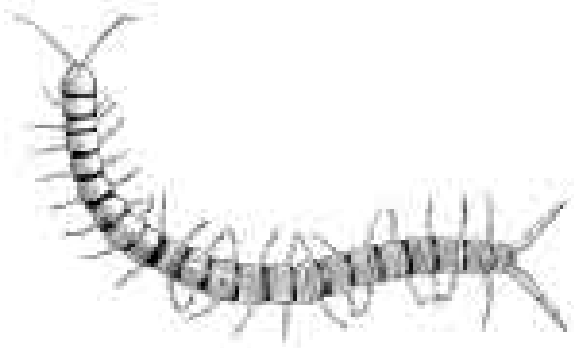
Cultural significance through belief systems

A plant or animal can be significant for a community based on community belief systems. These beliefs have been passed on to members of the community from their ***ancestors*** as traditional knowledge, including stories about how that plant or animal relates to people or the environment. Animals and plants may be considered sacred for a variety of reasons, including associations with creation, or with ancestors or spirits. These beliefs can also be part of traditional laws. There are a great number of examples of this across the Pacific. The following examples are from the Cook Islands and Papua New Guinea.

Traditionally tribes or clans of the Cook Islands recognised a particular fish, bird, insect or plant as being sacred to that tribe and often symbolised their unity. Because of this association, members of the clan are required to treat this animal or plant with respect. An example from the Cook Islands is the centipede, which is a common totem of chiefs and is customarily tattooed on the chief's back.

Members of the Saikou Clan from the Tarawa Village in the Kaliai/Kove subdistrict of West New Britain Province in Papua New Guinea have a special relationship with the willie wagtail or 'billy bird'.

Willie wagtail or 'billy bird'



Centipedes are customarily tattooed on the back of chiefs in the Cook Islands

The following story is told by Mrs Siwa Kupe Matawe:

The Billy Bird

I can remember my mum telling me about 'the Billy Bird' which actually brought fire to our ancestors when they were unable to get hold of fire cause of heavy rainfall that time. Since the bird brought fire to them, they manage to keep themselves warm until sunshine came back on. Since the Billy Bird saved our ancestors' lives which enabled them to live on until our generation, we are not allowed to kill any of these birds. If we do we will get sick. Now every time we see one of these Billy Birds on tree branches we sing a song to them and they dance to the song because they know we are related in some ways.
Song: " kolkol mo..re, kolkol mo..re, eee, tai..ia mo..re".

Symbols of cultural identity

Many times these elements of biodiversity are so important to the culture of people that they become part of their identity. Items or symbols representing them can be used to define a group that have something in common that sets them apart from others. This not only happens in traditional cultures but also occurs in modern societies. For instance, a youth group or a sporting team may identify an animal or plant that each member relates to; this may be a symbol, a motto or something that is significant to them and can represent them as a group.

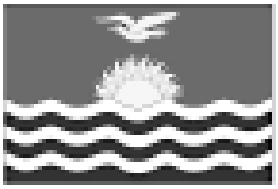
A symbol or significant plant or animal that is used to represent a community or group of people is also used to show other groups what the community values. In some cases, people tattoo their bodies, print T-shirts or use ***symbols*** in art to show what they value and its significant to their community.

Cultural identity of country

Countries or nations often use symbols from biodiversity to represent their national cultural identity. A national symbol can be anything that people identify with and feel represents a part of their culture. A national symbol can be used to unite people by representing their ***values***, beliefs, goals or history. Countries may have a symbol that is representative of all the different people living in their nation, using national colours, anthems, ***coat of arms***, flags or traditional emblems.

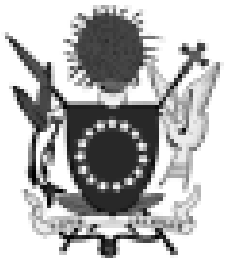
The following are some examples of Pacific Island countries and the symbols from biodiversity they use to represent their national cultural identity.

- The main symbol of the republic of Kiribati is the national flag, which shows a frigate bird (see p. 221) over an ocean sunrise. The frigate bird is also an important symbol in Nauru and the Solomon Islands; it appears on the coat of arms of both countries. It is also found on the fin of Air Nauru planes and appears as its official logo. Other symbols from biodiversity appearing on the Solomon Islands' coat of arms are a crocodile, a shark, an eagle and a turtle.



Kiribati flag

- The coat of arms of the Cook Islands has a shield as its focal point with a flying fish (maroro) and a white tern (kakaia) featured on the sides. It also features an ariki headdress (pare kura) made of red feathers, symbolising the importance of the traditional rank system.



Cook Islands' coat of arms

- The coconut palm is a common symbol from biodiversity that is used by a number of different Pacific Island countries. The coconut palm is depicted on the coat of arms in Fiji, Samoa and Nauru. In Vanuatu, the engraved picture of a ***germinated*** coconut is displayed on the 100 vatu coin. To the people of Vanuatu, this symbolises that many people depend on copra as their main source of income.

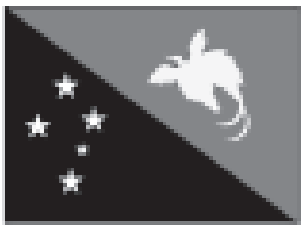
The Tongan Ta'ovala

An important item of cultural identity for Tongans is the ta'ovala. Worn by both men and women, the ta'ovala is a woven mat worn around the waist tied with a kafa, a traditional twine made from coconut fibre. Ta'ovala are worn as a sign of respect, similar to the way that a man might wear a tie to church.

Ta'ovala can be made from both natural and synthetic fibres. Traditionally and most commonly, ta'ovala are made from the leaf of the pandanas plant (lou'akau, in Tongan). The leaves are cut when they are green and their sharp edges and spines are removed.

It is not only the ta'ovala, but pandanas that is very important to the Tongan people. The pandanas is the basic material for making ta'ovala and without the pandanas Tongans would not be able to make ta'ovala in the traditional way. A change in the availability of pandanas material to make ta'ovala would have an impact on the culture and identity of the Tongans.

- Food is used as symbols of national cultural identity, including sugar cane and bananas, on the Fijian coat of arms. The sea, as a major source of food, is depicted on the Samoan national emblem.
- Important symbols in Palau include the half shell symbol of the giant clam shell, which represents the foundation of Palau and the creation of humanity from the sea.
- A very well known symbol of national culture is the bird of paradise in Papua New Guinea. It is used in the national emblem and is represented on the flag and the coat of arms. When someone from a different country sees a bird of paradise on a flag or document, they know that it relates to the people of Papua New Guinea.
- National symbols are often displayed on money. Items of traditional exchange, such as kina shells and pigs in Papua New Guinea and circle pig tusks in Vanuatu, are important symbols too.
- Some symbols are used as part of a national cultural identity to signify peace, such as the dove of peace on the Fijian coat of arms and the crossed cycad (namele) leaves on the flag and the national emblem of Vanuatu.



Papua New Guinean flag

Bird of paradise

Fijian coat of arms

This background reading supports the following two activities:

Activity 3 – Significant Plants and Animals

Activity 4 – Biodiversity and National Identity

The following two activities complement each other and work well if they are carried out one after the other. However, they will work equally well if they are conducted independently and you choose to only do one with your class.

Activity 3
Significant Plants and Animals

Suggested Timing

Teacher preparation time: 20 minutes
Lesson time: 90 minutes plus research time

Subject Areas

Social Science, Education, Language Studies

Glossary words

Culture, customs, traditional knowledge, subsistence farming, economy, ancestors, ritual, symbol, values, germinated

Materials

- Marker pens
- Butchers' Paper (if available)
- Coloured pencils
- Paper for creating posters (if available)

Teachers' notes:

This activity can be linked with Activity 2 of this module because the information that the students collect from the community about the culturally significant plant or animal is also 'traditional knowledge'. It is important that you and your students are aware of any restriction to the use of traditional knowledge that is applicable to your area or culture. Some information is 'tabu' or restricted by cultural rules. Some information is culturally inappropriate for women or children or for people from outside the area or cultural group to know or use. It is important to respect and be aware of any such restrictions so as not to cause offence.

Activity summary

Students will conduct research on plants and animals that are culturally significant to their community.

Outcomes

Students will be able to:

- Research animals and plants that have a special cultural significance to the people of your community (school, family, clan etc.).

Tuning in

1. Prior to commencing this activity the teacher should be familiar with the background reading. Read the section called 'The Billy Bird' aloud to the students (p. 216), and show them the picture of the Billy Bird (you could also draw it on the blackboard).
2. Ask the students why they think the Billy Bird is culturally significant to the people of Saikou Clan in Papua New Guinea? *It is associated with beliefs about their ancestors.*

What are some other reasons why people may think plants and animals are culturally significant? *Examples: they might be eaten, used for making things, have medicinal properties, be used in ceremonies etc.*

If you have a similar cultural story from your local area then you could use it for this part of the activity.

3. Ask the students to identify at least two plants and two animals that have cultural significance to their local community or country. List these on the blackboard.

Developing understanding

4. Draw the table (below) on the blackboard and have the students copy it into their exercise books. Involve the students in a discussion about each of the plants and animals that have been identified as culturally significant. Under the heading 'Uses', write down how the plant or animal is used. If the plant or animal plays a role in the community (for example, in ceremonies), write this under the heading 'Roles'. Finally, list any 'Beliefs' that the plant or animal may be associated with. It is OK to leave one or more columns blank if it doesn't apply.

5. When the table is completed, discuss the findings with the students. Are some plants and animals culturally significant for more than one reason? What (if any) is the link between use, roles and beliefs?

Use concept

6. In small groups or individually, ask the students to choose one plant or animal that is culturally significant to their community or country (this could be one from the table or another that they choose). Ask students to conduct research by interviewing older community members about the plant or animal they have chosen.

Ask students to design their own survey by writing down questions that they will ask the older community members. Questions could include the following:

- Why is the plant or animal culturally important?
- How is the plant or animal used?
- What would happen if the plant or animal were not around any more?
- How has the role of the plant or animal changed over time?

If required, help the students to think of questions to ask and to identify people to interview. (See Module 6, Activity 1, 'Decision Maker Survey' p. 243 for tips for conducting an interview).

7. When students have completed their research, ask them to report their findings by making a colourful poster, which may includes pictures, diagrams, explanations and stories.

Application/reflection

Organise a time for each student or group to 'show and tell' to the class about their culturally significant plant or animal. During the presentations, the students should show the poster of the animal or plant, read out their story and explain how their plant or animal is culturally significant to the community.

At the end of the presentations, lead a discussion about the importance of these plants and animals to the community. Ask the students to think of what can be done to ensure that knowledge of these plants, animals and customs is passed on to the next generation. Also discuss what would happen if the population of these particular plants or animals were to become extinct. Make a list of actions that students could take to protect these important species.

For further information and ideas about taking action see Module 4.

Plant or animal	Uses	Roles	Beliefs
#1			
#2			
#3			
#4			

Activity 4
Biodiversity and National Identity

Suggested Timing

Teacher preparation time: 20 minutes
Lesson time: 60 minutes plus research time

Subject Areas

Social Science, Language Studies

Glossary Words

Germinated, cultural heritage, symbol, coat of arms

Materials

- Money – coins or notes (if available)
- Coloured pencils
- Lead pencils

Teachers' notes:

Coin rubbing is a great way to make a picture or an impression of a coin. Students start by placing a blank piece of paper over a coin. The back of the coin needs to be placed on a flat, hard surface.

Students then use a lead or coloured pencil, chalk or a crayon to colour the paper over the surface of the coin. Students will soon see the image of the coin appearing on the paper. This technique is a great way to get a lot of detail in the picture. You can use this technique on other objects such as shells or leaves to get details of their surfaces. Why not try this in an art class?

Activity summary

The students will research national symbols or icons for different Pacific countries and identify the cultural significance of these symbols and how they relate to the country.

Outcomes

Students will be able to:

- Describe how biodiversity contributes to national cultural identity.

Preparation

1. Collect a range of different coins so that you have enough for each student. It would be good to provide coins from different countries if you can get them. If you have access to the internet you can download pictures of coins from all over the world from the website: http://www.worldcoingallery.com.

Tuning in

2. Give each student a coin or get the students to share the coins between pairs if you don't have enough. Ask the students to do a coin rubbing of both sides of the coin. (See 'Teachers' note' about coin rubbing). Once they have finished, ask the students to walk around and look at their friends' rubbings and identify the plant or animal that is a symbol and can be seen on the various coins, either on both sides and or one side.

Alternatively, if you do not have coins you could photocopy or draw some of the pictures of coins provided at the end of this activity and let students use the pictures for their investigation.

3. Ask the students to write down what the plant or animal on the coin might symbolise for the country. Write the names of the symbolic plants or animals on the board and discuss with the students the following questions:

- Why do you think this symbol is important to the country?
- How does this plant or animal relate to the people of the country?
- Where else can you find this symbol displayed?

Developing understanding

Divide the students into small groups of four or five. Tell the students that they are going to conduct research about a plant or animal that is used as a symbol or icon in your country (for

example, on a flag, coin etc.). If you have people within your school or community from a different country, consider asking some groups to choose a plant or animal symbol from that country as their focus.

Ask the students to write down how they will get information about their research topic. Encourage them to think about the following methods:

- Interview people with knowledge about the subject (e.g. someone from the country you have selected, or a community elder)
- Use their own ideas and knowledge (what do they already know?)
- Use the school library and books
- Use the internet, if it is available

In their research, students should explain how this symbol (plant or animal) relates to the cultural identity of the country.

The following will guide students in their research:

- Describe the plant or animal that is used as a symbol or icon for the country.
- What are some of the things (e.g. flags, stamps, coins etc.) that you can find the symbol on?
- What cultural relationship does this plant or animal have with the people of this country?
- Draw a picture of the symbol using the information you have collected.

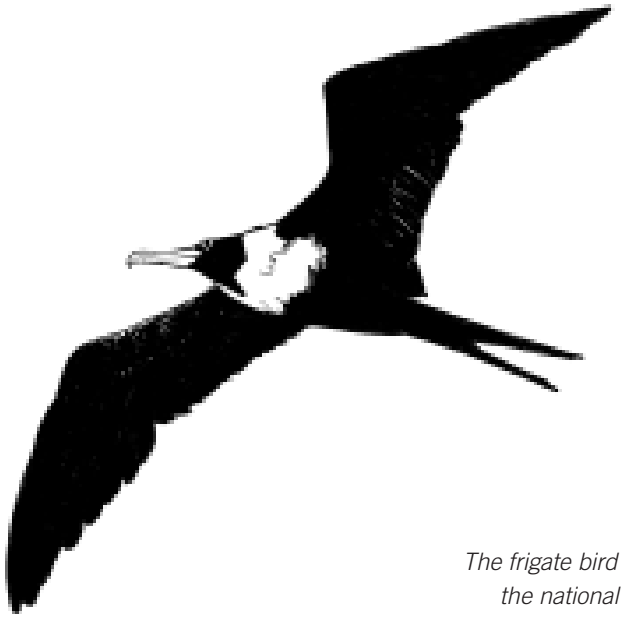
Practise skills or use concept

4. Once the groups have completed their research, ask them to present their findings to the whole class. Encourage the other students to ask questions; allow some time for this at the end of each group's presentation.

5. After the presentation, generate a general discussion about how and why plants and animals are valued in different countries. Emphasise that these cultural symbols can speak louder than words, because a country is unified under a national symbol, giving the people of that country a sense of pride and belonging.

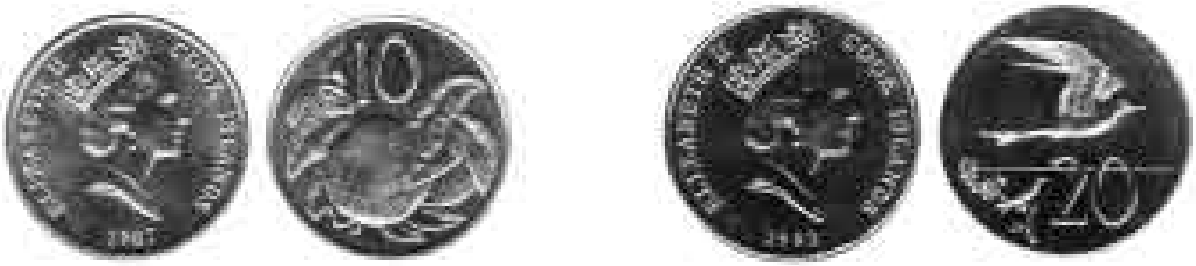
Application

Ask the students to identify a plant or animal from their local area that could be used to represent their class. Encourage them to suggest reasons why they believe this plant or animal would be a good symbol to represent the class. Students could each draw or paint pictures of this plant or animal to display in the classroom.



