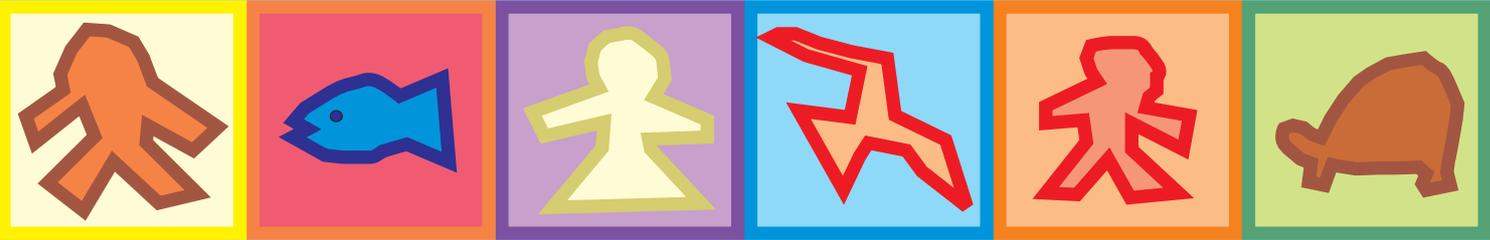
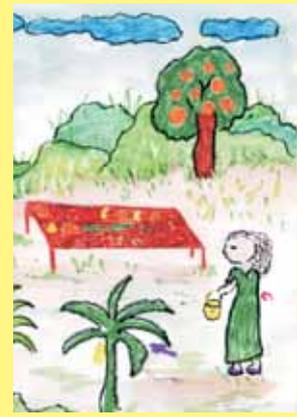
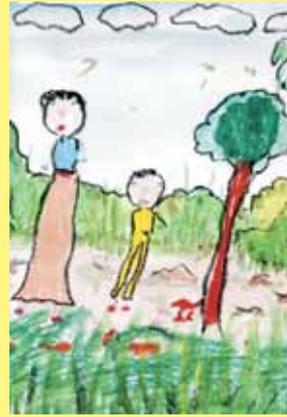


**LEARNING FOR SUSTAINABLE
LIVING IN SEYCHELLES**





LEARNING FOR SUSTAINABLE LIVING IN SEYCHELLES



MINISTRY OF EDUCATION AND YOUTH

This publication has been produced with funding from the

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SADC REEP

NATURE SEYCHELLES



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Foreword

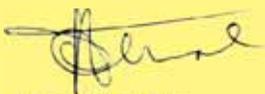
To Teachers, Students

Environmental Education has made tremendous progress since it was first introduced in the school curriculum in 1991. The Ministry of Education and Youth is proud to launch this novel resource that will provide teachers with locally relevant materials to facilitate the implementation of Environmental Education (EE) in the school curriculum.

This publication also embraces environmental issues not always addressed in the school curriculum, helping us to look outside of the classroom and review how we live our lives on a daily basis. At the same time these issues can easily be integrated into many different subject areas in the school curriculum.

Many of us take for granted the goods and resources readily available in Seychelles today. Some of us have adopted consumer-oriented lifestyles whilst others are wasteful of natural resources and energy for example.

We cannot look to governments alone to provide solutions to all our problems; some have to result from individual actions. Activities incorporated in this book encourage learners to explore issues and seek solutions in a more independent and creative manner. Collectively, we can make a difference if we choose alternative lifestyles. This book offers novel ideas, fun activities and tips for each one of us to try out.



Danny Faure
Minister for Education and Youth

To you the Readers

The production of this publication *Learning for Sustainable Living in Seychelles* comes at a time when the world is facing many challenges - from lack of access to drinking water, and lack of adequate food and health care for millions of people around the world, to dealing with the ravages of climate change.

Many of today's ills are a result of actions or decisions taken by individuals or governments in the past which have consequences on our lives today. To remedy this requires actions from both individuals and governments alike.

The Government of Seychelles has shown its commitment to a more sustainable future for all Seychellois with the implementation of the second Environmental Management Plan of Seychelles (EMPS) 2000-2010, in which the foundations for sound management have been laid.

It is important that the decision-makers of today and the citizens of tomorrow understand the interconnections between ourselves and elements of nature around us; that local actions and their impacts can have global consequences. Each one of us has the responsibility to minimise our ecological footprint and allow Planet Earth to sustain life long after we are gone.



Ronnie Jumeau
Minister for Environment

Dear Friends,

When I returned from the World Summit for Sustainable Development held in South Africa in 2002, I was convinced, more than ever, that we needed a new paradigm for living on small islands, one that was different from sustainable development. We need to live sustainably on our extremely fragile islands. So why not "sustainable living" instead of "sustainable development"? The concept of sustainable living goes beyond development. It captures what any of us would identify as being fundamental to having secure, productive and fulfilling lives, for ourselves and our children.

It is therefore with great pride that I oversee the publication of the first educational guide to *Sustainable Living in Seychelles*. It is an idea I have had for some time and now it has been catalysed by two outstanding local environmental educators and a leading team of professionals. My concluding message to readers of this publication is to think of this: We have 155 islands but only one country; sustainable living is a moral, environmental and financial imperative and we all have an obligation to achieve it.



Nirmal Jivan Shah,
Chief Executive, Nature Seychelles

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INTRODUCTION

What is Sustainable Living?

How Do I Want To Live?

Most people ask themselves the question: "How do I want to live?". But isn't it also necessary to ask: "If I live like this, what are the consequences for other people and for the environment?". For example, if part of your answer is: "I want to have my own car" shouldn't you also ask: "Will everyone else in Seychelles also want to own a car? Will there be enough fuel? Will there be enough roads?



Will there be traffic jams everywhere? Will there be more accidents? What about the effects of pollution?" If you say: "I can have a car but other people cannot", what will other people in Seychelles think, say and do?



Gaia



Living things are found everywhere on Earth, from the highest mountains to the deep ocean floor, even in hot sulphur springs and inside rocks. Yet this layer of life is incredibly thin if it is compared with the size of the whole planet - it is like a thin film of water over a football. This living layer is called the biosphere. Everything in the biosphere interacts with everything else: the plants, the animals, the atmosphere, the oceans, the land. It is as if the Earth is one gigantic living organism. Think of Earth like this, with everything interrelated (called Gaia, after the Greek goddess of Earth) - maybe it will help you to realise how fragile our existence is.

Another way of looking at the consequences of your choice of lifestyle (the way you live) is to imagine the lives of your grandchildren and great grandchildren. Will they want to live the same way as you? Will your choice to live in a certain way have any effect on their lives? It will for sure!

Footprints And Shadows

You can picture the long-term impact of lifestyle as a 'footprint' or 'shadow'. Your **ecological footprint** is the amount of productive land and shallow sea that you need to support your lifestyle (food, water, housing, energy, transport, leisure, consumer goods, waste absorption). An American gets his food, minerals and oil from all over the world and these things use some of the world's limited amount of productive land. His footprint is about 9.6 hectares. The footprint of an Indian is about 1 hectare. The world has only 1.5 hectares available for each person. If everyone adopted the American lifestyle we would need **five** planet Earths to support us! So we need to match our lifestyles to the Earth's available natural wealth.



An **ecological shadow** is just a different picture that you can use to understand the amount of impact we have on our Earth.



Sustainable Development

Earth and Humanity

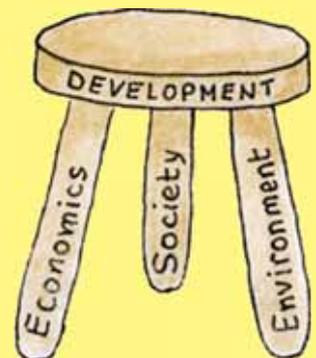
"The earth is a remarkable planet. Its old age and ancient beginnings, the fact that life exists at all, and the huge variety of life forms: all are part of an amazing story. Humanity has become part of this story. At first we were just one kind of animal among many. With time, we came to consider ourselves something apart from the rest of nature. We behave as though we have conquered nature and forget we are a part of it. Much of this so-called 'conquest' has produced bad results: polluted skies and waters, land stripped bare of trees, dwindling animal populations, and millions of people living in poverty. We need to learn from our mistakes, acquire a greater sense of responsibility towards our surroundings and our fellow human beings, and begin to repair the damage."