The frigate bird is used as the main symbol on the national flag of the Republic of Kiribati.

A selection of Pacific Island coins:



Cook Islands

Kiribati

Papua New Guinea

Samoa

Vanuatu

Tonga

Fiji

Papua New Guinea man wearing a headdress made from bird of paradise feathers

Topic

5

Local Biodiversity, Culture and Tradition

Background Reading

Many communities' cultural and traditional practices relate to specific plants and animals in their region or their local area. The diversity of a region's ecosystems and the availability of different plants and animals will greatly influence the cultural practices and beliefs of the people of that region. As a result, the difference in biodiversity within regions contributes to the differences, between culture, traditional practices and, at times, even language within these regions.

Language and culture hold the history, knowledge, experiences and beliefs of a community. Often, much of this language and culture is specific to a place and the ecosystems that make up the environment. For example, some indigenous names of plants and animals also describe the uses, the ***ecological*** relationship, and even warnings or other valuable information about the species. This knowledge may be lost if the language is lost. Some communities may have methods of farming that are more suited to local conditions than modern farming practices that have influenced their culture. For this reason, it is important to support the diversity of knowledge, beliefs and values that different communities hold within their culture.

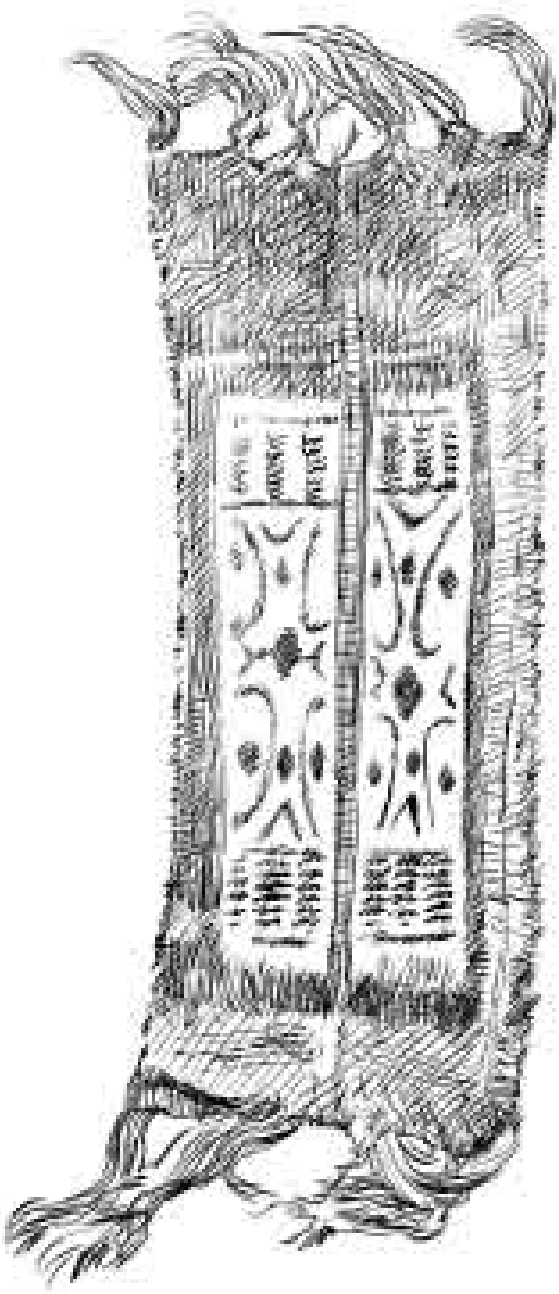
People of the Pacific, along with traditional people of other regions have a long history of using elements of biodiversity as important symbols to represent themselves or parts of their culture. To learn more about symbols of cultural identity that come from biodiversity see the background reading for Activities 3 & 4 in this module.

All cultures have traditions, food, songs, stores and art, along with many other cultural elements, that involve local plants and animals. Although some of these are unique, there are others that have

similarities with those of other ethnic groups in the region or even other groups somewhere else in the world. These similarities could suggest that different ethnic groups from different areas had a connection at some point in history. Through these connections, some sharing of knowledge by ancestors may have occurred, such as the sharing of farming techniques or ways of preparing or storing food. When our ancestors moved throughout the Pacific in search of new places to settle or opportunities for trade, these cultural practices travelled with them.

Similarities in cultural practices and traditions involving biodiversity between countries from different regions could be a result of people having the same use or value for a plant and animal that occurs in both places. An example of this is the use of pandanus to make baskets and mats. Aboriginal women of northern Australia have a long tradition of using pandanus to create materials that are woven and knotted to make baskets, bags and mats. Similarly, a number of Pacific Island cultures, such as Fijian, Papua New Guinean, Ni-Vanuatu and Tongan cultures, make use of pandanus to create mats and baskets.

By learning about connections between biodiversity and culture in different places within our region or in other countries of the world and comparing these to things we have or practise in our own culture, we not only learn more about the world's biodiversity but also the vital role that biodiversity plays in shaping our culture.



Traditional mat from Vanuatu made from pandanus

Diversity of Languages in Decline?

Scientists believe that language is the best indicator of cultural diversity.

More that half of the world's languages have disappeared in the last hundred years. This is a similar pattern to species decline. Species decline is happening largely where plants and animals cannot adapt quickly enough to rapid change within their habitat.

Similarly, many local ***vernacular*** or native languages disappear when communities change quickly and people no longer find their traditional language suitable for conveying their new needs and ideas.

Just as introduced species wipe out many native species, major languages from other countries may cause people to no longer use their traditional languages.

Activity 5
Nature and Culture Connection

Suggested Timing

Teacher preparation time: 20 minutes
Lesson time: 60 minutes

Subject Areas

Social Science, Language Studies

Glossary Words

Immigrants, ethnic, ritual, vernacular, ecological

Materials

- Copies of the six different 'Nature and Culture Connection' worksheets, p. 229–234 (If you don't have access to a photocopy machine then copy the worksheets in advance onto pieces of paper so there is enough for each group.)
- Pens or pencils

Activity summary

This activity requires students to think about their own culture and compare it with a variety of cultures from other countries or communities within their own country.

Outcomes

Students will be able to:

- Compare elements of your culture such as rituals, art, traditional farming practices, food storage and spiritual beliefs with other national cultures.

Tuning in

1. Write the phrase 'Human Culture' on the board. Divide the students into groups of four or five. Ask the students to make suggestions about all the words that come to mind when they think of human culture.

If the students need any guidance, ask them to consider some of the elements of human culture such as rituals, beliefs, language and art. List on the board all the words that each group came up with.

Ask the class if they can think of any ways that human culture and biodiversity may be linked. Give students enough time to think about and discuss their ideas. Encourage students to share their ideas and write their responses on the blackboard.

After this, tell them that they will be doing an activity that will enable them to learn more about these connections between culture and nature.

Developing understanding

2. Divide the students into six different groups. Pass out copies of 'Nature and Culture Connections' worksheet, p.229–234. Give a different worksheet to each group. Ask each group to read through the passage at the top of their worksheet and answer the questions on the worksheet related to their passage. Give the students time to complete the worksheets in their groups. If your students need a bit of coaching or help then you can start of using the first one as an example and let everyone discuss it together.
3. Once they have finished the worksheets, bring everyone together and ask each group to choose someone from the group to read aloud the passage at the top of their worksheet. Then ask a different student in the group to explain the answers they came up with as a group.

Below are some possible answers to the focus questions on each sheet that you might find useful during this session.

Worksheet 1: The Quetzal is a Sacred Bird

a. Only certain people could collect or wear quetzal tail feathers. How do you think this might have affected quetzal populations?

Restrictions on who could collect quetzal feathers probably helped protect these birds. Restrictions meant that fewer birds would be caught and injured. In addition, the practice of pulling out the feathers and letting the birds go didn't harm the quetzal populations as much as killing the birds would have.

b. Are there animals or plant products used in your culture or community that have restrictions put on them to protect their populations?

Answers will vary depending on the country you are in. Many chiefs or governments put restrictions on harvesting certain species of fish and shellfish at particular times of the year or during certain ceremonies. There may be 'closed seasons' on things such as birds, or wild bird or turtle eggs, and some areas have banned the harvesting of turtles.

Worksheet 2: Clothes Made of Animal Skins

a. Why do you think that early settlers in North America used deer skin to make their pants?

Animal skins were probably one of the few readily available sources of clothing material that could protect settlers from cold temperatures and thorny shrubs. When the settlers killed deer and elk for meat, it was efficient to use the skins for clothing instead of letting them go to waste.

b. What type of clothing is worn traditionally in your culture? Does any of it come from nature? Do any of these clothes you wear today have a connection with nature?

Answers will vary depending on the country you are in because the type of clothes people wore traditionally varies from place to place. In some countries people wore clothing made of leaves, grass skirts, bark-like tapa or even animal skins. All these materials would have been collected from nature. Today, modern clothes come from both natural and synthetic materials. Silk, cotton, wool and linen are all common natural materials that clothes are made from today. Leather from animal skins is also still worn today as shoes, belts and sometimes jackets.

Worksheet 3: Purple: A Sign of Importance

a. Why do you think only high-ranking and wealthy people wore purple? Why can all people wear purple today?

In many societies, rare products are used by only those who can afford them. Snails were the only source of purple dye, and because each snail produced only a little bit of dye, the dyes were considered very valuable. Wealthy or prominent people were probably the only ones that could afford to buy them or to pay for someone to collect them. Today, purple dyes (natural and synthetic) are readily available and are no longer any more expensive than other dyes.

b. Are there things in your culture that only high-ranking or wealthy people wear? What makes these things valued?

Answers will vary depending on the country you are in. In some Pacific societies chief or head men have particular items that they wear that identify them as high-ranking; these things include headdresses, shell or bone jewellery, and pig tusks. Some cultures have body markings such as tattoos or paint that identify them as important. Other valuable things include precious gems (diamond, rubies, emeralds, and so on), precious metals (gold, silver), and other materials that are scarce or expensive to produce. They are valued so much because they are expensive to buy and hard to find.

Worksheet 4: Buckingham Palace Bear Hats

a. Why do you think the elite French soldiers first wore hats covered in bear fur?

Wearing hats made of the fur from a bear was considered to be a sign of strength and victory in battle. Killing wild bears was also a sign of power, strength and manliness.

b. Do people in your culture use animals as symbols of strength? If so, in what ways?

Answers will vary depending on the country you are in. For example, in some countries sharks or shark teeth symbols are tattooed onto men's bodies as a symbol of strength.

Worksheet 5: Leaders in Lion Masks

a. What qualities or characteristics of lions do you think the dancers respect? Why do they demonstrate these characteristics in a story about human leaders?

The dancers probably wanted to imitate power, strength, bravery, dominance and control. They would be demonstrating these characteristics in a dance about human leaders because they would hope or want their human leaders to have these same characteristics when it comes to leading their people and making decisions that represent them.

b. How are animals or plants used as symbols in your culture or community? What characteristics or qualities of these animals or plants do people value?

Answers will vary depending on what country you are in. Examples include owls as symbols of wisdom, ants as symbols of hard work, and doves as symbols of peace.

Worksheet 6: Pigs Help to Find Food

a. Without the help of a dog or a pig, what skills would a person need to help them find truffles? List as many as you can.

A truffle hunter would have to have knowledge of the type of habitat where truffles grow and skills at locating these mushrooms in the wild.

b. What type of foods do you still collect from the wild? Where do you get most of your food today?

Answers will vary depending on what country you are in. Fish, shellfish, crabs, fruit bats, birds and turtles could all be foods that are still collected from the wild today. Plants such as fruits, seeds, roots and leaves are also collected from the wild and used as food by many still today. Depending on where the students live, many may get the majority of their food from shops and stores; others may still get the majority of their food from the wild or from family or community gardens.

Application/Reflection

4. After the group presentation you may wish to broaden the discussion by asking the following questions:

- What might happen to the cultures in the examples you've gone through if the species they used disappeared? *The people may have to adapt, or choose to replace that species with another one or with something manufactured. This means that they may gradually lose their tradition altogether.*
- Can you think of any other ways that these cultural traditions, which are connected to biodiversity, might threaten biodiversity? *Use could lead to overuse, especially if the human population grows or the species population decreases for other reasons.*
- Can you think of any other ways that these traditions might help preserve or enhance biodiversity? *People may be encouraged to sustain the species, or they may be adjusting to the species' status because they know it very well. In this case local knowledge of that particular species' traditional management practices may increase the possibility of species' survival.*

Adapted with permission from WWF, Windows on the Wild: Biodiversity Basics, An Educator's Guide to Exploring the Web of Life.

Nature and Culture Connection Worksheet 1

The Quetzal is a Sacred Bird

The forests of Central America are home to one of the world's most beautiful birds, the quetzal (Ket – SALL). The male quetzal is bright green and has a red chest and belly. Its tail feathers can grow to be more then 60 centimetres long.

The quetzal is a sacred bird to the traditional people of Guatemala (the Maya). The long feathers of the male were extremely valuable and used as decorations on headdresses of only the most important people in the community. The Mayas trapped the birds, plucked the long tail feathers and then let the birds go free, to grow another set of tail feathers.

Not just anyone was allowed to trap the birds. The right to trap quetzals was inherited by only a few people.

Focus Questions

A. Only a certain people could collect or wear quetzal tail feathers. How do you think this might have affected quetzal populations?

B. Are there animal or plant products used in your culture or community that have restrictions put on them to protect their populations?

Nature and Culture Connection Worksheet 2

Clothes Made of Animal Skins

Early settlers in North America often wore pants made of deer skins. These provided good protection against cold weather.

Leather pants and knee-high leather boots also helped protect their legs from being scratched by bushes or from being bitten by rattlesnakes.

Focus Questions

A. Why do you think that early settlers in North America used deer skin to make their pants?

B. What type of clothing is worn traditionally in your culture? Does any of it come from nature? Do any of the clothes you wear today have a connection with nature?

Nature and Culture Connection Worksheet 3

Purple: a Sign of Importance

In ancient Rome, ministers, judges and wealthy people were the only people who wore purple. That is because the only known source of purple dye was from a type of marine snail.

These snails live in rocky, shallow water and each snail only produces a tiny drop of dye.

Thousands of tiny snails were killed in ancient Rome for their purple dye.

Focus Questions

A. Why do you think only high-ranking and wealthy people wore purple? Why can all people wear purple today?

B. Are there things in your culture that only high-ranking or wealthy people wear? What makes these things valued?

Nature and Culture Connection Worksheet 4

Buckingham Palace Bear Hats

The guards at Buckingham Palace wear bright coats and tall furry hats. Their distinctive hats are covered in Canadian bear fur in a tradition that is hundreds of years old.

Elite French soldiers in the 18th century wore hats covered in bear fur. When British soldiers defeated Napoleon's soldiers at the Battle of Waterloo in 1815, they earned the right to wear the French soldiers' bear fur hats.

Today, Buckingham Palace guards and other British guards still wear bear fur hats.

Focus Questions

A. Why do you think the elite French soldiers first wore hats covered in bear fur?

B. Do people in your culture use animals as symbols of strength? If so, in what ways?

Nature and Culture Connection Worksheet 5

Leaders in Lion Masks

In many parts of Africa, lions and leopards are used as symbols in art.

In the African country of Mali, artists carve lion masks out of wood. These masks are worn during special ceremonies where dancers pretend to be lions.

These dancers tell a story about how human leaders should behave and the qualities or characteristics they should have.

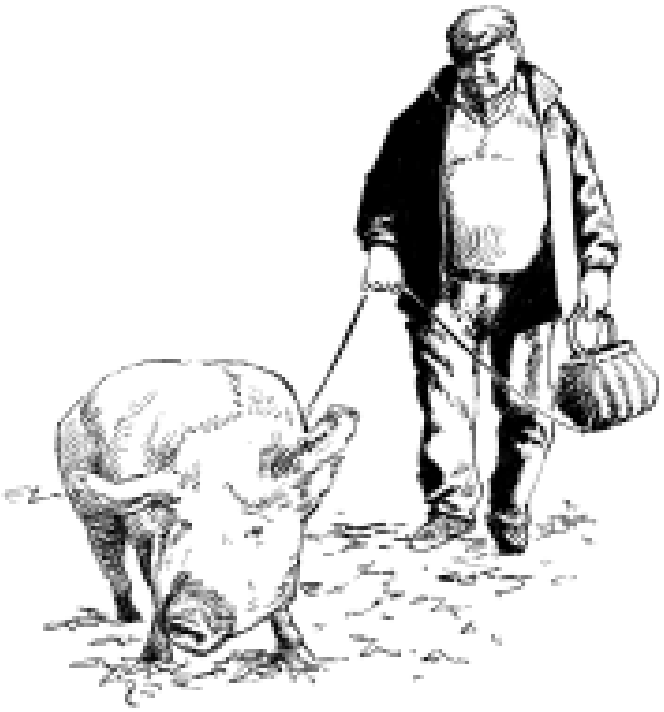
Focus Questions

A. What qualities or characteristics of lions do you think the dancers respect? Why do they demonstrate these characteristics in a story about human leaders?

B. How are animals or plants used as symbols in your culture or community? What characteristics or qualities of these animals or plants do people value?

Nature and Culture Connection Worksheet 6

Pigs Help to Find Food



Few foods are as rare or as special in Italy as the wild truffle. Truffles are a little like mushrooms and grow in the roots of oak trees. They are used to add flavour to pastas, meats and other food.

Truffles are very tasty but they are not easy to find, because they grow underground and only in unpredictable places. People who want to harvest truffles have to be experts at looking for signs of truffles. Traditionally, many would use dogs or even pigs to help them find truffles.

Focus Questions

A. Without the help of a dog or a pig, what skills would a person need to help them find truffles? List as many as you can.

B. What types of foods do you still collect from the wild? Where do you get most of your food today?

6 Biodiversity, Resources and Economics

"Only when the last tree has died and the last river has been poisoned and the last fish has been caught will we realise that we can't eat money."

Cree proverb

Module Introduction

Biodiversity, Resources and Economics

Environmental protection and the management of natural resources are closely linked with the economic and social pressures of the communities we live in. Protecting the environment not only impacts *on* our societies but it is impacted *by* our societies.

Environmental protection is linked with social and economic issues and is influenced by our values, beliefs and decision making processes. In this module, students will become more aware of the social and economic effects of protecting the environment. This will help explain why making decisions for our environment can be difficult.

Concepts of the cash economy and the impacts of using resources for export are covered to give students an understanding of how the resources of our countries are sought after and exploited by people worldwide. The module tries to make clear that environmental protection and resource

management are a global issue with pressures for resource use coming from outside of our countries as well as from within.

Topics on decision making and conflict are included here to give students knowledge of sound decision making processes as well as possible conflict resolution processes. In this module, students are encouraged to look at their own beliefs and values in terms of the environment, as well as their needs and wants as they relate to the environment. These concepts will assist students to make realistic and reasonable decisions about their local environments.

This module has six Topics that cover:

1. Biodiversity and Decision Making
2. Conflict and the Environment
3. Needs, Wants and Natural Resources
4. Distribution of Resources
5. Trade and Exploitation of Resources
6. Traditional Economy versus Cash Economy.

Our students are our future leaders, elders, chiefs and politicians. We must prepare them with the skills for understanding not only our societies and economies, beliefs and values but those of the world with whom we must trade and make agreements and against whom we must defend our resources from exploitation. This module attempts to give students the relevant skills and understanding to take on the roles their futures will demand. We must know and understand ourselves but also our place in the worldwide community.

Activity Details Summary: Module 6, Biodiversity, Resources and Economics

Topic	Activity Name	Activity summary	Outcome	Subject Areas	Timing
Biodiversity and decision making	Activity 1 – Decision Maker Survey	This activity will help students to gather information about decision making and decision makers through a survey. Students will use this information to construct a 'Decision Makers' diagram to show whose decisions affect others and how.	Investigate who makes decisions in their home, school and community. Explain how these decisions affect them and the biodiversity of the areas around them.	Social Science, Science, Language Studies	Teacher preparation time: 30 minutes Lesson time: 90 minutes
Conflict and the environment	Activity 2 – Biodiversity and Conflict	This activity will help students understand why people have conflicts, as well as allowing them to view conflicts from different people's points of view. The students will learn to appreciate how different people value resources differently. This activity also provides an opportunity for students to make use of a 'Conflict Resolution Model' in the context of conflicts about the environment and resource use.	Investigate how differences in personal values and beliefs can create obstacles to solving problems related to biodiversity use, loss and conservation.	Social Science, Science, Language Studies	Teacher preparation time: 60 minutes Lesson time: 90 minutes
Needs, wants and natural resources	Activity 3 – Needs and Wants	This activity will help students to think about the difference between needs and wants, and the ways in which both needs and wants impact on our environment. The students will also be able to identify their own needs and wants.	Examine wants and needs and identify how choices people make can put pressure on natural resources.	Social Science, Science, Language Studies	Teacher preparation time: 60 minutes Lesson time: 90 minutes
Distribution of resources	Activity 4 – Great Resource Grab	By conducting this activity students will discover some of the problems faced by the world as the human population increases and focus on the unequal distribution of resources among six regions of the world.	Explain how the distribution of population and resources varies among different regions of the world and how this affects biodiversity and the environment in your area.	Social Science, Maths, Physical Education	Teacher preparation time: 60 minutes Lesson time: 90 minutes
Trade and exploitation of resources	Activity 5 – Exploit and Export	This activity demonstrates the uneven use of limited resources so student can develop an awareness of protecting and being fair when considering our limited resources. The students also look at examples of resource exploitation for export from the Pacific region in order to develop an understanding of the issues involved.	Identify a local example of resource exploitation for export and consumption in another country.	Science, Social Science	Teacher preparation time: 60 minutes Lesson time: 60 minutes
Traditional economy versus cash economy	Activity 6 – Cash Society	This activity helps students to understand the differences between living in a traditional economy versus a cash economy. They are able to consider the advantages and disadvantages of both and have the opportunity to take part in a traditional economy exercise.	Discuss the advantages and disadvantages of living in a cash society and be able to compare this to a society of subsistence living.	Science, Social Science	Teacher preparation time: 40 minutes Lesson time: 90 minutes (plus an additional session for the guest speaker) Extra time needed to complete the traditional economy exercise.

A meeting of chiefs, who are traditional decision makers

Topic

1

Biodiversity and Decision Making

Background Reading

Decision making is part of everybody's life. Every day we make decisions. Decisions can be made by an individual person for themselves or others may make decisions for them. In all societies, only people in a particular position or with a particular status can make certain types of decisions. Examples of these kinds of decisions include those made by government leaders at the national level, by principals and teachers at school, by a chief in the community and by parents or older family members in the home.

Decisions and natural resources

Making decisions about the use of natural ***resources*** can be difficult because people hold different ***values*** and views on how resources should be managed and used. For example, the decision to allow access to ***customary*** land for mining exploration needs careful consideration. The ***traditional*** landholders, resource users and the community need to make this decision. This decision may affect many people – those within the tribe or community, as well as those people at a distance. Because a number of different people will be either directly or indirectly affected by these decisions, decisions need to be made carefully with full consideration of the consequences (both positive and negative) to all people.

Important decisions need time. The decision should be discussed with the appropriate people (which may include obtaining ***legal advice***) and thought about carefully. Sometimes decisions need to be made quickly, but this is not usually the case with ***resource management*** because the resource is there, and will remain there, while the decision making process is completed. There is no need to rush into an agreement, especially with outside interest groups such as large companies. If a company is sincere about the future of the resource and the community, they will wait for a well thought-out decision to be made.

Different levels of decision making

At home

Parents and older family members are usually the main ***decision makers*** in the home. Here are some examples:

- Adults decide what is planted in the family garden and where and when it is planted.
- Fathers decide where to go and cut firewood.
- Mothers decide what is collected from the garden and what meals are prepared.
- Mothers and fathers decide what the children may or may not do.

At school

The decision makers in schools usually include the principal and teachers but parent and community committee members may also assist in making decisions. Here are some examples:

- The principal decides whether or not students progress to the next year level.
- Teachers decide on educational materials they will use.
- Teachers decide what activities the students will complete and how they will use the materials.
- The school council committee decides on a fundraising event for the school.

In the community

The behaviour and values of a community can have a significant impact on biodiversity and the environment because it is at this level that most decisions about resource use and management are made.

Within the community level of decision making, there are further levels:

- The primary decision makers – usually the chiefs and landowners
- The secondary decision makers – other chiefs and families (sometimes from a neighbouring village) who decide to support or not to support the primary decision makers
- People in the village or nearby village who have held access rights to the area being discussed in the decision
- Representatives of any organisations involved
- Other local people

Here are some decisions that are made at a community level:

- Where the community should construct toilets and dump rubbish
- Where to make developments to land, if any
- Where tabu areas are and for how long they are tabu.

Decision making by council or governments

In government

Important decisions about the availability of resources, and their management and conservation are made at the various levels of government in Pacific Island countries. Here are some examples:

- Creating policies to ensure appropriate resource management
- ***Urban*** planning to prevent development that might result in negative impacts on our natural resources
- Developing and enforcing environmental legislation to prevent pollution
- Working with communities to find and carry out solutions to environmental problems

The Role of Women

Many tasks undertaken by women in our communities require an abundant supply of products and materials from the natural environment. Women therefore play a key role in managing the use of the natural environment and monitoring the health and availability of forest products, marine resources and wildlife.

However, women are frequently left out of community planning and decision making. It is important to ensure that opportunities are made for women to become involved in discussions and decision making processes, and that their ideas are heard as the harvesters and caretakers of the environment.

Activity 1
Decision Maker Survey

Teachers' notes:

Younger students may find the 'Decision Makers' cutting out part of the activity difficult. If so, the teacher could construct a single diagram and fill it in during a class discussion of survey answers.

Suggested Timing

Teacher preparation time: 30 minutes
Lesson time: 90 minutes

Subject Areas:

Social Science, Science, Language Studies

Glossary words

Influence, decision maker, decision making, resource, survey, interview, values, legal advice, resource management, urban, traditional, customary

Materials

- Student exercise books
- Survey worksheets (to be drawn up by students)
- Coloured paper (at least 4 different colours, if available)
- Poster paper (if available)
- Cup
- Plate
- Serving dish

Activity summary

This activity will help students to gather information about decision making and decision makers through a ***survey***. Students will use this information to construct a 'Decision Makers' diagram to show whose decisions affect others and how.

Outcomes

Students will be able to:

- Investigate who makes decisions in their home, school and community. Explain how these decisions affect them and the biodiversity of the areas around them.

Tuning in

Begin class by asking students to discuss among themselves the following questions:

- What does 'decision making' mean?
- Who makes decisions in their home, at school and in their community?
- What kinds of decisions do we make by ourselves or with others?

Ask your students to suggest answers to the questions and record them on the blackboard.

Developing understanding

Organise students to conduct a 'Decision Maker' survey where different students will ***interview*** different decision makers in the community, home and school to determine what decisions they are responsible for making. See possible questions, right.

Divide the students into three groups. One group will interview decision makers at school, the second, at home and the third in the community.

Example:
In school, the students will survey: the principal /teacher/student
At home: father/mother/sibling/self
In the community: chief/church leader/councillor/self

Use the Survey Worksheet to record information during the survey.

The students can use this basic list of questions as a guide when conducting their interviews, but each group should also come up with additional questions that are specifically related to the decision maker they are interviewing.

Encourage the students to come up with open-ended questions rather than questions that have 'yes' or 'no' answers.

- How do you make decisions? What process do you go through?
- When do you make decisions?
- What type of decisions do you make? What things do you make decisions about?
- Who do you make decisions for?
- How do your decisions affect the people you make decisions for? (*There may be positive or negative effects.*)

Survey worksheet

School

Principal	(Ask students to draw up the appropriate table for their survey leaving enough space to complete their notes here – it should take up a whole page in their exercise books.)
Teachers	
Students	

Home

Father	
Mother	
Brother/Sister	
Myself	

Community

Chief	
Landowners	
Myself	

Practise skills

Hand out copies or write up on the board 'Tips for Interviewing'. Carefully explain each tip below.

You might like to give your students some practice conducting interviews. Ask your students to form groups of four. In these small groups, the students can ask each other a sample of the questions they have come up with. You could also get your students to practise by interviewing their parents.

Once students become confident in conducting an interview, have your students conduct their survey using their worksheet to record their answers.

Application

Using the information they have gathered while completing the decision maker survey, students are to construct a 'Decision Makers' diagram to show whose decisions affect others and how.

Instruct students to cut out the following shapes, preferably from four different coloured pieces of paper – if you do not have access to coloured paper ask students to colour each shape differently with pencils or marker pens.

1. Draw around a cup and cut out to make a small circle.
2. Draw around a plate twice (on two different pieces of paper) and cut out the two large circles.
3. Draw around a large serving dish (or draw a shape comfortably bigger than the two plates together) and cut out the shape.
4. Collect a poster size piece of paper to construct the diagram on.

On the small circle, tell students to write their name in red. In blue or black, write some examples of decisions they make. (At each level, try to prompt students to think of examples of decisions that affect biodiversity.)

Tips for interviewing

Before the interview

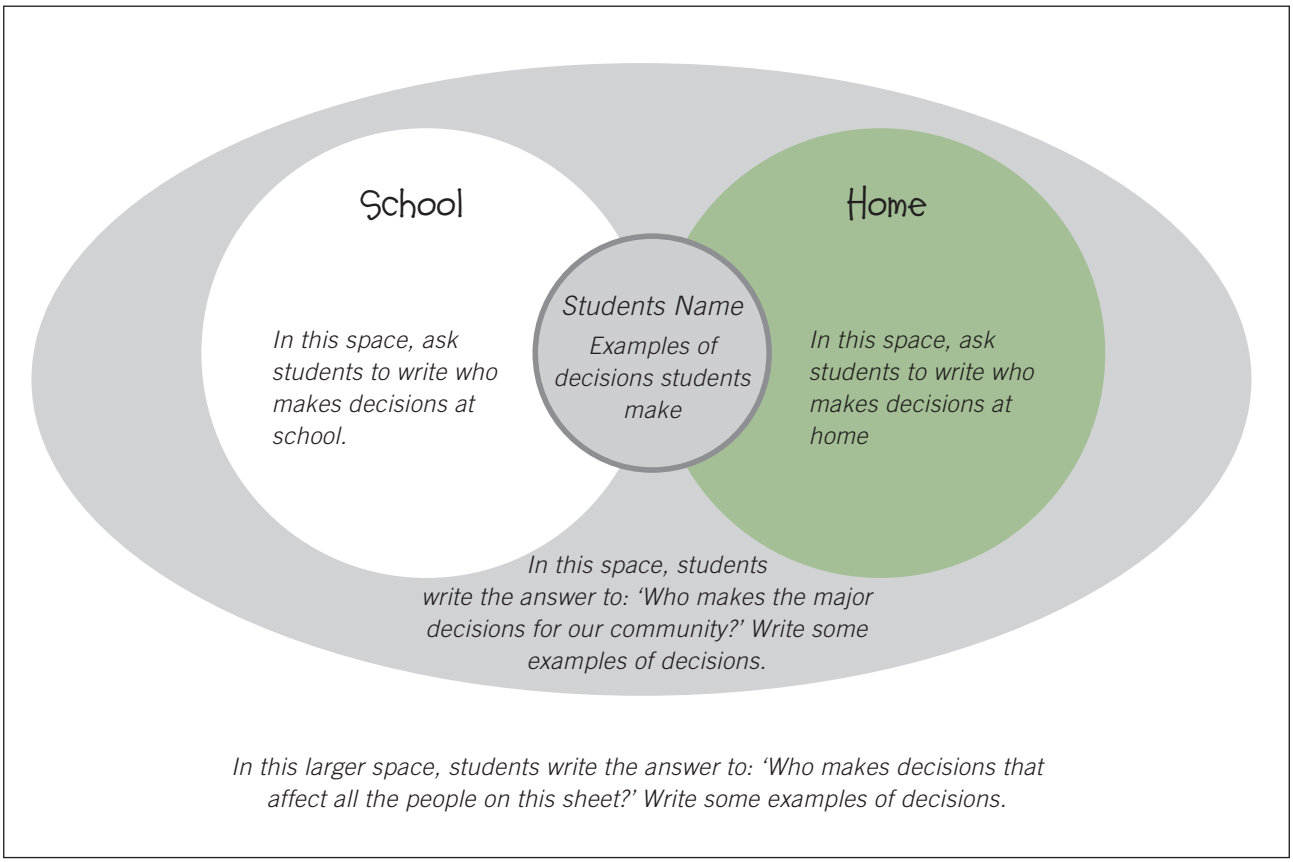
- When you contact your interviewee, introduce yourself, tell them your name, your school, what year you are in, and the purpose of the interview.
- Arrange a time for the interview.
- Make sure your questions are ready in advance. Limit the number of question you ask to about eight.
- If you are going to work in pairs, decide who will take notes and who will be asking the questions.