(taken from "Atlas of Earthcare" by Miles Litvinoff, Young Gaia books)

All countries are still "developing". But some poor countries are getting left far behind in the race to "develop". In spite of improvements in agriculture, scientific knowledge and technology, the wealth of the poorest people in the world has actually fallen. 20% of people living in the rich countries consume 80% of the world's resources. In 1960 the richest fifth of the world earned 30 times the poorest fifth. By 1997 they earned 74 times more! The wealth of the 225 richest people in the world went up by three times between 1995 and 2001, and the value of their possessions equalled the entire annual income of half the world's population.

So people now talk about the concept of **sustainable development**: development that can take place without spoiling the environment, and without creating such huge differences between rich and poor.

It is necessary to have **balance** between people (society, housing, health, education, etc.), the economy (money, business, industry, jobs, etc.) and the environment (which supports our life on Earth). You can picture this as a three-legged stool: Development is the seat,



supported by Society, Economics and the Environment. If one leg is shorter than the others, the stool will be unbalanced and development will be uneven. If the legs are all different lengths, or one is missing, the stool will fall over!

Sustainable Living

There is one problem with the idea of economic growth and development. It is the idea of growth itself. The difference between sustainable development (i.e. sustainable growth) and sustainable living is the simple word 'growth'. *What is your reaction to the following text?*

The first commandment of **Economics** is: Grow. Grow more. Grow faster. Grow forever. Companies must get bigger. National economies need to grow. People should want more, make more, spend more always more.

The first commandment of **Earth** is: Enough. Just so much and no more. Just so much land. Just so much water. Just so much sunshine. The planet does not get bigger, it gets better. It's creatures live within absolute limits.

Economics says: Use it up fast. Don't bother to repair; the sooner something wears out, the sooner you'll buy another. Throw things out when you are tired of them. Throw them to a place where they become useless. Grab materials and energy to make more.

Earth says: What's the hurry? Take your time building soils, forests, coral reefs, mountains. When any part wears out, don't discard it, turn it into food for something else.

Adapted from Donella Meadows 2001

A way to picture sustainable living is as a large flowerpot, containing rich soil in which three plants are growing: Society, Economics and Power. The soil represents the Earth, providing the life-support system on which we all depend. Society is people, community and culture. Economics is jobs, money, commerce and industry. Power is decision making i.e. who is making the decisions about living, whether political governments, individuals or people together? The flowers that grow depend on the rich soil, but the amount of soil is limited to what is in the pot. If one plant grows tall and strong, the others may be small and weak. Isn't it better to have three very beautiful flowers than one very big flower?



Sustainable living is therefore a way of life that is able to maintain itself for a very long time. It is a way of life that supports the environment in which we live, so that the environment can continue to support us and also future generations. Seychelles Constitution (1993) “recognises the right of every person to live in and enjoy a clean, healthy and ecologically balanced environment.”



This book is all about choices and decisions. It is full of ideas to discuss, suggestions for ways you can live sustainably, and ideas for actions you can take to help support the Earth, rather than destroying it. This is not just about governments making choices for us. We are ALL responsible! Each one of us has to decide how we shall live, and our decisions now will have an impact on the future for the next generations. And remember, working together, great things can be achieved!



“Do what you can, with what you have, where you are.” And make sure you have some fun while you are doing it!



How To Use This Book

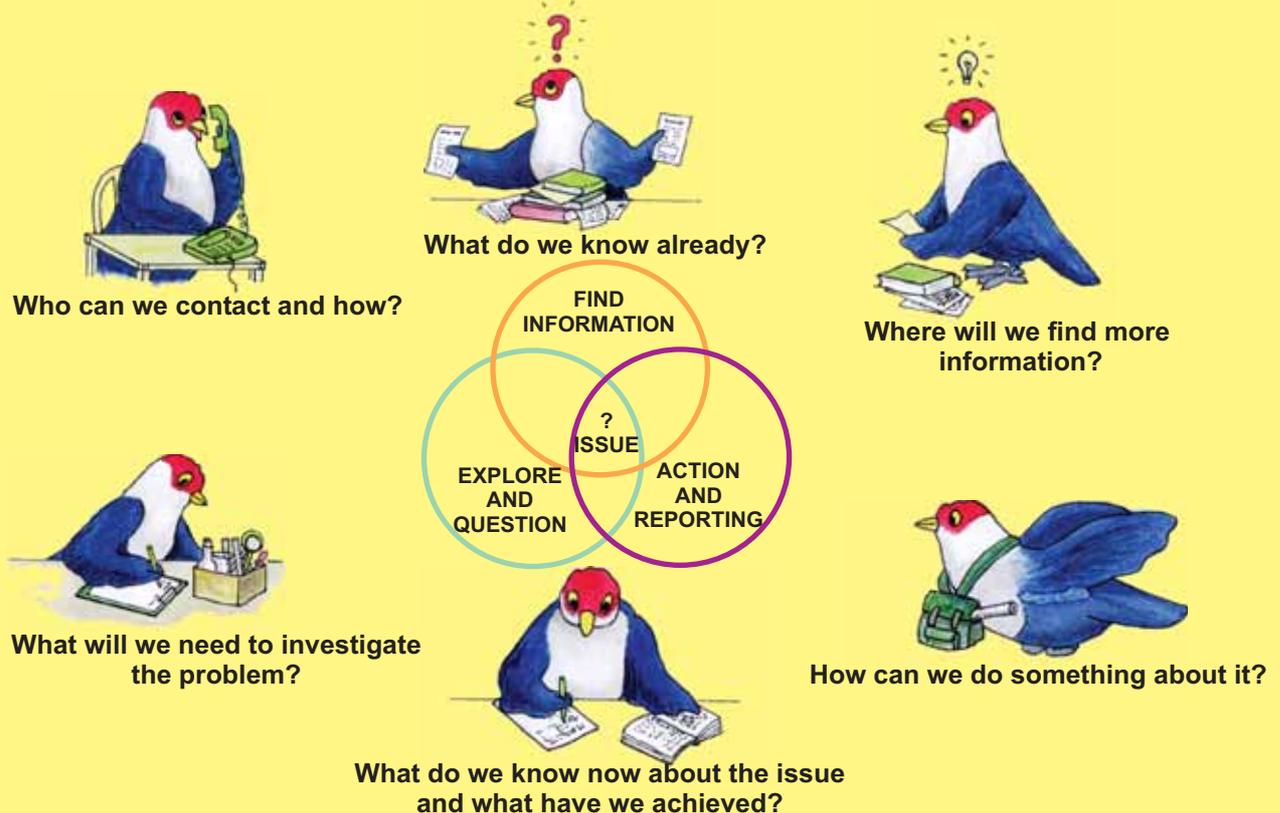
This cross-curricular book has been developed for learners of lower secondary school (S1-S3) levels. It has been designed to provide you with support materials and activities that will help you to integrate the concept of *Sustainable Living* across the school curriculum. Other students, parents and professionals are also encouraged to use this book. It has been developed after a series of workshops with teachers, and in consultation with the Ministry of Education and Youth as well as other professionals. The information and activities included here are not prescriptive but should be adapted to meet your needs. They cater for both the younger and older age groups. Teachers and parents are encouraged to use current articles from newspapers, magazines, video films, as well as other resources, to add variety, depth and stimulate discussion.

The style adopted is simple, accessible and user-friendly so that both adults and learners can make maximum use of the materials provided. The aim of this book is to make each one of us review our lifestyles and behaviours so that we may evaluate our impact on the environment and turn our efforts into environmental action.

Active Learning

This publication is designed to help you promote the concept of sustainable living amongst learners by an *Active Learning* process which is explained below. This will also be achieved via an *Integrated Learning* approach adopted by teachers within the school curriculum.