During the interview

- Be polite and considerate.
- Before you start to ask questions, explain how you are going to use the information.
- Ask your questions in a clear voice and give your interviewee time to think and then answer.
- At the end of your interview, thank the person for taking the time to help you with your project.

After the interview

- Send a thank you note a few days after the interview.
- If you are working in pairs, meet soon after your interview with your interviewing partner to compare notes, thoughts and information.



Ask students to place the two larger circles so they are touching and glue them in place by putting the small one on top as shown below. Write 'Home' in one large circle 'School' in the other.

In the 'Home' circle ask students to write who makes decisions at home. In the 'School' circle ask the students to write who makes decisions at school. Write some examples of the types of decisions this group makes in blue or black.

Now students glue the three attached circles onto the larger serving dish shape.

In the larger shape, ask students to write in red the answer to: 'Who makes the major decisions for our community?' Answer: *Chiefs, Community Leaders, Elders or Council of Chiefs*. Write some examples of the types of decisions this group makes in blue or black.

Students then paste the whole diagram onto a piece of poster paper. On the poster paper they write the answer in red to: 'Who makes decisions that affect all the people on this sheet?' Answer: *the Government*. Write some examples of the types of decisions this group makes in blue or black on the poster paper.

The students have constructed a Venn diagram that shows the spheres of influence of different decision makers in their community.

Looking at the completed poster, students should be able to see that there are different levels of decisions made by different people.

Ignoring traditional or contemporary restrictions can cause conflict

Topic

2

Conflict and the Environment

Background Reading

Different people have different personal ***beliefs*** and ***values***. Our personal beliefs and values cover our responses to a range of things - from the importance we place on our family to our ideas about religion, the role of men and women, and how we care for the environment. These are determined by our family and cultural background as well as our life experiences. Most usually, our values and beliefs form early in our life, but they change and develop throughout our lives according to the things we experience. Different people have different values and beliefs because of their different experiences. Today, many countries in the Pacific have internal ***conflict*** because of conflicting personal beliefs and values about ***resource*** use and management.

Conflict and conflict resolution

When the activities of two people, or two groups of people with different values and beliefs, start to impact on each other we have a conflict. Although conflicts have often led to warfare in the past (and will continue to do so), this is not the best way to resolve differences. ***Conflict resolution*** is used in Pacific islands in situations such as 'Village Court'. In these instances it is the role of our community leaders to help us to resolve the problems that we have, so we can all live in harmony. There are a number of ways we can resolve conflict but the best result that can occur is known as a win–win solution, where neither party feels that they have suffered unnecessarily in the decision.

Conflict and the environment

The main conflict that tends to arise when we begin to look at the environment and its ***conservation*** is the conflict between conservation and development. If we were to preserve all of our remaining natural areas then most development would have to cease. But if development was allowed to go ahead without any restraint, then our natural environment would be destroyed, taking

with it all the resources on which we depend. There has to be some middle ground that allows for both responsible development and ***sustainable management*** and use of our natural resources.

Conflict of resource users

Sometimes there is a conflict when two groups of people wish to make use of the same limited resource. This type of conflict is usually settled in local courts, which can make rulings on land ownership and therefore decide who is allowed to use the resource the land contains. Bigger, and more difficult, problems can arise when the use of one resource impacts on another resource, for example, when a mine is opened along a river in the mountains, and pollutes the water downstream. This has implications for all the communities that live downstream as their access to a clean water resource is affected. Even though the mine is not taking the water, its operation is affecting another resource and the people who rely on that resource. In cases like this, a conflict resolution model may need to be called upon as both parties have the right to use their respective resource.

A conflict resolution model

The aim of conflict resolution is a win–win situation. To achieve this outcome a number of steps can be followed, but it is sometimes difficult for people in conflict to really listen to each other's point of view. For this reason it is helpful to have a mediator, who is a person who is unbiased and who will keep the process on track. A good mediator will not allow one or the other party to dominate the discussion and will stop arguments from occurring.

Conflict Resolution Model

- A discussion is held between the conflicting people or groups where they talk about their expectations of a win–win situation. What do they want out of the decision and why? This step is only to express each of the participant's expectations; it is not for arguing or discussing how these expectations might be achieved.
- Each person or group's interests are then defined. What exactly does each want? The mediator may need to play an active role in helping each person or group to define their ***goals***, as this can sometimes be difficult when we are in the middle of a conflict.
- The conflicting people or groups then need to think about creative options for solutions. It could be a good idea for them to go back to their families or villages and also ask them for their ideas, especially if the decision is going to affect them or their way of life. The more ideas that can be brought back to the conflict resolution, the better. The ideas should try to cover the goals of both groups.
- Back in discussion, the conflicting people or groups talk about the various ideas that have been put forward and look at ways of combining the ideas to come up with a solution that both parties are happy with. When differences are settled in this way, with each side making concessions, it is called a compromise.

Examples of environmental conflict

Case Study:
The Mine that Destroyed Two Rivers

For 15 years, an Australian company called BHP had been dumping hundreds of tonnes of waste from its copper mine into the Ok Tedi River system in Papua New Guinea. The waste in the Ok Tedi ended up in the Fly River, which flowed into the sea. This waste had a terrible impact, causing so much pollution that vast areas of the two rivers were destroyed. Where there was once lots of fish for the local people, there were now none. Where there were once healthy forests along the rivers, there were now just dead trees. Many people had been forced to leave their traditional lands because of pollution.

A few years ago, the communities affected by the mine decided to tell their stories to the Australian media. Film of the pollution shocked many people in Australia. People with shares in BHP started to ask the heads of the company why they were polluting rivers in someone else's country. Then, an Australian law firm approached the Ok Tedi landowners and offered to take BHP to court. After a long battle in the courts, BHP was forced to pay millions of dollars in compensation to the affected people. This is an example of a conflict between the landowners and BHP Company, and a conflict between the environment and development.

Case Study:
Different Beliefs and Values: How Many can You Count?

A village chief went to the town and had a meeting with a logging company. The chief signed a ten-year contract to log his village's land, without talking to the people of his village first.

When the chief returned to his village, he came with a representative of the logging company and they called a village meeting. The chief and the logging company representative told the community about all wonderful things the village could have if the area was logged. There would be money from the timber and jobs for the local men, they could rebuild the primary school, and each family would be given a 10 kg bag of rice.

Many of the people thought the deal sounded good. They were thinking of the money they needed for school fees, clothes and food from the store. They were also happy to hear about the rice as they really like to eat rice with their soup but it was expensive at their local store. Other people were more worried about where they would have their gardens and how they would grow their own food. They didn't want to lose their forest, which was where they hunted and gathered wild foods, collected firewood and building materials, and found their custom medicines. The school students who were at the meeting were looking worried. They had just learnt about how tree removal loosens the soil and causes erosion. They knew that if the logging went ahead their river, where drinking water was collected, would become muddy and their reef at the mouth of the river would die from becoming silted up. They would lose their fishing resources as well as their forest.

This example shows many different personal beliefs and values about the same resource.

Activity 2:
Biodiversity and Conflict

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 90 minutes

Subject Areas

Social Science, Science, Language Studies

Glossary Words

Goal, conflict, conflict resolution, belief, value, opinion, role-play, resource, conservation, sustainable management

Materials

- Paper
- Sticky (celo) tape
- Scenario cards

Activity summary

This activity will help students understand why people have conflicts, as well as allowing them to view conflicts from different people's points of view. The students will learn to appreciate how different people value resources differently. This activity also provides an opportunity for students to make use of a 'Conflict Resolution Model' in the context of conflicts about the environment and resource use.

Outcomes

Students will be able to:

- Investigate how differences in personal values and beliefs can create obstacles to solving problems related to biodiversity use, loss and conservation.

Tuning in

1. Distribute one piece of paper to each student in the class. Ask the student to write on their piece of paper a goal they wish to attain for their family; a short sentence or one or two words will be enough. Students might need assistance to think of possible goals.
2. Ask each student to place their piece of paper in any part of the room, as long as they can see it. They might like to fix it to the wall using tape.
3. Divide the class into smaller groups of ten to twelve people and ask each group to form a circle with each person facing outwards. The group should stand shoulder to shoulder and link their arms.
4. Tell the class that during this activity they cannot talk or unlink their arms.
5. When the groups are ready, give them the signal to move towards 'achieving' their goals (this is done by trying to move towards the goal they wrote earlier on their piece of paper).
6. The activity ends when everyone reaches their goal or gives up.
7. After this activity, ask the students the following questions:
   a. How did you feel going after your goals when you were held together with the rest of the group?
   b. Were you able to reach your goal? Was it difficult?
   c. What made it difficult for you to reach your goal?
   d. Do you think this happens in real life situations?
   e. Do you think this could cause conflict?
   f. What steps need to be taken to stop or prevent conflict occurring?

Developing understanding

1. Read through with the class or hand out copies of the case study 'Different Beliefs and Values: How Many can You Count?' about conflicts related to biodiversity use. (You will find it in the background reading).

2. Lead a discussion with the students to start them thinking about the situation presented in the story. Use the following questions to guide the discussion:
   a. Why is there a conflict?
   b. Who is involved in the conflict?
   c. How do the conflicting groups value the resource. What are their personal values and beliefs related to the resource?

Answers can be written up on the blackboard.

Use concept

1. Divide the students into small groups (about four groups). Provide each group with a scenario card. Each card has a story that involves characters that have differing uses for or values about the same biological resource. (See 'Scenario Cards' on p. 250)

2. 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 stated in their specific scenario card. Each group presents their role-play, expressing the ***opinion*** and values of the character to the rest of the class. You might like to spread the role-plays over a number of lessons.

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

4. Present the 'Conflict Resolution Model' (you will find it in background reading) to the class, and using one group's scenario and characters, go through the process. Encourage the class as a whole to add ideas and thoughts for defining the interests of the conflicting people or groups and for coming up with solutions.

Reflection

Ask the students to write a comparison of struggling to your goals, as they did in the 'Tuning In' activity, and working together for a solution, as they did when using the conflict resolution model and the scenario cards.

When they are writing, encourage them to consider the following questions in the comparison:

- How did each method feel?
- Which is likely to be more successful in the long term?
- Which will keep more people happy?

Scenario Cards

Tourist and Fisherman

A tourist went swimming and diving on the 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's actions and complained to the village chief, but the fisherman argued that he has 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. The people from a nearby island did not want the legislation passed to make the island a Marine Protected Area because they used the reef there to catch their food. They demanded compensation if the legislation went ahead.

Family and Village

There was a village on a river. The people used the water from the river to drink, wash and swim. One day, a family decided to build a house on their land upstream of the village. They cleared trees along the river to build their garden. As a result, the river downstream became dirty and some living things in the river died. The people of the village became angry with the family and wanted them to stop using the river and the riverbanks.

Chief, Tribe and Businessman

There was a tribe that owned an area near a beautiful beach. A businessman came and bought the land from the chief. The people of the tribe did not agree with the sale of the land but the chief made the decision without asking their opinions. The businessman built a resort hotel and blocked off the beach so that the people from the tribe could no longer go to the beach area and use its resources.

Two Communities

There was a reef between two communities that both used to collect trochus. One community valued the trochus as a customary food in their marriage ceremony. The trochus must be part of the ceremony or it signifies that the marriage will not be happy and gives a bad reputation to the families of the bride and groom. The other community gathered trochus to sell for button making and they took too many, leaving only a few for custom feasts for the other community.

Communities, Chief and Grazier

There was an island with many communities around the coast and steep mountains in the middle. Each community owned land from the coast and up into the mountains directly behind their villages. One chief, who owned a large area of land, sold the tops of all the mountains to a grazier so he could clear the area and graze cattle in the steep areas, which were not used very much by the villages. All the communities were affected because their rivers became polluted.

Common items considered as 'wants'

Topic

3

Wants and Natural Resources

Background Reading

We make use of ***resources*** for one of two reasons. The first is that we need to use the resource; the second is that we want to use the resource. There is a clear difference between ***needs*** and ***wants***. A need is a necessity for survival. The term 'needs' covers such things as food, water and shelter. Wants are different; these are things that we like because they make our life more comfortable. The term 'wants' covers things such as DVD players, television and soft drink.

But this is a very simple way of looking at it. In reality, the definition of our needs and wants will change depending on the type of society we live in and our environment. For example, a warm coat might be nice for us when the cooler months come and it will make us more comfortable, but for people from very cold climates, such as in Alaska, warm clothing is necessary for survival because without it they would freeze to death. For us, the coat is a want but for Alaskans, the coat is a need.

Different people's needs and wants place varying ***pressures*** on our natural resources.

Natural resources: meeting our needs and wants

A serious threat to the wellbeing of all people of Pacific nations is that we are running out of some resources. The pressure on natural resources comes from the growing needs and wants of an increasing population. Satisfying needs puts pressure on resources, but most damage is done when we also try to satisfy wants.

Modern living can come at a very high cost when people start buying things they do not really need, such as tinned and processed food, alcohol, junk food and expensive clothing. Indulging in our wants puts pressure on our limited resources because we use the resources to earn the money that we spend on these unnecessary items. The story at the top of p. 252 shows how our wants can be very damaging to our environment.

DVD Player versus Biodiversity

Joseph is a landowner in a village in Vanuatu who wants very much to watch DVDs with his family. Joseph knows he needs money to buy a DVD player, a generator, fuel and DVDs. He has seen all these things in stores in Port Vila and plans to make the money he needs by growing kava to sell. Joseph clears a large area of bush to make his kava garden. A big area of natural forest is lost and the animals that used to live in it run away or die. He grows the kava, harvests it and sells it. The area of the kava garden is now left bare and in the next rain a lot of erosion occurs. When Joseph buys the DVD player, DVDs and the generator, they are packed in a lot of plastic. This becomes litter that is difficult to dispose of in the village. Jopseph and his family enjoy watching the DVDs but soon he runs the generator without the proper fuel because the fuel is hard to get on his island. The generator breaks down. Nobody in the village knows how to fix it so it sits in Joseph's yard and goes rusty. Eventually he throws it out on the reef to get rid of it and it poisons the coral and fish.

Activity 3
Needs and Wants

Suggested timing
Teacher preparation time: 60 minutes
Lesson time: 90 minutes

Subject Areas
Social Science, Science, Language Studies

Glossary Words
Resource, pressures, needs, wants, vote, rank

Materials
- Blackboard
- Bag or box (to hold tickets)
- Small pieces of paper or tickets (to write needs and wants on)
- Paper for students' drawings
- Poster or butchers' paper
- Coloured pencils
- Glue or tape
- Old magazine and newspapers (optional)

Teachers' notes:

It is important in this activity that students are not made to feel guilty about 'wanting' something. It is perfectly natural for children to 'want' items that are not essential for their survival. The purpose of this activity is for the students to recognise the difference between needs and wants and the direct and indirect effect these have on resources, the environment and their community.

Activity summary

This activity will help students to think about the difference between needs and wants, and the ways in which both needs and wants impact on our environment. The students will also be able to identify their own needs and wants.

Outcomes

Students will be able to:

- Examine wants and needs and identify how choices people make can put pressure on natural resources.

Preparation

Before the lesson you will need to prepare the 'needs' and 'wants' tickets. On small pieces of paper (ticket size), write items that could be sorted as either needs or wants – e.g. water, juice, meat, jeans, car, DVD player, mobile phone, soccer ball, TV, a house and a pet (make some up that are relevant to your class). Write a different one on each piece of paper.

Tuning in

1. Hold a brief discussion (10 minutes) with the class about what they think a need and a want is. Do not correct students during this discussion; it is intended for them to express what they think, not what is right or wrong.

2. After the discussion draw a line down the middle of the board. On one side put the heading 'Needs' and on the other 'Wants'.

3. Place the pre-prepared tickets into a bag or box. Pass the bag or box around and ask each student to take one ticket out and suggest where they think it should go on the board. Make it clear to students that no answer is wrong – it is just about what they think the items might be. Write the item in the column that the student suggests.

Developing understanding

Now have a more detailed discuss with the class about the definitions of 'needs' and 'wants' as explained in the background reading.

Use the following questions as a guide:

- What things do all humans need to survive?
- Do you think these things would be different for different places in the world?
- What other things do we use but we would not die without (i.e. our wants)?
- Where do our needs and wants come from? What resources do we utilise to get them?

You might like to record the class's ideas up on the blackboard.

Use concept

4. Give each student a piece of paper and ask them to draw ten things that they use in their lives. Make the pictures colourful and separate so they can easily be cut out. (If newspapers and magazines are available they may like to cut the pictures out.) Ask students to think about a variety of things, not just 'material' things, e.g. an education and a happy family. Some prompting may be necessary.

5. Taking their pictures with them, students join a group of five and cut out their items. If there are multiples of a particular item, set one copy aside and keep only one in the pool of needs and wants. For example, if all students have a picture of a car, remove all but one.

6. With all of the items in front of them, ask each student to create a list of the items, choosing the ten most important items, with number 1 on the list being the most important and down to number 10. Encourage students to do this independently so that they get a chance to express their own opinions.

7. Once each student has completed their list, ask them to share their lists and create a group list. Taking into consideration everyone's choices, the group should ***rank*** the items from most important to least important. If it is difficult for students to choose between any items, encourage them to take a ***vote***.

8. When ranking is complete, ask the students to determine where the needs finish and the wants begin. How many items are really needs and how many are wants?

9. Give each group two pieces of butchers' paper (if available). Place the needs in their ranked order (according to the group's list) on one piece of butchers' paper and the wants in their ranked order on another and glue them down. Write appropriate headings on each sheet of paper.

10. Stick the posters up around the room. Ask the students to view each other's posters and determine where we get these needs and wants. Where do these needs and wants come from? What resources do we utilise to get them? Lead a class discussion on the resources that are used for us to obtain these items. If necessary, read the 'DVD Player verses Biodiversity' story to the students to make it clear.

Reflection

Go back to the initial task of determining whether the items on the tickets are needs or wants. With the ideas the class has developed, do they now think that any of the items should be moved?

Topic

4

Foreign fishing vessel

Distribution of Resources

Background Reading

The people of the world are not evenly distributed across the vast landmasses of the Earth's surface. Some areas of the world cannot support a high number of people. Originally, differences in population density in the world occurred naturally according to the amount of people that the land and its ***resources*** could support. This is known as an environment's ***carrying capacity***. For instance, deserts cannot support large, concentrated populations because of lack of water. Deserts therefore have a lower carrying capacity than a temperate forest region.

Developments in health, ***trade***, agriculture and education have impacted on the natural ***population distribution***. Health and agricultural developments have led to greater numbers of people being able to live in a smaller area. Education and trade have encouraged people to concentrate in certain areas such as cities and towns.

Thanks to these advances, some areas of the world are now going beyond their carrying capacity. This means they do not have the resources within their area or country to support their population. And populations continue to grow. These places now need to look for resources outside of their country or region. This can be a positive means of income for developing countries such as many of our Pacific Islands. However we need to ensure that our resources are protected and managed sustainably so they are available for our own future generations.

Resource distribution

As with the world's population, the world's resources are also not evenly distributed around the planet. Different areas have different kinds and amounts of resources. In some areas, resources have been depleted by the human population. And some places simply do not have a particular resource.

Collecting resources

When the resources needed by a population are not available in their area, people will look for that resource outside of their area. In some cases, this leads to very local trading of the resource and in other cases, the resource will have to travel a long distance to another community.

As populations increase, the need for resources also increases. The distribution of populations and the amount of resources available are also related.

In places of high population, more resources are used; in places with low population, the demand for resources is lower. As a result, areas with higher populations start to look to the resources belonging to less populated areas. The example of tuna presented below, demonstrates this well; Asian countries have a high demand for tuna and since their tuna resources have become depleted, they move into the Pacific region and fish there. This results in the Pacific tuna resource beginning to be depleted.

Case Study:
Tuna

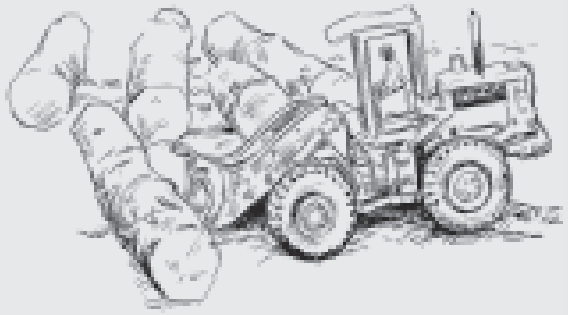
The world's largest fishery for tuna is located in the Western and Central Pacific Ocean. It is also one of the last healthy fisheries left in the world. More than half of the world's tuna supply comes from this region but scientists warn that some species of tuna, such as 'bigeye' and 'yellow fin' will be in serious trouble if fishing continues at the current rate.

The global consumption of tuna is increasing and the demand for tuna in countries such as China, Korea, Taiwan, Japan and the United States drives fishermen from these countries to move into the fishing grounds of the Pacific. In many cases, fishing vessels from these countries are fishing illegally at unsustainable levels in our region. Overfishing by other nations will damage our fish stocks and therefore threaten the way of life of local people in the Pacific who utilise this resource.

Case Study:
Forests

Many Pacific Island countries have a high degree of forest cover. They hold some of the world's last remaining areas of intact lowland tropical rainforest with significant levels of biodiversity. Forest resources are important for the subsistence economies of some of the smaller countries (for example, Federated States of Micronesia, East Timor, Niue and Tonga). Papua New Guinea, Solomon Islands, Fiji and Vanuatu support forest industries that are very important to their economies, particularly as a source of international trade.

In Solomon Islands and Papua New Guinea, logging continues at an unsustainable level, and it is widely believed that the majority of natural, accessible forests in both countries are likely to be logged out by 2020, if not earlier.



The more of a particular resource a nation has, the more they can become dependent on it economically. This can lead to exploitation and is a threat to biodiversity. If an area has a lot of a particular resource, the people of that area may depend on it for their livelihood. A high concentration of a resource also attracts others to come and exploit the resource.

Activity 4
Great Resource Grab

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 90 minutes

Subject Areas

Social Science, Maths, Physical Education

Glossary Words

Population distribution, resource distribution, over-exploitation, quality of life, indicator, population increase, income, import, export, carrying capacity, resource, sustainability, trade

Materials

- Coloured marker pens and pencils
- Butcher's paper
- Graph paper
- Rulers
- 'Population and Resources Information' sheet (p. 259)
- Small sandbags/balls/sticks
- 4 hoops/tubs/bins

Teachers' notes:

This activity can raise some difficult and controversial issues regarding family size, birth control, culture, poverty and resource use. It is worthwhile contacting other teachers, educators and leaders in your community to discuss the best ways to address the links between population, resource use and biodiversity in your local context.

To learn more about the effect of population growth on biodiversity see Module 3, Activity 2, 'The Midwife and the Grave Digger'.

Activity summary

By conducting this activity students will discover some of the problems faced by the world as the human ***population increases*** and focus on the unequal distribution of resources among six regions of the world. Students will consider their opinion of world regions and then use data to examine the ***quality of life*** in those regions.

Outcomes

Students will be able to:

Explain how the distribution of population and resources varies among different regions of the world and how this affects biodiversity and the environment in your area.

Tuning in

The Great Resource Grab

1. Take the students outside and ask them to collect 5 sticks about 10 cm in length each (if your school has small sandbags used by young students in PE, you can use these instead). These are to represent 'resources'.
2. Divide the class evenly into four groups and give each group an even share of the 'resources'. Place each group at the corner of a square (you can pace out the distances to make them roughly even; make it at least 20 paces distance). Give each group a hoop or a bucket in which to place their resources.
3. Tell the groups that they are each a community that is trying to survive. In order to live, they must have enough resources – but others will be coming to take their resources away. One member of the team is the 'resource watcher'. This person is going to stand at their group's hoop or bucket and watch to see they still have resources in it. Another member of the team is the 'resource user' representing all members of the community who use up resources. This person is going to take one stick out of their own community's bucket every 20 seconds (encourage the students to count the seconds themselves). If at anytime their bucket becomes

empty, they must lie down on the ground to show that the community has run out of resources and died.

4. The rest of the community must go out and gather resources from the other communities (take them from their buckets or hoops) but they are only allowed to carry one stick at a time back to their bucket. They are not allowed to get in the way of any other team members. While this is happening, the 'resource watcher' should be checking to see that the gatherers are only taking one stick at a time. In the first round, play the game for one minute and see if all the communities survive. (At the end of one minute, hopefully, all the groups are still surviving.)

5. Play the game a second time but this time make three of the communities only three members in size (one 'resource watcher', 'one resource user' and one 'resource gatherer'). Place all the other community members into the fourth community as extra 'resource gatherers' for the big community. Take all of the resources except three sticks from the large community and distribute them evenly between the small communities. Tell the students that the big group now represents a country with a high population density that cannot grow enough food for all its people so they must go and find it elsewhere. Play for one minute again and see if the small communities can survive – remind the 'resource watcher' that s/he must lie down as soon as their bucket is empty.

6. Play the game a third time with one large community and three small communities but this time tell the small communities that they may 'protect' their resources by taking their bucket and running away. If another community member catches them, they must give them one of their resources. See if they can survive this time.

Developing understanding

Back in the classroom, discuss with the students the significance of the 'Great Resource Grab', explaining what that game means in terms of population and resource distribution.

Lead a class discussion that covers the following questions:

- Is it important what a region's population is?
- In what ways does population growth affect a country or region and its resources?
- Does population matter when countries are ***importing*** and ***exporting*** resources? (You will need to add information for the students here about protecting our resources and what impact it has on our economy to be importing such items as tinned fish and rice.)
- Explain to the students that there is a link between the quality of life in a region and the availability of resources. Ask the students what they think determines 'quality of life'. What makes a 'good life'?

The quality of life in these regions and throughout the world depends in part on the balance between population and the availability of resources. Introduce the students to the four ***indicators*** of quality of life: area for crops per person, amount of fresh water per person, average ***income*** per person, annual population increase.

Practise skills

Organise the class into groups of four. Each student in the group will look at one of the indicators for quality of life for the six regions of the world. These are: cropland (availability of), fresh water (availability of), annual income and population increase.

Students must create a table in which to collect their information. The table must have a heading for the indicator they are looking at and the units of measurement for that indicator. For cropland's the table would look like this:

Cropland Data

Region	Cropland (hectares per person)
Africa	
Asia	
Europe	
Latin America and the Caribbean	
Oceania	
United States and Canada	

Hand out copies of the 'Population and Resources Information' from p. 259 (if you do not have access to a photocopier, you can put this information on the board or on pieces of butchers' paper around the room). From this information, students must complete their data table.

Once students have gathered their data, they need to rejoin their groups and construct a bar graph of their information on the graph paper. Remind the students to use an appropriate scale on their graph so that the graph takes up a whole page. Note, too, that each member of the group's graphs will be different because each student's graph will represent a different indicator. Encourage the students to create a neat and colourful graph using the rulers and coloured pencils.

Application/Reflection

When the group has completed their graphs of the 4 indicators of quality of life ask them to draw a large world map, and, using that as their starting point, display the data for each of the six regions. Encourage students to be inventive. You may want to ask an art teacher for ideas. Using this map and the data from their bar graphs, each group can create a display to help others understand the worldwide balancing act between people and resources. The message of the displays should be that the quality of life in these regions and throughout the world depends in part on the balance between populations and the availability of resources.

Link the activity to biodiversity; conclude this activity with a class discussion about ways that unequal distribution of resources can affect biodiversity. For example:

People need to have their basic needs met and when they don't have access to these they may be forced to clear forest for firewood and for land to grow crops on. They also may have no choice but to over-harvest some plants and animals.

Activity adapted from National Geographic Society, "Millennium in Maps: Population" lesson plan.

Population and Resources Information

Africa

- Cropland (area per person): 0.4 hectares
- Fresh Water (annual usage per person): 7.6 million litres
- Income (annual per person): AU$1,040
- Population Increase (annual): 20 million

Asia

- Cropland (area per person): 0.2 hectares
- Fresh Water (annual usage per person): 3.8 million litres
- Income (annual per person): AU$3,985
- Population Increase (annual): 51 million

Europe

- Cropland (area per person): 0.4 hectares
- Fresh Water (annual usage per person): 11.4 million litres
- Income (annual per person): AU$21,940
- Population Increase (annual): 1 million

Latin America & the Caribbean

- Cropland (area per person): 0.4 hectares
- Fresh Water (annual usage per person): 37.9 million litres
- Income (annual per person): AU$5,940
- Population Increase (annual): 8 million

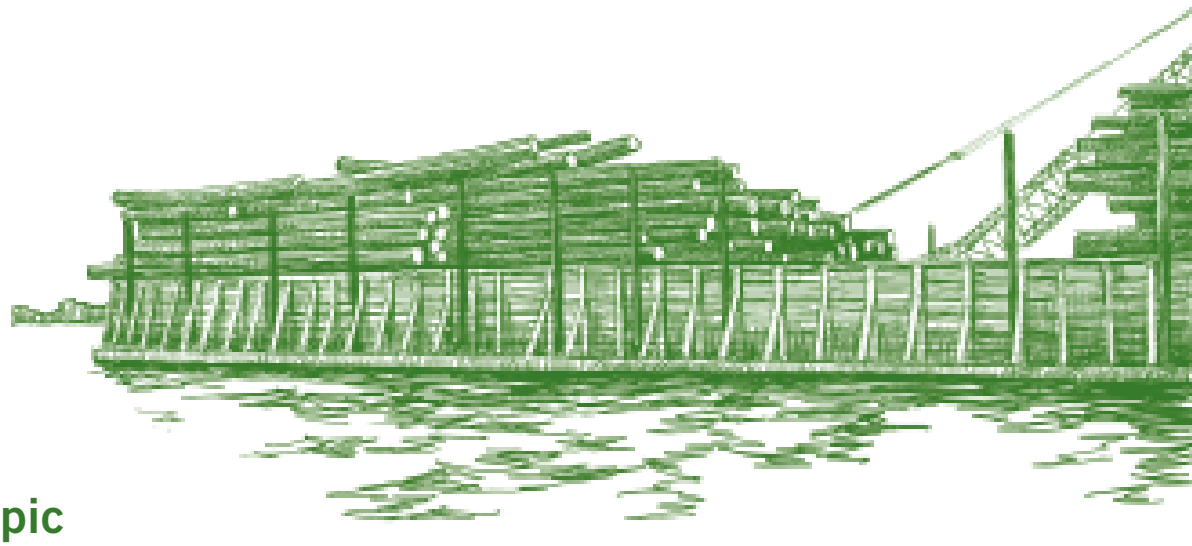
United States of America and Canada

- Cropland (area per person): 0.81 hectares
- Fresh Water (annual usage per person): 22.7 million litres
- Income (annual per person): AU$43,360
- Population Increase (annual): 3 million

Oceania (including Micronesia, Polynesia, Melanesia, Australia and New Zealand)

- Cropland (area per person): 2 hectares
- Fresh Water (annual usage per person): 72 million litres
- Income (annual per person): AU$24,690
- Population Increase (annual): 1 million

Source: data from National Geographic Society, 1998



A logging ship in the Solomon Islands

Topic

5

Trade and Exploitation of Resources

Background Reading

For as long as there has been communities settled in our Pacific Islands, there has been trade between them. People of the Pacific have traded ***resources*** that they have plenty of, for those they do not have. For example, the trade of clay pots for sago palm was an important traditional exchange along the south Papuan coastline.

Since the first contact with Europeans, however, the trade and ***exploitation*** of our resources has moved the resources to other regions and other countries altogether. Historically, a great deal of damage was done and unsustainable practices led to resource loss. For example, when British merchants became interested in increasing their trade with China in the 1800s, they took ***sandalwood*** from some Pacific Islands and sold it to China. As a result, sandalwood was wiped out in Fiji and the Marqueses by 1815, sandalwood trees were destroyed in Hawaii in the 1830s, and the sandalwood traders and cutters had moved to New Caledonia, the Loyalty Islands and the New Hebrides (now Vanuatu) in the 1830s with similar results of species loss in these countries.

Today, Pacific countries have the opportunity to protect their natural resources but, unfortunately, many of us are still falling victim to the lure of quick money by selling off our resources. Many contracts that do not acknowledge the true value of the resource being taken are still being signed. Foreign companies that take our trees, fish and land are getting them at a much lower price than they should and Pacific people are left with the loss of biodiversity, ***erosion*** and ***pollution*** caused by resource exploitation.