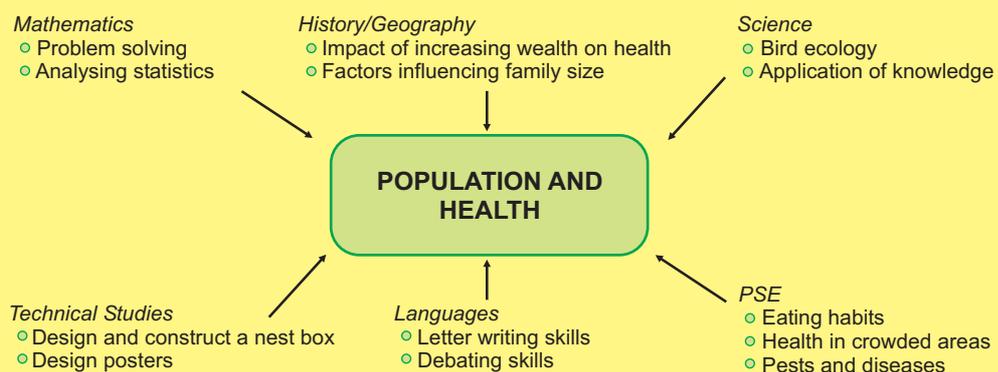
Framework for Active Learning



Adapted from "Learning for Sustainable Living" - BirdLife South Africa 2000

Integrated Learning

The themes developed in this book can be easily integrated in different subjects across the curriculum. Guidelines are provided to assist you in each thematic area. Teachers must emphasize that the guiding principles of environmental education - *knowledge, skills, attitudes and values* - are interlinked and are built into all the themes addressed in this book. An example is given below:



Themes of the book

There are fourteen themes addressed in this book and each one is colour-coded. The order in which the themes are laid out in no way reflect any order of importance. The themes follow closely the Thematic Areas adopted in the Environment Management Plan of Seychelles (EMPS) 2000-2010. The EMPS is a tool used to help decision-makers plan and manage our environment in a sustainable manner. It provides guidelines on how we should also be using its resources and managing our environment over the next 10 years, and beyond. Some themes are lengthier than others as they address more than one issue. They include:

- Population and Health
- Water
- Sanitation and Waste
- Tourism
- Biodiversity
- Agriculture
- Fisheries

- Energy
- Land Transport
- Laws and Regulations
- Land Use
- Money and the Environment
- Industry and Commerce
- Climate Change

Format of the book

Each theme is organized into two main sections: Background Information followed by Activities.

Background Information

At the start of each thematic area there is background information to supplement materials already in circulation in schools. Leading questions are incorporated to prompt discussion and encourage learners to explore how they feel about issues. Teachers and parents are encouraged to use other sources of information to extend their knowledge of each topic or theme being covered. A list of suggested references is included at the back of this book.

Glossary

Technical terms are indicated in ***bold italics***. A glossary features at the top of each page and explains the terms used in the text (except for the title page where it is found at the bottom of the page).

In a nutshell is a summary of the key concepts covered in the background information and denotes the end of this section.

Learning Outcomes

This is a small section before the Activities which covers the **Curriculum Areas** the theme can be integrated into. **Knowledge and skills** include what the learner should *know* and *be able to do* at the end of the activity. **Attitudes and values** include what the learner *feels* about the topic and his/her reaction to it.

Curriculum Areas - Agriculture, Maths, PSE, Social Economics, English

Knowledge and Skills

Understand the importance of food production; assess food cultivation and use in the home; debate issues about food production

Attitudes and Values

Be aware of environmentally friendly methods of farming; value locally produced fresh food and locally processed food

Activities

The **ACTIVITIES** are action-oriented and encourage the learners to undertake research, carry out surveys and questionnaires, participate in projects and a host of activities that take them outside the classroom. At the same time they will be helping to solve environmental problems in a creative way. These pages can easily be photocopied and used as worksheets.

Further activities and actions are activities that stretch the learners further and encourage them to think critically. They are found at the end of most thematic areas.

Illustrations

The blue pigeon is used as a cartoon character throughout the book. The blue pigeon (*pizon olande*) is a bird endemic to Seychelles. It features at the start of each new theme. A tree frog has been used as the logo for the main ACTIVITIES. Different animals native to Seychelles have been used for Further Activities and Actions.

Other logos have also been used in the book. They include:



WORLD ISSUES



**LINKS WITH
NATURE**



**ISSUES SPECIFIC
TO SEYCHELLES**



IN A NUTSHELL

Other illustrations are also used in the book. These can be used to generate discussion, debate and analysis.

Assessment

Assessment is a tool to evaluate the learners' level of performance. Various methods of assessment could be used. Some of these include:

1. Encouraging the learners to keep a record of all their work in a portfolio/file to include:
 - worksheets used
 - written assignments
 - research project notes
 - a report of oral presentations
 - audio-visual materials produced (leaflets, posters or photographs of these)
2. Self-assessment - how the learner sees his or her own performance
3. Peer assessment forms - have an 'Enviro Buddy' who will provide feedback on the other's performance.



POPULATION & HEALTH

● What influences where people or animals live?

● What are the consequences of population growth?

● How can we save populations of endangered species?

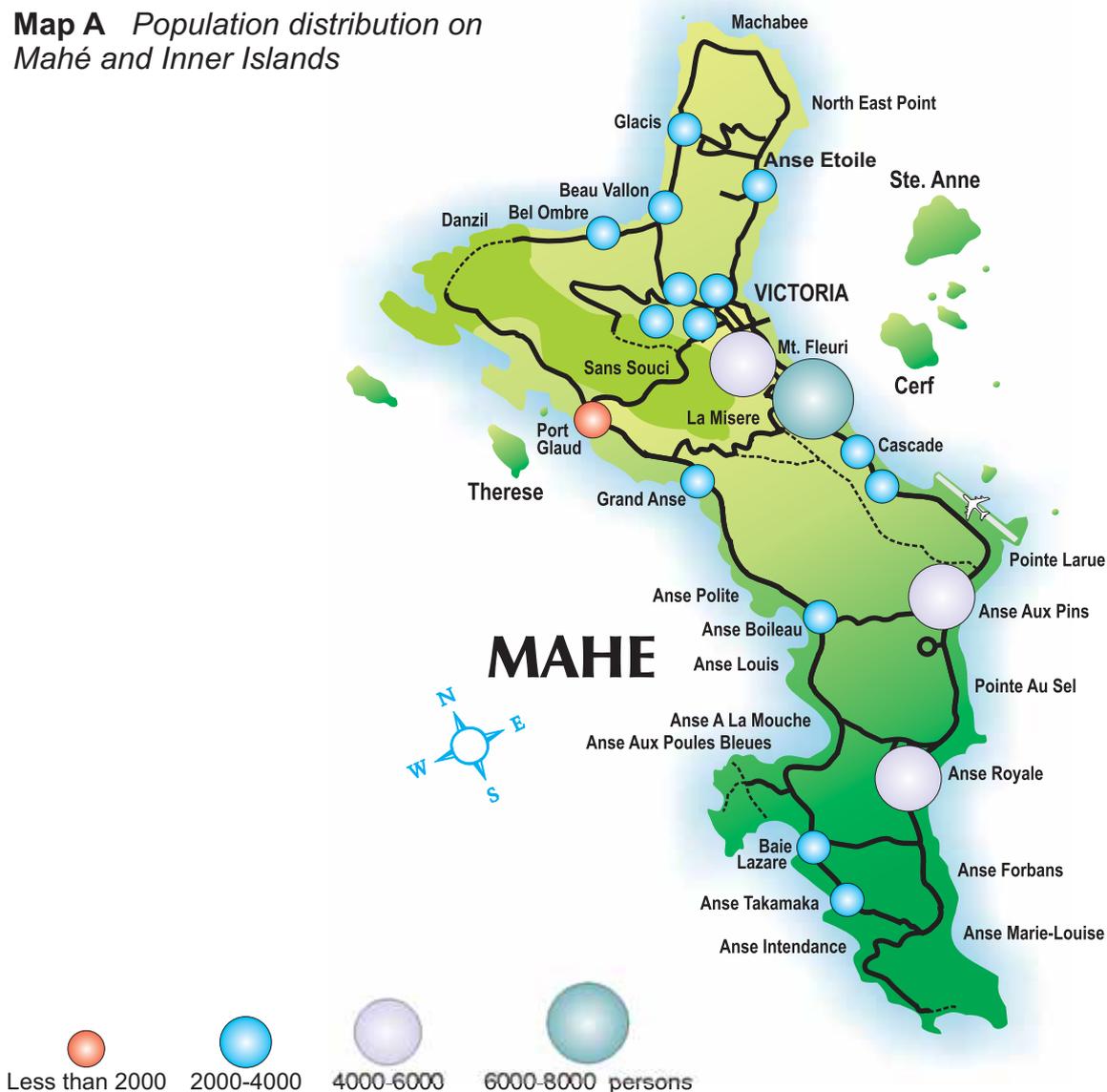
Populations in the World

Population refers to the number of individuals in any given area. We count populations of human beings as well as animals.