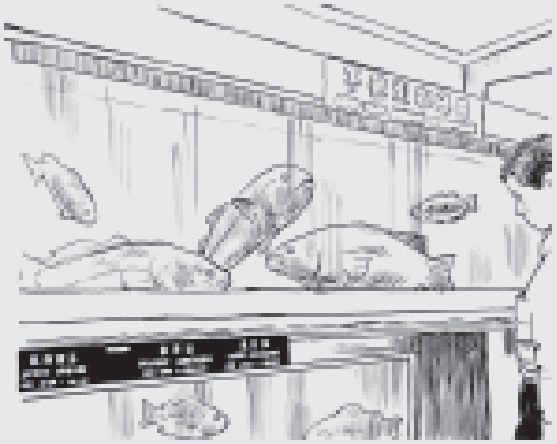
Examples of resource exploitation for export

The following case studies illustrate some examples of resources that have been exploited in the Pacific region by non-Pacific countries.

Case Study:
Live Reef Food Fish Trade (LRFFT) in the Pacific

The Live Reef Food Fish Trade is the collection and trade of coral reef fish species that are bought and kept by Asian restaurants. The fish are kept in tanks in the restaurants and customers select the fish from the tanks to be caught and cooked for their meal. This tradition has been in practice in China for many centuries, but recently Chinese fishermen have begun moving into Pacific waters because of declining fish ***stocks*** in their own seas.

In the 1980s, the LRFFT moved into waters around Palau and Indonesia. Now companies buying live reef food fish are also operating in PNG, Federated States of Micronesia, Solomon Islands, Kiribati, Fiji and Tonga as well. The companies trading in live reef fish buy the fish from local fishermen who are encouraged to use destructive methods such as cyanide fishing. ***Juvenile*** fish are also targeted so that companies can raise the fish in holding tanks. These methods are damaging to the marine ***ecosystems*** and the payments received by the fisherman do not cover the true value of the resource being lost.



The LRFFT provides incomes for Pacific Island communities and boosts our economies. The price offered for the fish may sound good but it is only a fraction of the resource's actual worth. We also need to assess whether or not this level of fishing is ***sustainable*** or we may be left with no fish for ourselves.

Case Study:
Logging in Solomon Islands

Traditionally, our forests have provided our communities with food, building materials, carving materials, firewood and medicines. Since contact with Europeans, our forests have been logged and the timber shipped to other countries, causing extensive damage to the ecosystems and biodiversity of our islands.

Today, in the Solomon Islands, many logging companies are cutting down trees in large quantities for export. Experts predict that if logging continues at the present rate, the forests may be over-exploited by the year 2015. Estimates from 2003 to 2005 believe that loggers are harvesting 1 million metres of round logs (1,000,000 m^3) in the Solomon Islands every year.

Many Asian logging companies, including Silvana Logging Company, Earthmovers Solomon Islands Group, Pacific Timbers Ltd, Delta, Maving Brothers, Hundai Timber and Kayaken Logging Company, operate in Solomon Islands. These companies employ local men in their logging operations. They use heavy logging machines to fell trees, transport them along the cleared roads on trucks and pile them at their ***log ponds***. Asian buyers come and select the logs they want. The logging company's barge will then transfer the selected logs to huge log boats waiting in deeper waters offshore. The buyers, when reaching their destination in Asia, sell the logs to manufacturing companies, which use them to make materials for construction, plywood and many other wooden items.

Although employment for local workers is provided by logging, we need to consider the long-term effects of the loss of our forests and whether or not we are receiving adequate payment for our resources.

Activity 5
Exploit 'n' Export

Suggested Timing

Teacher preparation time: 60 minutes
Lesson time: 60 minutes

Subject Areas

Science, Social Science

Glossary Words

Stocks, juvenile, resource, barge, log pond, export, exploitation, sandalwood, erosion, pollution, ecosystem, sustainable, over-exploitation, consumption

Materials

- Peanuts in their shell (enough to pass around to the whole class) or other small objects that can be placed on a bowl to represent our resources e.g. pieces of coral or shells
- Serving bowl
- Copies of the case studies (it will be beneficial for the students if you can research and write up some from your own country as well)

Teachers' notes:

When doing this activity, it should be noted that not all foreign investment leads to over-exploitation of resources and biodiversity loss. There are many socially ethical businesses and some Western investors look specifically for these companies so they can feel confident that their money is not being used to exploit the people of developing countries. An example of this is companies that are certified as 'Fairtrade' by the Fairtrade Labelling Organisation (FLO). If research materials and resources such as the internet are available, it may be of interest to students to conduct research into such companies, their activities and their visions and values.

Activity summary

This activity demonstrates the uneven use of limited resources so student can develop an awareness of protecting and being fair when considering our limited resources. The students also look at examples of resource exploitation for export from the Pacific region in order to develop an understanding of the issues involved.

Outcomes

Students will be able to:

- Identify a local example of resource exploitation for export and consumption in another country.

Tuning in

1. Ask students to sit in a large circle on the floor. Explain that you are going to model resource use and exploitation for export. Select two students to be an international company; each of the other students will represent a landowner. Distribute five peanuts to each 'Landowner'.
2. Begin the game by walking around the circle and handing out one peanut to each 'Landowner'. This will represent what the landowner can grow or make in one year. Now ask the two students representing the 'International Company' to walk around the circle and have each 'Landowner' give them two peanuts. This will represent the landowner selling their resource to the international company. At the end of this round of the game ask the 'Landowners' to count how many peanuts (resources) they have left.
3. Repeat another round of this activity as above; again at the end of the round ask the 'Landowners' to count how many peanuts (resources) they have left. What is happening to the amount of resource the 'Landowners' have?
4. Continue doing this exercise until the 'Landowners' have nothing left. How many rounds did it take for the 'Landowners' to end up with no resources? Look at the distribution of peanuts. Ask students to compare how many peanuts the 'International Company'

has compared to the local people who own the resource. Is this fair?

5. Now ask the 'International Company' to 'pay' for the resources by giving one peanut only to each of the Landowners. Is it fair now? Has the 'International Company' paid a reasonable price?

   Explain to students that this is similar to what is happening in the real world. Big companies from foreign countries take a lot of resources and pay very little for them.

   Return all the peanuts to the bowl, distribute evenly and allow students to eat the peanuts.

Developing understanding

6. Ask students to return to their desks. Conduct a discussion about local resources that are exported for ***consumption*** in another country.

   Ask the students:

   Do you know of any resources from our country that are sent overseas for other countries to use? (Record answers on the board.)

7. Split the students into groups and give each group a copy of one of the case studies of resource exploitation for export from p. 261. It will be beneficial for the students if you can research and write up some from your own country as well. Other examples from the Pacific region include bech de mere (sea cucumbers), aquarium fish, mineral resources, intensive cash cropping (oil palm) and phosphate (guano).

8. Give the students time to read and understand the case study. Then ask them to answer the following questions:

- What resource has been exploited?
- Where is the resource exported to?
- What is it used for?
- How does it affect us (or people of other Pacific nations)?
- What can or should be done to reduce the exploitation?

Use concept

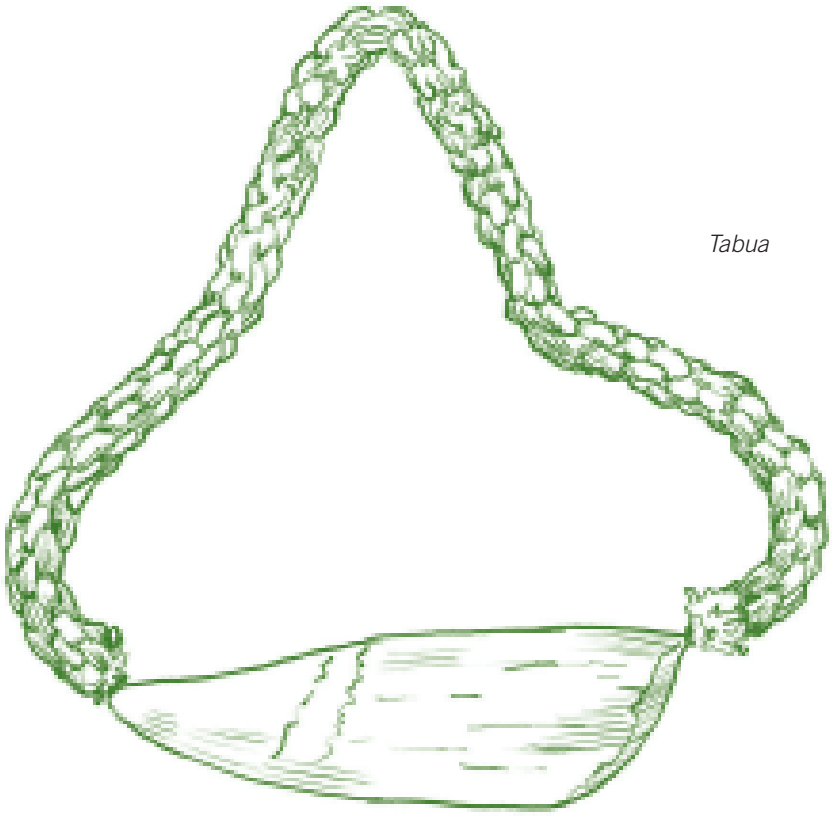
Students report back to the class. In their report they should include:

- A summary of the situation
- Their answers to the above questions
- A reference to the peanut-sharing activity. Is it similar? Are the local people receiving their fair share or fair payment for the resource?

Application

After a discussion with their group about resource exploitation for export, ask students to write a letter to their local member of parliament expressing their opinion on a local resource that is exploited for export and what they believe should be done about it.

Frigate birds are a source of guano in countries such as Nauru



Tabua

Topic

6

Traditional Economy versus Cash Economy

Background Reading

Long before the introduction of money into the Pacific Islands, people depended on the land, rivers and sea to provide them with all that they needed for survival such as food, shelter and water. The sea provided the islanders with fresh fish, crayfish and other seafood. The land provided vegetables, fruits, nuts, meat, medicine and shelter. ***Subsistence gardening***, fishing, hunting, playing and ***foraging*** on reefs and in the bush to gather food were daily activities of the island men, women and children. This traditional Pacific lifestyle is called subsistence living. ***Resources*** were abundant and used only by ***customary*** owners for daily needs. In some islands, barter systems and traditional money were used to buy goods and services before the introduction of modern money.

In some countries, such as Papua New Guinea, Solomon Islands and Vanuatu, this ***traditional economy*** is still very strong. People still have access to land on which to make gardens to grow food for their families and make a small ***income***. With the introduction of a ***cash economy***, people's lives began to change. The resources that were once for 'our family' become the resources for the 'nation' and the 'world'.

The cash economy

With the arrival of Europeans came the idea or concept of a cash economy. These new settlers introduced plantations such as sugar cane, copra and cocoa, and other small businesses into the Pacific islands only a century ago. Big and small businesses were established in the islands to harvest natural resources, not only to sell in the islands but also to sell to other countries. This created jobs for local people but it also created the need to earn and to spend money. New goods and services were introduced and these changed the tastes and diets of the people. Resources in the sea and rivers were harvested and exchanged for ***imported*** foods. Many people were no longer satisfied that the land, rivers and sea could provide

them with all that they wanted. Traditional forms of exchange were being replaced more and more with exchanges of cash money.

Changes caused by cash economy

The changes brought about as a result of a cash economy are an unavoidable part of our communities today. Today many people engage in traditional subsistence activities as well as the cash economy. Often villagers make bush gardens for their daily food but will sell some in the markets to earn money to buy imported items such as soap, kerosene, salt, sugar and tea. People in rural areas also need cash to pay for school fees and buy clothing. Some Pacific islanders totally leave the subsistence lifestyle and move to ***urban*** areas where they are employed to work and earn an income. The arrival of the cash economy has caused unavoidable changes to lives of Pacific island people; the changes have been both positive and negative.

The positives

The advantages of a cash economy include the building of roads, schools and hospitals. The government of a cash economy nation can provide these services because taxes are collected when cash is earnt or spent. This tax money goes to running the country and providing services to all its citizens. Markets, shops, movies, vehicles, planes, ships and clothes are other things that have come with a cash economy. These items can improve our ***quality of life***. These changes have benefited people's health, comfort, convenience and enjoyment. For instance, travelling is now easier, faster and safer. It can take only hours to reach the other islands by plane or days by ship compared to several months in dangerous conditions by traditional canoe.

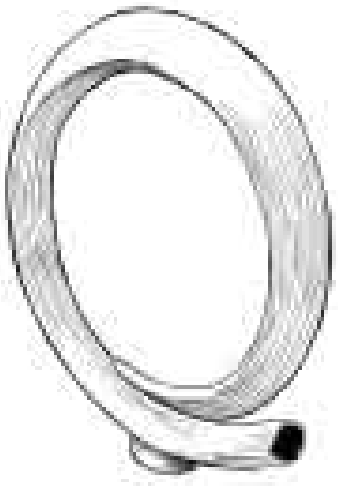
The negatives

One disadvantage of living in a cash economy is that we may sell too many of our resources. In some cases we do not get the true value of the resources and the foreign investor may not sustainably manage the resource.

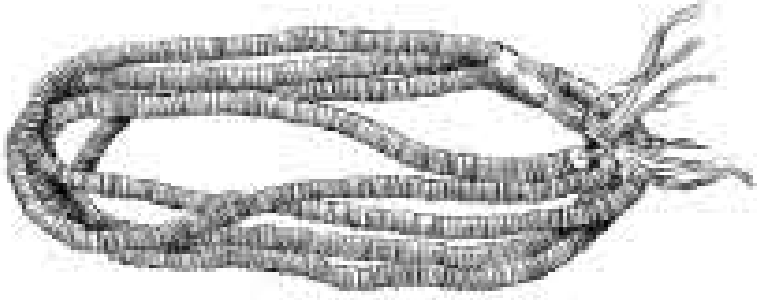
Another disadvantage is that, a difference develops between those who can and cannot find employment. Not everyone is able to find a job and they may find it hard to make a living. In some countries, people without work end up homeless and sleeping on the street because they have no other place to go after moving away from or selling off their land. They may go hungry and sometimes have no choice but to beg for food or money from people passing them in the street. This happens around the world every day in large and small countries, no matter whether they are a 'rich country' or a developing country.

Living in a cash economy makes money an 'essential' item for survival. The need for money often drives industries and people to use resources at an unsustainable rate in order to build up wealth. Sometimes this leads to devastating problems in society and the environment.

Pig's tusk



Shell money



Cash economy and decision making

A cash economy makes money essential to survival. Participating in a cash economy gives us services such as health, education and modern transport. But a cash economy can also influence how decisions in the home, community, province and the country are made.

Good decisions are made in the best interests of the community and the environment. In an example of a good decision, a village leader decided to connect piped water to his village. The whole community participated in making the water supply and they all benefited in the end. Their access to fresh water became easier and everyone was healthier and happy.

Poor decisions are often made in the interest of certain groups or individuals only and may be ignorant of any hazard they pose to the environment. In an example of a poor decision, a village chief allowed his friends to use dynamite for fishing. The friends benefited by collecting plenty of fish in a short time. They sold the fish and earnt money. However, the rest of the community were disadvantaged because their reef was now damaged, few fish were left and poison had entered the ecosystem and would effect it for a long time. Decisions such as this are often influenced by greed, selfishness and the need for quick money. A cash economy can influence how decisions are made especially if people are not mindful of their responsibilities to their communities, their natural environments and their future generations.

Some information provided by 'No Lusum Kastom Ekonomi' pamphlet produced by the Vanuatu Cultural Centre for the 'Yia Blong Kastom Ekonomi'. Used with permission.

Case Study:

The Importance of Mats in Ambae Island, North Vanuatu
Told by Jean Tarisesei

On my home island Ambae, in the north of Vanuatu, weaving is one of those activities that women grow up with. It's part of their lives.

We make fine mats in the north of Vanuatu. In the south they make big mats. There are different sizes and different types and different colours and patterns. In my island, Ambae, we have seven different types of mats and they all have different uses.

Some mats are for exchange. They are like money because we didn't have a currency so we traded with mats. Some mats are used for the kastom ceremonies and dancing. Some mats are tabu that are used for our grade taking. We have to learn to do certain things before we get access to money mats. Grade taking mats are different to money mats. They are small and the patterns are more important in grade taking mats. We have to pay for the rights before we can use these patterns. When you wear one of these mats it indicates that you have been doing certain things in kastom ceremonies.

The mats are stored in baskets. Each woman has her own basket: her bank! They used to call it the bank because anytime they needed to get mats to exchange or buy anything they used their mats. The mats are not very strong so we have to keep them close to the fire all the time so insects don't get into them.

Activity 6
Cash Society

Suggested Timing

Teacher preparation time: 40 minutes
Lesson time: 90 minutes (plus an additional session for the guest speaker)
Extra time needed to complete the traditional economy exercise.

Subject Areas

Science, Social Science, Language Studies

Glossary Words

Subsistence, cash economy, traditional economy, groceries, nutritional value, import, foraging, resource, urban, quality of life, sustainablility, reliance, customary, income

Materials

- Examples of store-bought ***groceries*** (empty containers are fine as long as the labels are intact)
- Note paper
- Butchers' paper
- Marker pens
- Pencils

Activity summary

This activity helps students to understand the differences between living in a traditional economy versus a cash economy. They are able to consider the advantages and disadvantages of both and have the opportunity to take part in a traditional economy exercise.

Outcomes

Students will be able to:

- Discuss the advantages and disadvantages of living in a cash society and be able to compare this to a society of subsistence living.

Tuning in

Begin this lesson by reading to your class the case study about mats from Ambae in Vanuatu in the background reading. After reading it, ask students to give you some examples of items that are used in a traditional economy in your area. Suggestions might include things such as mats, kava, shell money, tabua and pigs. Write the students suggestions' on the board under an appropriate heading.

Now ask your students about what is used for payment in a cash economy. Answers will include cash, cheque, credit or services. Write these suggestions on the board under another heading.

Tell your class that today they are going to look at the differences between living in a cash economy and a traditional economy.

Developing understanding

Split the students into small working groups and give each group an arrangement of groceries (food or other items you can buy at a store). Items could include tinned fish or tinned beef, rice, noodles and juice.

Ask students to look at the grocery items they have in front of them and in their groups discuss the following questions, recording their ideas on a large piece of butchers' paper or in their work books:

- Where can you get these things from? *Store, supermarket etc.*
  Discuss their origin and where they are made. *This will vary according to products but the idea is to get students to realise that by consuming these*

products they are reliant on other countries/ regions to produce these things for them.

- What do you need to be able to get these goods? *You need cash and you need a means of making this money, such as a job or something to sell.*
- What would your ancestors have instead of these items? Get them to suggest an alternative to each item. *This will vary according to the products.*
- What did your ancestors need to be able to get these goods? *Time, access to land and sea, skills, family or traditional forms of exchange. The idea is to get students to realise that their ancestors were self-reliant – that is, they could grow, catch or collect almost everything they needed.*
- What can you say about the ***nutritional value*** of the modern alternatives versus the traditional foods? *Generally food from gardens is safer, healthier and more nutritious. It does not have added salts, sugars, preservatives and fats/oils.*
- What would our ancestors have done if they did not have enough food to support their families? *Ask family to help them, exchange goods or services with other members of the community.*
- What are some things that happen in a cash economy if someone does not have enough money to buy food to support themselves or their family? *There are many things that could happen. Answers could include: rely on relatives, move to a different location to try to find work, beg, steal and seek support from churches/charities.*

Invite the groups to share their ideas with the rest of the class.

Use concept

In the second half of the activity, invite an older person from the community or a senior member of the school staff to come and talk to your class about traditional economy and traditional forms of exchange that happen in your community/culture. If you have more then one culture represented in your class, try to invite representatives from all groups. The invited guest(s) might be able to bring in some examples of items used in traditional economic exchange.

If the school has access to a guest speaker from a developed country, such as an Australian, New Zealand or American volunteer, you could ask them to also speak about what life is like in a very cash-reliant society. Ask them to explain about issues such as poverty and unemployment.

Get your students to prepare questions to ask the guest before they arrive so that the students get the most out of the experience.

Especially for urban schools

Using the information the students gained from the previous grocery activity and the guest speaker(s), set up a class system of using traditional economy for a week (or whatever length of time works for you). Students could be encouraged to bring items from their home gardens or other produce made at home, such as jam, sweets and roti and exchange them for canteen items or use them as payment in some other transaction at school. You might even like to talk to your neighbouring market and see if stallholders would be interested in taking part in the activity with the students. Students could perform services in exchange for produce from the market or students could prepare items, such as signs that the stallholders would like to use, in exchange for some produce.

Reflection

Ask your students to keep a journal for the duration of your traditional economy exercise. Encourage them to record the ideas they have about items they can use in exchange, the response they got from others involved in the exchange, and the benefits and limitations they found using a traditional economy. Use the journals to form the basis of a class discussion or for students to complete a small report at the end of the exercise.

Students could also use the poem format on the following page to complete a reflection of their traditional economy exercise.

Worksheet: Poem format

1. In custom times we had

_____, _____, _____

(list 3 items used)

2. In cash times we have

_____, _____, _____

(list 3 items used)

3. Money can buy me

_____, _____, _____

(list 3 store-bought items)

4. But my world gives me

_____, _____, _____

(list 3 subsistence items)

5. If I have no money

_____

_____

(write about a consequence of poverty)

6. But I am lucky because

_____

_____

_____

(write about an advantage of traditional lifestyle that helps when you have no money)

Glossary

A

Adapt
To make fit or suitable by changing to meet the conditions of the surrounding environment. In cities, birds sometimes make their nests the tops of power poles instead of trees; they have adapted their nest-making to the changes in the environment.

Adaptations
Special traits that help living organisms survive in a particular environment. These adaptations may be structural (size and shape), or behavioural (differing ways of reacting to the environment).

Aerobic
Living, active, or occurring only where there is oxygen (air) available, such as aerobic bacteria.

Agroforestry
Growing of trees on the same site as agricultural crops and/or livestock in order to increase the total harvest. Used to generate income, and improve the environment (for example, erosion control).

Amphibians
An animal without scales, adapted for life both in water and on land. Examples are frogs and toads.

Ancestors
People that we come from or are descended from. Our family from past generations.

Aquaculture
Farming of plants and animals that live in water, such as fish, shellfish, and algae.

Aquatic
Associated with water; growing in water; living in, swimming in, or often at the margins of waters; as, aquatic plants and insects.

Atmosphere
The layer of gas that surrounds the Earth; the air.

B

Bad practice
When the way of doing something, whether traditionally or using modern techniques, has a negative impact on the environment.

Barge
A type of flat-deck boat that is often used for transporting heavy or large amounts of goods. They are also used to guide larger boats into harbours.

Belief
What is believed to be true by an individual or community. Traditional beliefs of a community, tribe or group have been passed down from generation to generation.

Biodegradable
Natural (organic) things which are capable of being decomposed (broken down) by natural biological processes by bacteria or fungi.

Biological resources
The number and different types of living things in an ecosystem that may be used in some way.

Birth rate
The ratio of total live births to total population in a community or area over a period of time. The birth rate is often expressed as the number of live births per 1,000 of the population per year.

Biodiversity
The variety of life forms - the different plants, animals and micro-organisms, the genes they contain, and the ecosystems of which they form a part.

C

Campaign
Messages, activities and action to teach people about good practices. Used to raise awareness among people on important matters, for example, public health and how to look after the environment. Often the campaign hopes to change the behaviour of people.

Canopy
The layer formed by the leaves and branches of the tallest trees in the forest. A habitat is formed in the upper, denser regions of these taller plants.

Carcass
The dead body of an animal. Often used to describe an animal that has been killed for food.

Carnivorous, carnivore
An animal that feeds mostly on the meat of other animals.

Carrying capacity
The largest number of animals or plants an area, habitat or ecosystem can support (provide food and shelter) during a given time.

Cash
Cash usually refers to money in the form of physical currency, such as banknotes or coins that we use to exchange for goods.

Cash economy
The part of a countries economy in which payment for goods and services is made with money.

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

Classification

The systematic grouping of organisms into categories on the basis of evolutionary or structural relationships between them.

Coat of arms

An arrangement of symbols that indicates ancestry, history or achievements by a group. Some national flags have the coat of arms for that country on them and even some international football team uniforms use them.

Co-exist

Organisms living in harmony with each other; often their differences complement each other or the ecosystem that they live in.

Compost

Process whereby organic wastes, including food wastes, paper, and yard wastes, decompose naturally, resulting in a product rich in minerals used for fertilizing and rebuilding soil.

Conflict

A state of opposition, disagreement or incompatibility between two or more people or groups of people. Conflict is usually based upon a difference over goals, objectives, or expectations between individuals or groups. Conflict also occurs when two or more people, or groups, compete over limited resources and/or perceived, or actual, incompatible goals.

Conflict resolution

The process to solve differences between opposing groups or individuals. To prevent fighting or further conflict, groups must work together – often with a third party known as mediators – to solve their differences.

Conservation

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

Conservation organisations

Groups of people that work together to improve environmental management.

Consequence

Something that follows as a result of an action or a change in an environment. The consequence of not enough rain may be the death of crops and shortage of food in a community.

Consumer

An organism that gets its energy by eating other organisms.

Consumption

Using a product or service.

Contemporary

Current and modern. Something that is from the time we live in now.

Cultural diversity

The many different human social groups, belief systems and ways for adapting to situations in different parts of the world. Language is a good indicator of cultural diversity, with over 6,000 languages currently being spoken.

Cultural heritage

The history of behaviour patterns that are learned from previous generations and are used by people within a society or group.

Cultural values

A desirable or preferred way of acting or knowing something that is continued over time and that governs actions or decisions.

Culture

The accumulated habits, attitudes, and beliefs of a group of people that define for them their general behaviour and way of life; the total set of learned activities of a people. Culture consists of the knowledge, belief, art, law, morals, customs, skills and habits learned from parents and others in a society.

Customs

A practice followed by people of a particular group or region.

Customary

A practice based on a tradition or custom that has been passed down from previous generations. Sometimes rules in communities may be customary rather than in a written law.

D

Death rate

The ratio of total deaths to total population in a community or area over a period of time. The death rate is often expressed as the number of deaths per 1,000 of the population per year. Also called fatality rate.

Decision maker, decision making

The person or people responsible for making decisions or reaching conclusions on behalf of a group of people. The process of making decisions varies depending on the group and the decision maker/s. Some groups will listen to all other members of the group before reaching a conclusion; others will make decisions based on their own experience and knowledge.

Decomposer

Organisms such as bacteria, fungi, earthworms that break down and digests dead organisms and return valuable nutrients to the soil and water.

Decomposition

The process of breaking down dead plant and animal material into simpler components (atoms, molecules and compounds) so the materials can be used again. A dead tree turns into a log, which then slowly turns (decays) back into soil, out of which new plants can grow, as a result of the process of decomposition.

Deforestation

The change of forest covered areas to non-forested areas, such as farms and cities, as a result of human activities.

Degradation

The negative impact on habitat and ecosystem size or quality often due to human disturbances such as land clearing, pollution, and the spread of introduced plants and animals.

De-sex

To remove part of all of the reproductive (sexual) organs of an animal so that they can no longer reproduce. Also known as 'neuter'.

Domesticated

A plant or animal that has been adapted or trained to live in a human environment and be of use to humans. Also used to describe the introduction of an animal or plant into another region.

Draft law

A law (enforced rule in a community) that has not been finally decided on.

E

Ecological

The relationship of organisms and their environment, also used to describe the study of ecosystems.

Ecological processes

The many different processes (chemical, biological, and physical) that happen within an ecosystem to maintain the ecosystem and keep all the species living within it alive.

Economic

Relating to the production, development, and management of material wealth (having money and possessions) for a country, household or business.

Economy

The human activities related with the production, distribution, exchange, and consumption of goods and services.

Ecosystem

A collection of living things and the environment in which they live. Ecosystems are communities of plants and animals interacting with each other and with their non-living environment – forests, wetlands, mountains, lakes, rivers, deserts and farm landscapes. Ecosystems are sensitive to changes as pressure on one part of an ecosystem can upset the whole balance and reduce the diversity of species living within the ecosystem.

Ecosystem Diversity

The many different types of species of both plants and animals living within an ecosystem.

Emigration

Organisms leaving a habitat or ecosystem to live somewhere better or more desirable. People leaving one location to live in another.

Endangered

Referring to a species (plant or animal) currently in danger of extinction. The World Conservation Union defines species as endangered if the activities that are causing their disappearance are continuing.

Endemic

Referring to a species which is native to a single geographic region and is found nowhere else.

Environment, natural environment

All living and non-living things that occur naturally on Earth or in a particular area.

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

Ethnic

Groups of people sharing a common and particular racial, religious, or cultural heritage and language.

Exoskeleton

The supporting structure of an organism when it is on the outside of the body. Insects, crustaceans, and spiders all have exoskeletons.

Evolved, evolution

Any slow or gradual change. Organic evolution is any genetic change in organisms from generation to generation.

Exploitation

Use of a resource at the maximum profitable short-term rate, without regard for long-term resource quality or availability, including the killing, catching or collecting of wild organisms for human use.

Export

To send something to another country or another place especially for trade or sale. Export is also the spread of an idea, for example, into another part of the world.

Extinct, extinction

The dying out of a species of any living thing; the complete disappearance of a species from the earth, forever.

F

Fallow

Leaving farming areas without seeds for growing plants. This gives the soil time to recover after being farmed for many seasons in a row.

Fertilise

Bringing together a male and a female cell (sperm and ova in an animal or pollen and ovule in a plant) which will eventually grow into a mature adult form of the parent organisms.

Food chain

A simple food (energy) pathway. Food chains start with a producer (green plants), followed by a herbivore or primary consumers (plant eating animal), then a carnivore or secondary consumer (meat eating animal) with each organism feeding on or getting nutrients from the previous organism.

Food web

A number of food chains linked together form a food web. Food webs show the relationship between different plants, animals and micro-organisms within a community.

Foraging

The act of searching for food and provisions.

Fossil fuel

Any naturally occurring fuel from organic material formed by the decomposition of plants or animals; includes coal, natural gas and petroleum. Fossil fuels have a high carbon and hydrogen content.

Fragile

Delicate or easily broken, damaged or destroyed, therefore may need additional levels of protection.

Fragmentation

The breaking up of large habitats into smaller, isolated chunks. Fragmentation is one of the main forms of habitat destruction, which is a primary reason biodiversity is in decline.

Fungi

Organisms that use living or dead organisms as food by breaking them down and then absorbing the substances into their cells. Fungi make up one of the five kingdoms of living things on Earth. Mushrooms, yeast and moulds are types of fungi.

G

Genes

The part of organisms that makes each species and individual unique. Genes contain characteristics that are passed form one generation to the next (inherited) and determine how organisms look and behave. Genes are responsible for features such as hair colour and texture, and resistance to disease.

Genetic diversity

The variety of genes within a particular population, species, variety or breed. For example, the genetic diversity in the hundreds of varieties of sweet potato can be seen by their difference in size, shape, colour, taste and rate of growth.

Germinated

Once a seed has sprouted and starts to grow into a plant.

Global scale

Considering something in relation to the whole world.

Goal

The purpose towards which actions and activities are directed. The stated purpose that a plan is intended to achieve.

Good practice

When the way of doing something, whether traditionally or using modern techniques, has a positive impact on the environment and is therefore sustainable.

Groceries

Food and other things that are used regularly in a house that are bought at a shop that is often called a grocery shop.

H

Habitat

A place or type of site where an organism or population naturally occurs. A Habitat provides an animal or plant with adequate food, water, shelter, and living space.

Herbivore

An animal that feeds on plants.

I

Immigration, immigrants

Organisms including people arriving from somewhere else to live in a new place.

Import

To bring or carry something in from outside the place that you are in. Often bringing things (goods or materials) from a foreign country for trade or sale. Also to receive an idea from somewhere else.

Income

The amount of money or goods received in exchange for labour or services. Can also include money or goods received from the sale of things.

Indicator

An indicator provides evidence that a certain condition exists or certain results have or have not been achieved. Indicators enable decision-makers to assess progress towards achieving outcomes, goals, and objectives.

Indigenous

An indigenous species is an organism which is native to a given region or ecosystem and were not introduced there by people. Also refers to the people whose ancestors inhabited a place or country when persons from another culture or ethnic background arrived and settled (colonised). Also 'native peoples' or 'tribal peoples'.

Infertile

When an individual cannot reproduce or is no longer productive. Soil or land that is no longer productive.

Influence

A power that causes things to change. The ability to affect things, people and events.

Insectivore

An animal or plant that feeds mainly on insects.

Interdependence

The idea that everything in nature is connected to everything else; what happens to one plant or animal also affects other plants and animals.

Interview

A conversation with a person or a group of people in order to obtain information. Often a formal meeting where a person/s ask questions to another person/s to collect information on a subject area to be used in decision making.

Introduced species

A species which can now be found in an area outside of its known natural habitat that was either introduced on purpose or by accident during human activities. Also known as alien species.

Invasive

Species that enter into new ecosystems and spread, which may cause damage to native species and their habitats. Invasive species often have few natural predators or other biological controls in their new environment.

Invertebrate

An animal without a backbone, such as snails, worms, and insects.

J

Juvenile

A juvenile is an individual organism that has not yet reached its adult form, sexual maturity or size.