Did you know?

- In 1999, the population of the world was 6 billion (6,000,000,000) and 1/3 of the people lived in Asia alone!
- The population of the Seychelles was estimated at 81,202 people in 2001.
- The population of giant tortoises on Aldabra was estimated to be 100,000 individuals according to the census of 1997 (SIF)

Map A Population distribution on Mahé and Inner Islands



POPULATION & HEALTH



Population Distribution

Map A shows where most people live on Mahé. Population distribution refers to how spread out the people are. Population of the world and in Seychelles is not evenly distributed as the map shows. Population distribution is influenced by many factors. These are summarised below:

Sparsely populated areas (negative factors)

- ◆ Very cold/hot
- ◆ Too steep
- ◆ Poor, thin soils
- ◆ Too dry
- ◆ Poor water supply
- ◆ Few raw materials
- ◆ Little industry
- ◆ Not many jobs
- ◆ Poor communications

Densely populated areas (positive factors)

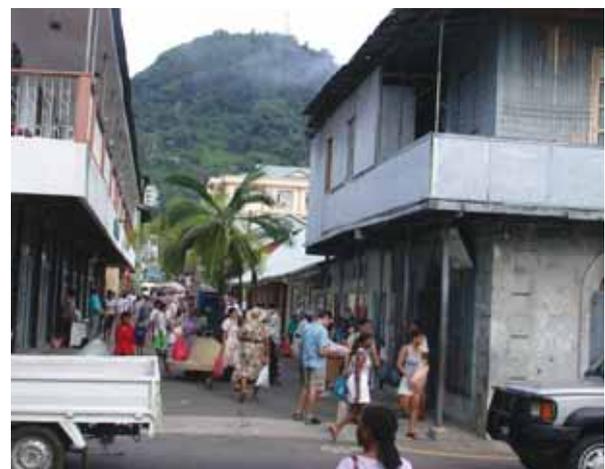
- ◆ Pleasant climate
- ◆ Gentle slopes
- ◆ Lowland
- ◆ Flat land
- ◆ Fertile soils
- ◆ Food availability
- ◆ Water supply
- ◆ Raw materials e.g. building materials
- ◆ Industry and jobs
- ◆ Good communications

Photos B

Study the two photographs below. Make a list of the factors that attracted the first settlers to stop at Victoria in the 1770's. Which of the above factors have influenced 33% of the population to live in Victoria today. Compare your two lists.



Victoria in 1900



Victoria in 2002

Population density refers to how crowded a place can get and is measured in persons per km². Census figures show that 99% of the population live on three main islands - Mahé, Praslin, and La Digue.

$$\text{Density} = \frac{\text{Population}}{\text{Area}}$$

Example:

Seychelles where Area = 455 km² and pop = 81,202

$$\text{Density} = \frac{81202}{455} = 178 \text{ persons per km}^2$$

Population densities for countries in the region

- Mauritius has a population density of 645 persons per km²
- Singapore has a density of 6,637 persons per km²
- Australia has a population density of 3 persons per km².

Work out the population density for Mahé where the Area = 152 km² and the population is 72,065. Compare the population densities of Mauritius, Singapore and Australia with that of Seychelles, and Mahé. Can you account for the different densities in each case?

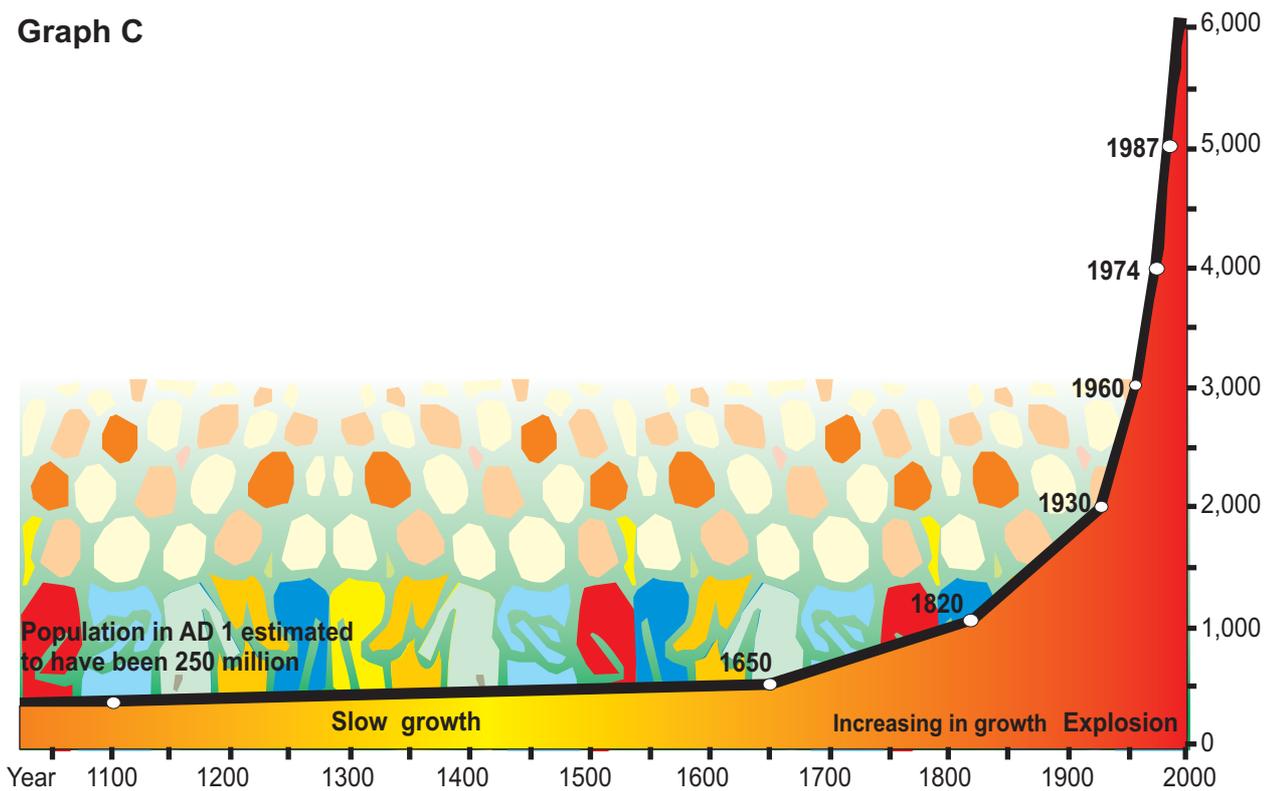


POPULATION & HEALTH

Population Growth and Consequences

The population of the world is increasing very rapidly. Experts say that every hour there are 12,500 extra people living on our planet; that is there is an increase of **3 people every second!** This increase is happening so fast that it is called a **population explosion**.

Graph C



Graph to show growth in population of the world (1700- 2000)

Population in Seychelles also has grown over the years. This growth is influenced by birth rates, death rates and migration.

The **birth rate** is calculated as the number of live births for every 1000 people in that country.

The **death rate** is the number of people who die for every 1000 people in that population.

The difference between birth rates and death rates gives the **natural increase**.

Life expectancy is the average number of years a person is expected to live.

The dependency ratio is the number of people in the population who depend on the working population per 1000 (it does not include the unemployed)

Migration refers to the movement of people within and between countries.



Population Characteristics

Table D summarises some of the features of the Seychellois population. Use Table D to describe what is happening to the following:

1. the fertility rates i.e. the number of babies a woman can expect to bear in her lifetime
2. the number of women of child-bearing age (15-49 years)
3. life expectancy
4. the total population

Table D

Population Projections	1977	1985	1990	2000	2000 (Actual)
Total fertility rate	5.1	4.2	3.6	2.9	2.55
Total population	61 786	65 244	69 550	82 445	81,202
% under 15 years	40	36	35	33	26.3
Women aged 15-44 years	11 850	14 050	15 440	19 885	21,000
Dependency ratio(per 1000)	859	744	705	642	504
Life expectancy					
Male	64.6	66.2	67.3	68.7	72.9
Female	71.1	73.5	74.2	75	77.9

Source: Statistical Bulletin, Seychelles in figures, MISD

Discuss the factors that may have contributed to each one of the changes listed 1-4 above. Use the **Diagram E** to help you.

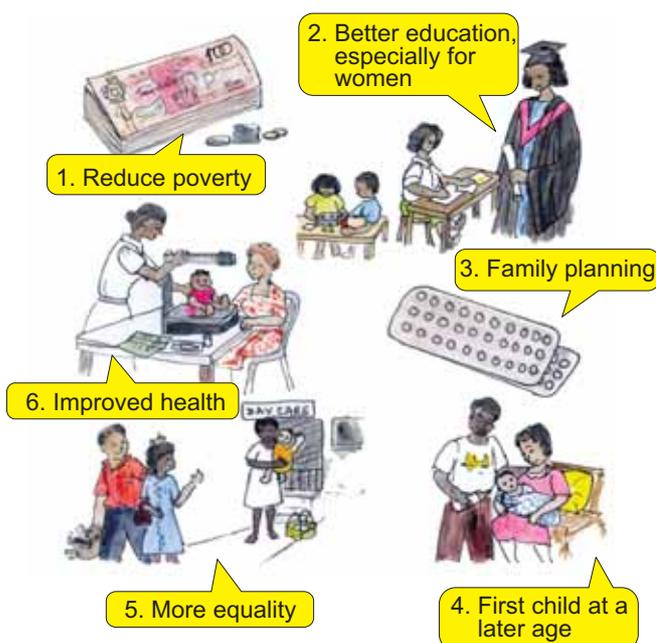


Diagram E

A growing population puts additional pressure on the environment especially where there is limited land. 89% of the population already live on Mahé alone and by the year 2019 it is estimated that the population will be 102,000. In Seychelles flat land is needed:

- to grow food
- to build houses
- for tourism activities
- for parks and gardens
- for recreation or leisure activities
- to build roads and factories
- for treating and dumping wastes

Note where most of these activities are presently taking place on Mahé. Use Map A to help you. What are the consequences of the expansion of these activities on nearby habitats?

An increasing population means everyone will need and use more resources e.g. food, water, homes, land, jobs, clean air, and electricity. *Can we provide extra resources to meet everyone's needs?* Population growth has, however, slowed down in recent years by out-migration or emigration.



POPULATION & HEALTH

Glossary

Habitats - the natural homes of wildlife where they find food and shelter. **Restored** - returned to original state. **Leptospirosis** - a disease spread by rats through contamination of food, soil.

Populations in nature - Magpie robins

The Magpie robin or *pi santez* is the most critically endangered bird species in the Seychelles. It was once common in the coastal forests of many of the granitic islands. In 1959 there were only 20 of these birds left in the whole world. This small number is a result of changes in their habitat and the introduction of predators such as the Norwegian rat on Frégate, cats and predatory birds such as the mynah birds (*marten*). At the start of 2002, there was a population of 113 birds and they all lived in the Seychelles! Some measures to control the spread of rats include spreading rat bait but most importantly by keeping the island rat-free. This is done by closely monitoring boating activities, one of the most important measures if this very rare species of bird is to be protected for generations to come. There are few remaining rat-free islands and they include Cousin, Cousine, Aride, and Frégate where **habitats** are still intact or have been **restored**.



Competition for resources also occurs in nature. Magpie robins for example need approximately one hectare of land each. This is to provide them with sufficient food, shelter and territories for their young. Where this is not always available nest boxes and supplementary (extra) food have to be provided.

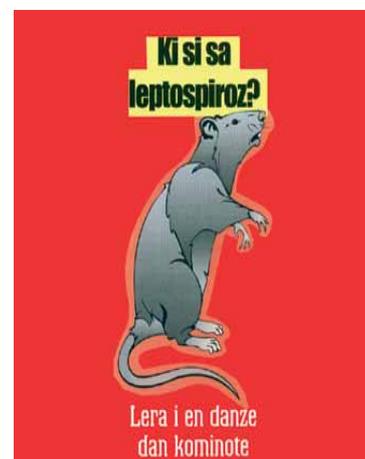
Pests and Human Health

Pests like rats do not only interfere with wildlife populations but also affect human health if not kept in check. **Leptospirosis** is today being spread by rats, is on the increase and can be deadly.

Reported cases of leptospirosis			Number of deaths	
Total	Males	Females	Males	Females
1995	53	5	5	1
1996	55	5	2	0
1997	45	6	6	0
1998	35	1	2	1
1999	16	5	2	1
2000	22	2	3	0
2001	60	10	7	0
2002	45	5	5	2
2003	10	0	0	0

Table G

Source: Statistics Division, Ministry of Health



(Available at Ministry of Health)

Compare the number of male and female cases. Why does leptospirosis affect more men than women? Pick up leaflets from the Ministry of Health to find out more about how it is spread.



Glossary

Infectious - that can be passed on from one person to another. **Aquatic** - to do with water. **Pyrethrum** - aromatic plant of the daisy family whose dried flowers are used to make an insecticide. **Propagation** - spread.

Leptospirosis is caused by bacterium leptospira which is carried by many animals, including rats. The bacteria inhabit the liver of their hosts and are spread through their urine and faeces. Many domestic animals such as dogs and pigs can get infected if they come in contact with the bacteria. Improved sanitation around our homes and in the community e.g. proper disposal of kitchen and other wastes will help to control rat populations and the spread of the disease.

Promoting Health

The Environmental Health Service in the Ministry of Health is responsible for the prevention of diseases and to continually improve health facilities in the country. There has been considerable improvement in environmental health and sanitation in Seychelles in the last 30 years. Great efforts have been made to eliminate life-threatening, **infectious** diseases, such as tuberculosis, leprosy, intestinal parasites, smallpox, measles. To control the spread of carriers such as mosquitoes, the Ministry of Health is using environmentally-friendly products to help prevent the spread of dengue, malaria, yellow fever, and heartworm in dogs. When applied to water surfaces this product does not harm fish, insects or other **aquatic** organisms.

To control mosquitoes and cockroaches, a chemical derived from the plant **pyrethrum** is used. It has been certified by the World Health Organisation as *not* being harmful to the environment. It is used in the spraying of aircraft and ships entering port to prevent the introduction of malaria into the country. Although Seychelles is free of the disease, we have ideal conditions for its **propagation**. Every year there is an average of nine reported cases of imported malaria. This may be a result of people returning from overseas trips with the infection or it may be the result of expatriate workers arriving with the disease.

As well as disease control and prevention, much effort has been made in improving quality and quantity of food, improving housing and conditions in the workplace. As a result of such efforts, Seychellois rank amongst the healthiest populations on the African continent. Today 93% of households have treated water, and 90% have flush toilets. People live much longer than even 15 years ago (See Table D).



Improved living conditions for Seychellois people



POPULATION & HEALTH

Glossary

Communicable - that can be passed from one to another. **Hypertension** - abnormal high blood pressure which can damage arteries and cause strokes. **Diabetic** - person suffering from a disorder where the body cannot break down sugars. **Overweight** - excessive or extra weight. **Obese** - very overweight.

Changing Lifestyles

The Ministry of Health is today concerned about the newly emerging diseases of the 'rich world' in Seychelles as Table J shows.

Table J

Causes of deaths	Average per year
Disease of the circulatory system	204
Cancers	92
Disease of the respiratory system	51
Injuries	43
Nutritional disorders, including diabetes	15

Infectious diseases such as leptospirosis and HIV/AIDS are a concern but it is the non-**communicable** diseases that have taken over as the main cause of ill-health. Today 25% of all adults suffer from **hypertension** and 7% are **diabetic**.