L

Larval

The early stages of development of an animal prior to it developing its adult form. E.g. insects, shrimps, frogs and fish have larval forms.

Laws, law-making

The system of rules recognised by a community that are enforced by an agreed process. Law-making is the process of an authority within the community writing and enforcing the rules.

Legal advice

Giving an opinion regarding the basis or process of the law by an officer of the court such as a solicitor or barrister.

Lichen

Species composed of an algae and a fungus living together as one organism. Often found living on or in trees and rocks.

Lineage

The children and family (descendents) of one individual, organism or species.

Log pond

Bodies of water used by companies that cut down and sell wood from trees to clean and move logs. Log ponds are found at the mill (place they turn the trees into timber).

Lower Plants

A term for three main groups of plants (mosses, liverworts and lichens), which do not have roots and produce spores to reproduce, rather than flowers.

M

Mammal

A warm-blooded animal with fur or hair that suckles its young on milk produced in mammary glands (breasts). Humans are a type of mammal.

Marsupials

Common name for a group of mammals with a pouch in the female, where offspring are carried. The kangaroo, koala, wombat and opossum are well-known marsupials. Most marsupial species are found in Australia and PNG.

Metamorphosing, metamorphosis

A stage in the life cycle of certain animals, during which time the larva (growth stage of some species) changes into an adult. Examples are the change from a tadpole to a frog, or from a caterpillar to a butterfly.

Microbe

An organism so small you can see it only with a microscope; a tiny living organism. See also micro-organism.

Microhabitats

A small part of a habitat, which has distinct physical conditions, such as a hollow in a mature tree or a pool of water in a dark cave.

Micro-organisms

Organisms that are too small to be seen with the naked eye. Bacteria, protozoans, viruses, microscopic algae and some types of fungi are all micro-organisms. Most are beneficial, but some produce disease. See also microbe.

Migration

The movement of humans. Also the movement of animals in response to seasonal changes and changes in the food supply. Examples of animals that migrate include some hummingbirds, salmon, monarch butterflies, buffalo and elephants.

Molecule

The smallest part of anything (substance) that still has the qualities of that substance. As an example, a molecule of water is called H_2O; this molecule is made up of two atoms of hydrogen and one of oxygen.

Mulch

Natural (organic) covering placed around plants (or covering the ground where it is bare) to prevent the growth of weeds. If placed around plants, a mulch provides other benefits, including preventing erosion and water loss, and keeps the soil temperature stable. When the mulch decomposes (for organic mulches it improves the quality of the soil for growing plants.

Mutualism

An interaction between two species that benefits both.

N

National Trust

A group or organisation with authority at the country level that is created to protect or conserve something, such as an environment or historical and cultural sites.

Native

Flora and fauna species that occur naturally in a given area or region. Also referred to as indigenous species.

Needs

Things that organisms must have to survive. Human needs include water, food and shelter. If we do not have these things we will die.

Niche

Within a habitat, a specie's area with specific conditions that supplies it with things necessary for its survivial. It is also the role of the organism in the ecosystem.

Non-biodegradable

All things that are not capable of rotting, decaying or breaking down into parts. Organic materials, or living things, are biodegradable. Plastic is non-biodegradable.

Non-endangered

Species that are not in danger of becoming extinct.

Non-sustainable

When the rate at which resources or parts of biodiversity are used is too fast for the natural processes to replenish the resource. Often used to describe the human use of minerals found in our environment.

Nutritional value

How good a food is for your body, or how effective the food is at keeping your body healthy. For humans, nutritional value means how much proteins, fats, carbohydrates, minerals and vitamins are in food, because these are things we need to be healthy.

O

Omnivore

An organism that eats both plants and animals to obtain its food energy.

Opinion

An opinion is a person's ideas and thoughts towards something.

Organic

Derived from living organisms.

Organism

An individual living system, such as animal, plant or micro-organism, that is capable of reproduction, growth and maintaining itself.

Over-exploitation

The use or extraction of a resource to the point of depletion (or extinction). Biologically, it usually refers to over-harvesting of a resource population to a level below the amount needed to sustain the resource.

Over-harvesting

Taking too much of a renewable resource (such as fish) so that the harvesting leads to a noticeable decrease in numbers.

P

Parasite

A plant or animal that lives off another plant or animal and gets food from it.

Persistant Organic Pollutants (POPs)

Persistent Organic Pollutants (POPs) are chemical substances that never disappear from the environment. POPs are passed through the environment into different animals through the food web.

Photosynthesis

The process by which green plants, algae and other organisms that contain chlorophyll (which makes plants green) use sunlight to produce carbohydrates (food). Oxygen is released as a result of photosynthesis.

Pledge

A promise to do, give or not do something.

Pollination, Pollinate

The process by which pollen is transferred from the male part of a flower to the female part of the same or another plant. Insects, birds, mammals and other creatures, as well as wind or water, can all pollinate plants.

Pollution/Pollutants

Any substances in water, soil or air that reduce the natural quality of the environment, don't look, taste or smell very good, or are a health hazard. Pollution can cause damage to natural resources.

Population distribution

How people are spread out over an area. It can also mean how a group of individuals of one species is divided by age and sex (male or female).

Population explosion

A sudden rapid rise in the number of people or other living things.

Population increase

When a group of individuals of one species multiply and produce more new individuals than die in a time period. There will then be more of that species over time.

Predators

An organism that feeds on other living organisms (prey).

Predictable

When something in the future is just the way that we think it will be. When our past experiences and knowledge allow us to be sure of how things will be in the future.

Pressures

When the resources existing within biodiversity are limited and the regular use of the resources means that the resource may eventually be completely used up.

Prey

A prey animal is one that is hunted and eaten by another animal.

Primary vegetation

Plant life that has been in the area since the area reached its final stage of development.

Producer

Organism that uses solar energy (green plant) or chemical energy (some bacteria) to manufacture its own food from inorganic nutrients.

Q

Quality of life

People's overall wellbeing. Quality of life is difficult to measure (whether for an individual, group or nation) because it is not a tangible concept. It consists of two components; the physical and the psychological. Our quality of life can be affected by our physical health and also by things we feel, such as happiness, pleasure, security, stress, worry, safety and freedom.

Quarantine

Forced isolation, usually of infected or suspected to be infected, people, animals, plants, food, equipment or goods to prevent the spread of infection.

R

Rank

To give things a particular order. To put things into different groups according to certain factors or criteria.

Rare species

A native species of plant or animal which exists in low numbers or in isolated areas.

Recreational

Something done for enjoyment and pleasure. A forest has recreational value for people who like hiking. The ocean has recreational value for people who enjoy snorkeling.

Recycle

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

Refined

A process to remove all the impurities (parts of a resource we don't use) from a substance. For example sugar is refined from the plant sugar cane. During the process sugar is taken from the plant and turned into pure sugar, taking all the other substances out. White sugar, white flour and white rice are all examples of refined foods. Refining generally results in huge nutrient loss.

Regulating the climate

The natural processes on Earth, created by the oceans, forests, lakes, mountains, icebergs, coral reefs, deserts and grasslands, have an effect on our climate (the weather; how warm, cold, wet and dry the air is). These natural processes keep the climate the way it is (regulate it).

Rehabilitation

To restore to the condition of good health. The act of revegetating an area or otherwise repairing a damaged environment.

Reliance

Being certain that something is going to happen or be available to use. When animals and plants rely on something they may also be dependent on it for survival. Animals often have a reliance on their habitat for food and shelter. They are dependent on the food available in their habitat.

Reptile

A type of cold-blooded animal that is covered in scales. They breathe air, like mammals. E.g. lizards, snakes, turtles and crocodiles.

Resource

A supply of goods or services that can be drawn upon for use. Resources are used by humans in living and development, e.g. water, food, wood, metals, stone and energy. They also include what humans need to satisfy recreational and aesthetic needs such as water for swimming and the scenic value of the landscape. To determine the (sustainable) use level of resources, it is important to make a distinction between renewable resources and non-renewable resources.

Resource distribution

How resources are divided and shared among people or organisms. This can be looked at all levels: on a global scale, such as looking at how fresh water is distributed across countries of the world, or within ecosystems how much fresh water is available for a plant to grow.

Resource management

The considered use of renewable and non renewable resources bearing in mind both the needs of people and the conservation of the resource for use in the future.

Respiration, respire

The process in which an organism uses oxygen for its life processes and gives off carbon dioxide.

Ritual

A ritual is a set of actions, performed mainly for their symbolic value, which is prescribed by a religion or by the traditions of a community.

Role-play

To act out and play a certain role (person, animal or a function). Often used in classrooms as a way of learning how it might feel to be someone else and see a situation from another perspective (through someone else's eyes).

S

Sandalwood

A type of tree that has good smelling oil that can be removed from the wood to be used in perfume, beauty products and natural medicines.

Sanitation

Practice of maintaining clean, hygienic living conditions.

Scat

Solid waste or droppings of animals. Many scats can be identified by their shape, size, and colour.

Scavengers

Animals that eat already dead animals (carrion). Scavengers play an important role in the ecosystem by contributing to the breakdown of dead animal remains.

Sediments

Soil particles, usually sand, silt or clay that are carried by flowing water or that have gathered at the bottom of water.

Species

A group of closely related organisms that are capable of interbreeding and are isolated from other groups of organisms in reproduction (in other words, they breed among themselves and not with others); also the basic unit of biological classification.

Species diversity

The number and variety of species found in a given area in a region.

Species extinction

When a group of organisms capable of interbreeding freely with each other becomes extinct and no longer exists.

Stocks

The population or amount of a resource, in particular animal resources such as fish or cattle. Such stocks are usually identified by their location.

Strategy

A plan of action that sets out activities to reach a purpose.

Subsistence

The means of living; obtaining food and shelter necessary to support life; everything that is done to "make a living".

Subsistence farming/ gardening

Farming that provides for the basic needs of the farmer and his family without any extra produce to sell at market.

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).

Sustainability

The ability of a system to withstand or adapt to change that is perceived as threatening over time.

Sustainable

Means meeting the needs of the present without compromising the ability of future generations to meet their needs.When the rate at which resources or a part of biodiversity are used within a system is balanced with the natural processes to replace the resource used (replenish the resource).

Sustainable management

Finding a balance between meeting the needs of our current generation while conserving natural resources and protecting the environment for the benefit of future generations.

Sustainable practice

A way of using a resource that ensures that the resource will be available for all future generations.

Symbol

Something used or regarded as standing for or representing something else; an emblem, token or sign, something that is symbolic.

T

Terrestrial

An organism that lives on land.

Toxic

Able to poison or harm an organism. Toxic substances are bad for the health of living things.

Trade

The exchange of things (goods or raw materials) either for money or for other things by individuals, communities, companies or countries.

Traditional

Relating to, or in agreement with tradition. Tradition is statements, beliefs, stories or customs passed from one generation to the next.

Traditional knowledge

The passing down of practices, beliefs, legends, customs etc. from generation to generation, often by word of mouth or by practice.

Traditional economy

A system for exchanging goods and services that has been used by earlier generations and continued throughout time.

Trochus

A marine snail found on the reef in tropical waters. The spiral shell is collected for its mother-of-pearl.

U

Urbanisation, urban

Urban describes areas in cities instead of on farms (rural). There is an increasing number of people in the world moving from farms to cities, this is called urbanization.

V

Values

Beliefs or qualities that a person or group hold as important and true. Often values are a set of things that are most important to person or group.

Vernacular

A local style preferred and performed by ordinary people. Often used to describe the local language or local architecture.

Vertebrate

An animal with an internal backbone. Humans have a spine so are vertebrates.

Vision

A realistic, credible, attractive future for a person or group. It may be used to inspire the group to achieve this future.

Vote

A process where a person formally chooses one thing as better over another thing. Showing which option or alternative they prefer.

W

Wants

The things we would like to have but are not necessary for our survival. For example, we need water, food and shelter but want a television and a mobile telephone.

Wilting

The response of a plant to excessive heat or water loss. Leaves that were previously standing firm and upright become lose and limp.

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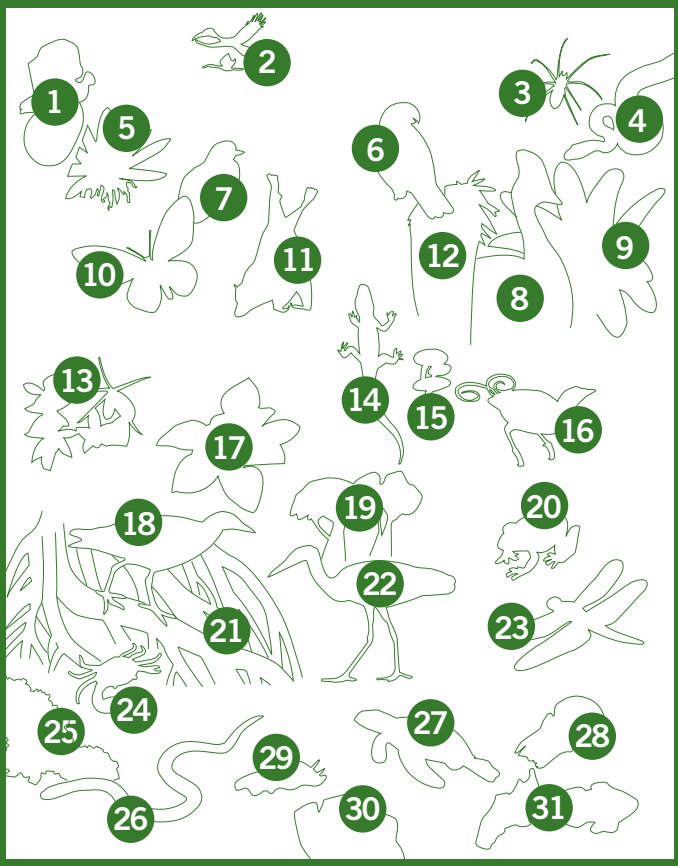

Key to flora and fauna on cover illustration

1. Spotted cuscus is a mammal found in New Guinea and the Solomon Islands.
2. Papuan hornbill occurs throughout New Guinea, Bismarck Archipelago and east to the Solomon Islands.
3. The golden orb weaver (Nephila) is the largest orb spinning spider in the world and is common in the Pacific region.
4. Green tree python is found in Papua New Guinea.
5. An epiphyte is a plant that grows on another living plant.
6. Yellow-bibbed lorikeet was once common through the eastern Solomons Islands.
7. The orange dove is endemic to the islands of northern Fiji (Vanua Levu, Taveuni).
8. Cassowaries are found in Papua New Guinea.
9. Cycads have been around since before dinosaurs.
10. Green birdwing butterfly - Papua New Guinea.
11. The mariana flying fox is found only on Guam and the other Mariana Islands.
12. Bamboo is extremely valuable to people in many pacific countries.
13. Orchids - Papua New Guinea has over 3,000 known species
14. Geckos, such as this Ring-tailed gecko from Papua New Guinea, are found throughout the pacific Islands.
15. Bracket fungi - one of the many different types of fungi found in tropical forests in the pacific.
16. Wilson's bird of paradise – found in West Papua.
17. Beach hibiscus is found throughout the Pacific
18. Buff-banded rail is bird a found throughout the western Pacific.
19. Pandanus - native throughout the Pacific islands is one of the Pacific's must useful plants.
20. Tree frog - frogs are an important indicator of how ecosystems are faring.
21. Mangroves are important to people in the South Pacific.
22. Pacific reef heron – found commonly across the region.
23. Dragon flies are found in all countries in the Pacific; the Solomon Islands and Papua New Guinea have a very high diversity.
24. Fiddler crabs found commonly across the region.
25. A wide diversity of coral species are found across the Pacific Region.
26. Banded sea snake found in shallow coral reefs of the South Pacific.
27. Marine turtles are an integral part of the traditional culture of many Pacific Island peoples.
28. Jelly fish can be seen drifting in estuaries, near the shore and in the open sea.
29. Nudibranchs are a type of sea slug, which live in tropical seas.
30. Giant clams can be found in shallow coral reefs of the South Pacific.
31. Anemones and clown fish have a well-known relationship and are found on coral reefs throughout the Pacific.

Discovering Biodiversity

An Educator's Guide to Exploring Nature's Variety

Discovering Biodiversity: An Educator's Guide to Exploring Nature's Variety is a teaching and learning resource that has been designed specifically for use by teachers and educators in the Pacific. The resources' six modules, topics and activities have been designed to support the teaching of key learning outcomes specified in school curriculum and have been developed with extensive input from teachers and educators across the region. It is packed full of ideas and information to explore the scientific, social, cultural and economic aspects of biodiversity with your students.

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