Statistics from the Ministry of Health indicate that 11% of boys and 16% of girls are **overweight** or **obese**.* 20% of school children have hypertension. Hypertension can lead to strokes and other heart problems. **These figures are as high as those for the USA and higher than those for Western Europe.** They indicate that most of these children will grow up to have diabetes or hypertension. This will eventually create a burden on the health resources of the country.

What is responsible for this state of affairs?

Some of these conditions are attributed to changing lifestyles. Our diet has changed a lot and young people are consuming foods high in salt and saturated fats such as chicken and chips, samosas etc. Many young people lack exercise and some consume too much alcohol.

The good news is that we can do something about it **NOW**. Young people can:

- ◆ Exercise regularly, around 4-5 times a week
- ◆ Eat more fruit and vegetables (five portions a day). Both are known to lower blood pressure
- ◆ Reduce the number of soft drinks and amount of fatty/fried foods you eat
- ◆ Avoid smoking and using alcohol - a person who starts smoking before s/he is 18 years old has a 25% risk of dying before the age of 60 due to tobacco-related diseases. Alcohol abuse affects the liver and shortens the life span.

*(from a survey carried out over four years with a sample of 6,000 students from creche to S4).



In a nutshell



- *Population is not evenly spread across the globe, not even in Seychelles.*
- *Population distribution is influenced by the availability of flat land, clean water, food, jobs, industries, etc.*
- *Most of the people on Mahé, Praslin and La Digue live on the coastal plain and as a result increasing pressures are put on coastal habitats.*
- *Marine and land resources have to be managed well if they are to last for other generations to enjoy.*
- *People need to share resources with other creatures e.g. birds, reptiles, insects.*
- *The Seychellois society is adopting new eating habits and lifestyles that may be detrimental to health.*
- *More healthy eating habits have to be promoted as well as more active lifestyles to ensure longer life expectancy.*



POPULATION & HEALTH

Learning Outcomes

Curriculum Areas - Geography, History, Science, Mathematics, PSE

Knowledge and skills

Understand that people and wildlife share basic needs; analyse and interpret statistics; formulate actions to ensure healthy lifestyles

Attitudes and Values

Appreciate that resources are finite and should therefore be used wisely; appreciate the factors that influence good health

Activities

1. Population Growth

The population of Seychelles was estimated to be 81, 202 in 2001. If the population grows at 1% each year how many people would there be in Seychelles

- 1) Next year
- 2) In 5 years' time
- 3) In 50 years' time?

2. Populations In The Wild

1) In January 2002, Frégate Island had a population of 60 Magpie robins; Cousin Island had a population of 27 birds, Cousine had 19 birds, and Aride Island 9. Draw a pie chart to show the *distribution* of magpie robins in Seychelles.

2) Draw a line graph to show changes in the population of Magpie robins (*pi santez*) over time using the statistics given below:

- a) 1978 - 41 birds, b) 1980's - 20 birds, c) 1990 - 22 birds, d) 1999 - 90 birds,
e) 2002 - 115 birds, f) 2003 - 125 birds

3. What Factors Shape Robin Populations?

Complete Table K below to show what magpie robins need to survive and the threats they face. Choose your answers from the labels provided below.

Basic needs of the magpie robin	Threats to the magpie robin	Measures to increase the population
Cockroaches	seabirds eggs as food	moved to rat-free islands
bigger territory	Fish	nest boxes
cats	Captive management	open woodland
planting of native tree species	Millipedes	reduction in pesticide Use
	brown Rats	mynah birds
	artificial food (pellets and egg mix)	coconut trees
		skinks

Table K

Glossary

Captive management - keeping and caring for animals in cages until they are ready to be released into the wild.



4. Eating Healthily

Below is a menu pinned up at the school canteen:

<i>Menu</i>	
ITEM	COST
Tuna sandwich	SR 5.00
Hamburger	SR 8.00
Toasted cheese sandwich with brown bread	SR 10.00
Grilled fish, rice and satini	SR 15.00
Spaghetti bolognaise	SR 16.00
Chicken/sausage and chips	SR 18.00
Mineral water	SR 4.00
Soft drinks, juice	SR 3.00
Apples/mangoes/zanmalak	SR 4.00
Ringo snacks/banana chips	SR 3.00
Samosas/chilli cakes	SR 2.00
Moutay/nouga koko	SR 3.00



1. What would you choose for lunch? Say why.
2. Which lunch would be the healthier choice? What influences your choices?
3. Does your canteen provide a variety of foods? How healthy is the food?
4. What could be done to ensure that healthier foods are sold?
5. Write to your head teacher and suggest what types of food you would like to see sold at the canteen.
6. Design posters to illustrate healthy and unhealthy foods and say why you think they are so.



Further activities and actions

- **Imagine** that you were one of the **first settlers** to land on Mahé in the 1770's. Describe what you would see, eat and how you survived. Compare this to a tourist stopping here now for a day on a cruise ship.
- Talk to elderly people in your community about family size in their times. What were the reasons for the **larger numbers of children per family in the past**? What do they see as factors that have brought about change in modern times? What are your opinions about family size?
- **Investigate a new development** in your area or neighbourhood. List the benefits it will bring to the local community. Does it bring any disadvantages to:
 - a) people
 - b) wildlife
 - c) the environment?
- Find out more about the **causes and effects of hypertension and diabetes**. What can you do to ensure that you do not become a sufferer? Present your findings as a role play.



WATER

● Water is important to all living things

● By using water we also create pollution

● How can we conserve our water resources?

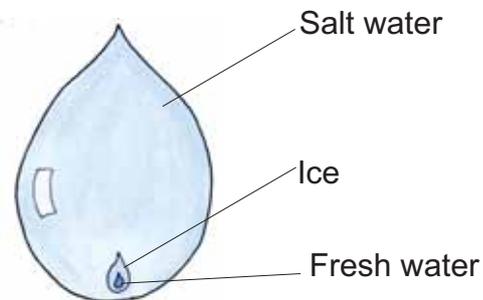
Water, Water Everywhere?

Water is vital to our planet as it sustains all life be it plant or animal. 70% of the human body is made up of water and more is used to maintain life, cleanse our bodies and maintain clean environments. Water is colourless, odourless and tasteless and appears as a liquid, solid or gas.



The World's Water Supply

About 3/4 of the Earth's surface is water but 97% of this is salt water. Only 3% of the earth's water is fresh and 2 % of that is held in ice caps. Fresh water makes up less than 1% of the world's **potable** water.



Importance of Water

Water has traditionally been used for daily activities such as drinking, bathing and for river transport but as populations grew and industries developed water became important for other purposes. Today water resources are important for the **irrigation** of crops in **commercial** farming, in manufacturing, for the production of hydro-electricity. Rivers and seas are also used as a dumping ground for many of our waste products.

Water harvesting and consumption in Seychelles

Past Practices

- Water was fetched from rivers or streams
- Water was collected from rooftops in '**dalo**'
- Water was collected in a '**ladal**' which took the water to a '**gannel**'
- Small dams held back river water
- Untreated water had to be boiled
- Water used for bathing and drinking mostly
- Very little was stored
- Low demand, few people

Water power for industry

Rope Factory at Cascade

- Water power was used to run the factory at Cascade which made rope from coconut coir.
- the coir was twisted into rope which was used in local industries
- Rope was also exported to Madagascar



Potable - clean, drinking water. **Irrigation** - artificially watering the land. **Commercial** - large-scale, where profits are made. **Dalo** - drain pipes made of corrugated iron or 'tol'. **Ladal** - split bamboo that collected water from rivers. **Gannel** - locally made wooden barrel used to store water.



Glossary

Aquifers - water bearing rocks. **Bore hole** - deep hole sunk into water-bearing rocks. **Sewerage treatment works** - a place where waste water is purified before being released into the sea. **Impermeable** - does not let water go through.

Did you know?

- Earth is the only planet known to have water to support life
- Every living thing consists mainly of water
- A person can live for weeks without food but will only survive a few days without water
- The 1993 Seychelles Constitution states that access to potable water is a basic human right
- The average person in Seychelles uses around 160 litres of water a day



What do the following have in common - an earthworm and a pineapple, tomatoes and cucumbers, you and an elephant?

Read on and find out more:

An earthworm is made up of 70% water

A pineapple - 80%

Cucumbers - 95%

The human body - 70 %

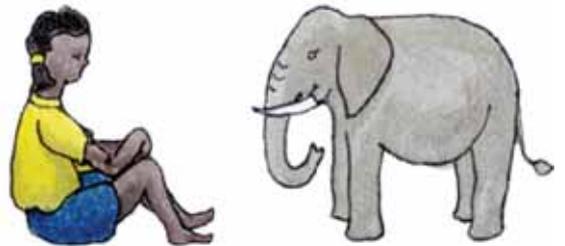
Carrots - 90%

An elephant - 70%

Milk - 85%

Tomato - 95%

Watermelon - 92%



Sources of Water

When rain falls to the ground it may travel on the surface as streams or rivers or it may be soaked up by the ground and stored underground between rocks. You may be surprised to know that two thirds of the world's water is found underground. This water is held in **aquifers** and may later be tapped by wells or **bore holes**. Underground water may reappear naturally at the surface as springs. In Seychelles, most of our water comes from small streams. However, some people get water from natural springs and in the south of Mahé some obtain their water by digging wells. Piped water is supplied by the Public Utilities Corporation (PUC) who is responsible for providing clean, potable water to homes and disposing of liquid wastes. To date, 90% of homes are supplied with piped water and 30% will be connected to **sewerage treatment works** when the Greater Victoria Sewerage Works and the Greater Beau Vallon Treatment Works are completed.

Rainfall Distribution on Mahé

Rainfall amounts are high (an average of 2,200 mm a year) and the northern region of Mahé records higher rainfall amounts as it is here that the higher mountains are found. (See Activity 4 on Page 29). Most of the rain flows on the surface as rivers and streams because of the **impermeable** soils and quickly runs into the sea. As a result very little water is soaked up by the ground. Seasonal differences in rainfall amounts also make it necessary for water to be stored in large reservoirs. This is necessary as homes, hotels and industries are using up increasing amounts of water.

Can you list three industries that use up a lot of water? What would the water be used for? Why do hotels use up so much water? (See Tourism theme)



Glossary

Catchment areas - areas from which rainfall flows into rivers. **Dual-flush toilets** - use small amounts of water for liquid waste and larger quantities for solid wastes.

Fresh Water is Running Out

It is estimated that 1/3 of the world's population will suffer from severe water shortages in the next 25 years. This shortage is to a large extent the result of human activities where we consume water more quickly than it can be replaced naturally.

So what can we do?

- Help to protect water **catchment areas** by not cutting down trees in forested areas and close to rivers
- Make water conservation a way of life. We, as individuals, can make a difference if we make it our responsibility to use less water every day. Try out the following at home to see how much water you could conserve. Complete the column on the right:

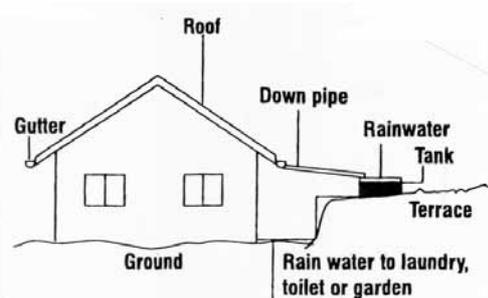
Water-saving activities to try out at home	Litres of water used	Alternatives	Litres of water used	Litres of water saved
Have a shower	30	Have a bath	110	
Wash vegetables in a bowl	9	Wash vegetables under a running tap	69	
Hand wash clothes in a bucket	40	Under a running tap	240	
Wash a full load in a washing machine	130	Wash half load	30	
Use rainwater for washing a car or watering the garden	30	Use treated water	230	
Wash your car using a bucket of water	18	Wash your car using a hose	300	
Install dual-flush toilets				
Half flush	4.5	Full flush	9	
Install spray taps for washing up to minimise the outflow of water	30	Normal flow	90	
When brushing your teeth fill a mug with water	0.5	Leave the tap running	45	
Wash dishes by filling two bowls or sinks; one for washing, one for rinsing	25	Leave the tap running	30	
Use a mop and bucket to clean floor	18	Use a hose for five minutes	78	

N.B. All figures are approximate

How many of the above do you regularly do at home? List three things you do that save the most water. Can you think of other ways you could help to save water at home?

The alternatives

The diagram illustrates how rainwater can be harvested and stored at home. The gutter can be made of plastic, metal or bamboo; the tank can be made of bricks, a recycled plastic barrel or fibreglass. It is, however, advisable to keep the container in which the water is stored covered so that mosquitoes do not breed in it and other particles don't fall inside it. This water can be used in the laundry, to flush toilets and water the garden. This will bring savings in treated water consumption and reserve water for other families to use.



Harvesting rainwater from roof tops



Glossary

Demand - amount needed. **Desalination plants** - places where sea water is converted into fresh water. **Adverse** - negative or bad. **Detergents** - soluble cleaning materials which combine with impurities in water. **Sewage** - waste matter especially human wastes. **Slurry** - animal wastes (manure) in a liquid form. **Siltation** - the build-up of fine particles of sand deposited by water.

Other Solutions

To meet the increasing **demand** for water, and due to the seasonal pattern of rainfall, the PUC has had to look for alternative ways of providing people with water. The existing reservoirs of La Gogue and Rochon are unable to meet the present demand and one alternative is to turn sea water into fresh water. This is referred to as desalination. **Desalination plants** on Mahé can be found at Anse Boileau and Providence and two others are planned for Praslin and La Digue. Desalination, however, means purifying the water so much that you then need to add essential minerals to it. Chlorine has to be added to the water before and after the purification process. These materials have to be imported and cost money. The purification process uses up a lot of energy and the waste water will be dumped into the sea. Its high salt content may affect coastal ecosystems.

From toilet to tap - Singapore turns to recycled water

Fancy a glass of recycled water from sinks and toilets? That's the reality Singaporeans may soon face as the city state searches for alternatives to cut its dependence on neighbouring Malaysia which supplies half of its water needs.



The Public Utilities Board is looking at the findings of an international panel that has declared recycled water, the so-called Newater, safe to drink. The tests carried out over two years, showed that the water produced at a demonstration plant was of consistently high quality and met the World Health Organisation (WHO) guidelines. Resource-scarce Singapore plans to build two plants that will produce 68 million litres of water a day for industrial use by the end of 2002. The recycled water will be fed to reservoirs where it will be treated to produce drinking water, a practice in place in the USA for over 20 years now with no **adverse** health effects. This method, it is hoped, will make the use of water more acceptable to the consumers.

Extract from Nation article, July 17th 2002

What are your views on drinking recycled water? Why was water imported from Malaysia? What alternative(s) has the Singaporean Government got?

Polluting Our Water Resources

Water is a liquid that can dissolve most substances and is therefore most likely to become easily polluted. Rivers get polluted by **detergents** and **sewage** from our homes, litter, factory discharge, oil from boats, chemicals and **slurry** from agricultural lands, as well as by hot water released by some factories. These may have negative impacts on ecosystems and have long term effects on organisms. Another form of pollution is **siltation** which is a result of rivers eroding the top soil during heavy rainstorms. The silt is deposited on the river bed and may lead to floods in times of storms as the water level rises.



Be a water detective

Look in rivers, marshes and drainage ditches for signs of pollution. The following are indicators of pollution:

- Strings of water algae (*gomon*) and low levels of animal life indicate pollution by sewage, fertilisers and phosphates.
- Factory wastes are seen as froth (bubbles) or sludge.
- Muddy waters indicate soil erosion.
- Rusty tins, plastic bags and wrappers are signs of littering.

Wonderful Wetlands

A wetland is an area of land that is covered in water for part of the year and includes freshwater and saltwater bodies. In Seychelles they exist as marshes (freshwater) and mangroves (saltwater). Marshes act as our kidneys, breaking down sewage and many chemicals, leaving clean water and soil behind. They also act like great sponges, soaking up rain before they drain into rivers and the sea. This way they help to reduce flooding after heavy rains and keep soils nearby moist in dry spells.

Wildlife need water too

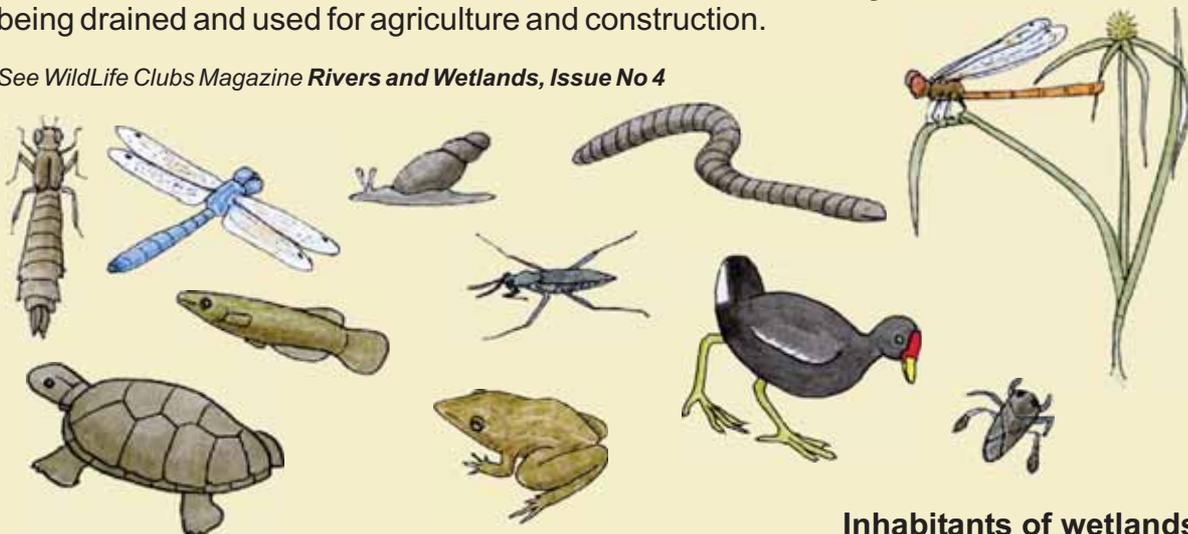
Wetlands are important habitats for a host of animals and plants; animals include the killifish or *gouzon*, frogs, terrapins, dragonflies and damselflies or *sigal*, mosquitoes and the moorhen or *pouldo*.



However, some of them are today threatened as a result of human activities. The killifish, a small brown fish endemic to the Seychelles, initially inhabited most rivers but today has been greatly reduced in numbers by the introduced tilapia. Its population has also been affected by pollution and siltation.

Terrapins or *torti soupap* are freshwater turtles that could be found in many marshes but today are more abundant on La Digue. They are secretive and spend their time hunting for fish, insects and snails. Their numbers have been declining as more marshes are being drained and used for agriculture and construction.

See *WildLife Clubs Magazine Rivers and Wetlands, Issue No 4*



Inhabitants of wetlands



Find a nutshell



- We tend to take water for granted; it is time we treated it like liquid gold.
- We are as dependent on water to drink as we are on air to breathe.
- Water resources are finite.
- We can all contribute to water conservation and make a difference.
- Now that you know how important water is, help to take action to conserve it.

Due to space constraints 'Further Activities and Actions' are put here, before the main Activities.



Further activities and actions

■ Sharing a Limited Resource

Note to teachers - The following activity is best done in pairs spread out over one week

For one week you have to bring 2 litres of water each day which you have to share between you. Decide who is going to bring the water to school. What did you use it for? What difficulties did you encounter in sharing your water? Were there responsibilities involved? What positive thing have you learnt by doing this exercise?

At the end of the week, write a report on your experience of sharing water.

- You are on a "**Survival of the Fittest**" competition and have to survive a weekend on Aride island which is known to be a dry place. You may not borrow or share anything with the other contestants. List five essential items you would take to see you through those three days in the field. Explain why you have chosen the items in your list.
- **Talk to your parents or grandparents** about how they obtained their water supply when they were your age. Find out how far they had to walk to fetch water. If you had to walk 1 km with a 10 kilo container, would you be more careful about using water? Give examples of how you would save water.

Note to teacher

For other activities related to water conservation and use refer to **Environmental Education for Sustainable Development, Activity Guide for Teachers** produced by the Ministry of Education: *Our Basic needs (Page 12); Water sweet water (Page 16); What's in a river (Pages 43-44).*



Learning Outcomes

Curriculum Areas - History, Geography, Science, Maths, English, PSE

Knowledge and Skills

Understand the importance of water in our lives; analyse and interpret data; work in groups; negotiating skills

Attitudes and Values

Appreciate that water is a finite resource; identify ways to conserve water; contribute to national efforts to save water

Activities

1. Household Water Consumption

Note to teacher - This activity is designed to help learners find out how much water they consume in a day and how they could minimise water use if necessary. Students may use a calculator.

- 1) Think of a 5 litre container or '*galon*' as an average unit to help you work out water usage in your home. Calculate how many 5 litre *galons* you would need for your daily activities. Now calculate how much water is used in your home:
 - o In a day
 - o In a week
 - o In a month
- 2) Calculate how much it would cost your family if a cubic metre (**or kilolitre**) costs SR 2.11 (for the first 10 cubic metres; SR 7.00 per cubic metre as your units increase).
- 3) Enter your results in the table below:

HOUSEHOLD WATER CONSUMPTION						
	Number of 5L <i>galons</i> needed	Number of litres used per day	Total number for a week	Cost in SR for a week	Cost in SR per month	Total cost per year
Per person						
For your family						
Your neighbour in class						

Consumption - the amount of water used. **Kilolitre or cubic metre** - is equal to a 1000 litres.



- 4) Compare your results with your neighbour in class. What are the differences between the two of you? Think of reasons for the differences in your respective households.
- 5) Does age, occupation, sex or lifestyle make a difference? Which factor has the greatest influence on water usage in your household? Can you think of *other* factors that could make a difference in your water usage?
- 6) Make a large chart so that you can compare water usage for the whole class. Are there ways in which you can all help to save water at home? Discuss what you could do differently.

2. Water Usage in Industry

- 1) Choose one of the following businesses to find out how much water is used in their operations in a month. *Ensure that you have their permission first.*
 - A factory producing soft drinks/beer
 - A canning factory
 - A factory processing food (e.g. milk or juices)
 - A factory producing carved stone
 - A laundry service
 - A construction company/site
- 2) How much water is used in a month? What is the water used for? What percentage of their production costs does water usage take up? Draw a pie chart to illustrate your findings.
- 3) What measures have they taken to ensure they have water all year round? Was any of the water recycled/reused? Were there costs involved? Are there ways that water use could be minimised in the different businesses? Compare results with other groups.
- 4) Present your findings as an exhibition on World Water Day (March 22nd) or one of the school's Open Days.

3. Start a Campaign in Your Community: 'Adopt a river or wetland'

- 1) Begin by carrying out a survey of the area. What is the best time of day to carry out the survey? Design a worksheet on which you will record your observations. You may wish to use the following headings:
 - Name of the wetland or river
 - Location
 - Description
 - Common plants
 - Common animals
 - Threatened or rare species found there/on river bank
 - Threats to the wetland/river
 - Changes you have observed
 - Recommendations for conservation/sustainable use.



- 2) Design a leaflet to illustrate plant and animal life that is found there. Give your reasons for wishing to protect them. Distribute the leaflets on one of the Theme Days such as World Wetlands Day (February 3rd).
- 3) Take photographs at regular intervals. They are an excellent tool to help you record long term changes to the area.
- 4) You could develop a nature trail to encourage visitors to come and visit it.
- 5) Write a report on your adopted area and send it to the Ministry of Environment or Nature Seychelles once a year.

4. Rainfall over Mahé

The map on page 30 shows annual rainfall amounts for Mahé. Lines which join place with equal rainfall are called *isohyets* (*iso=equal*). High rainfall amounts are taken as 2000 mm and above.

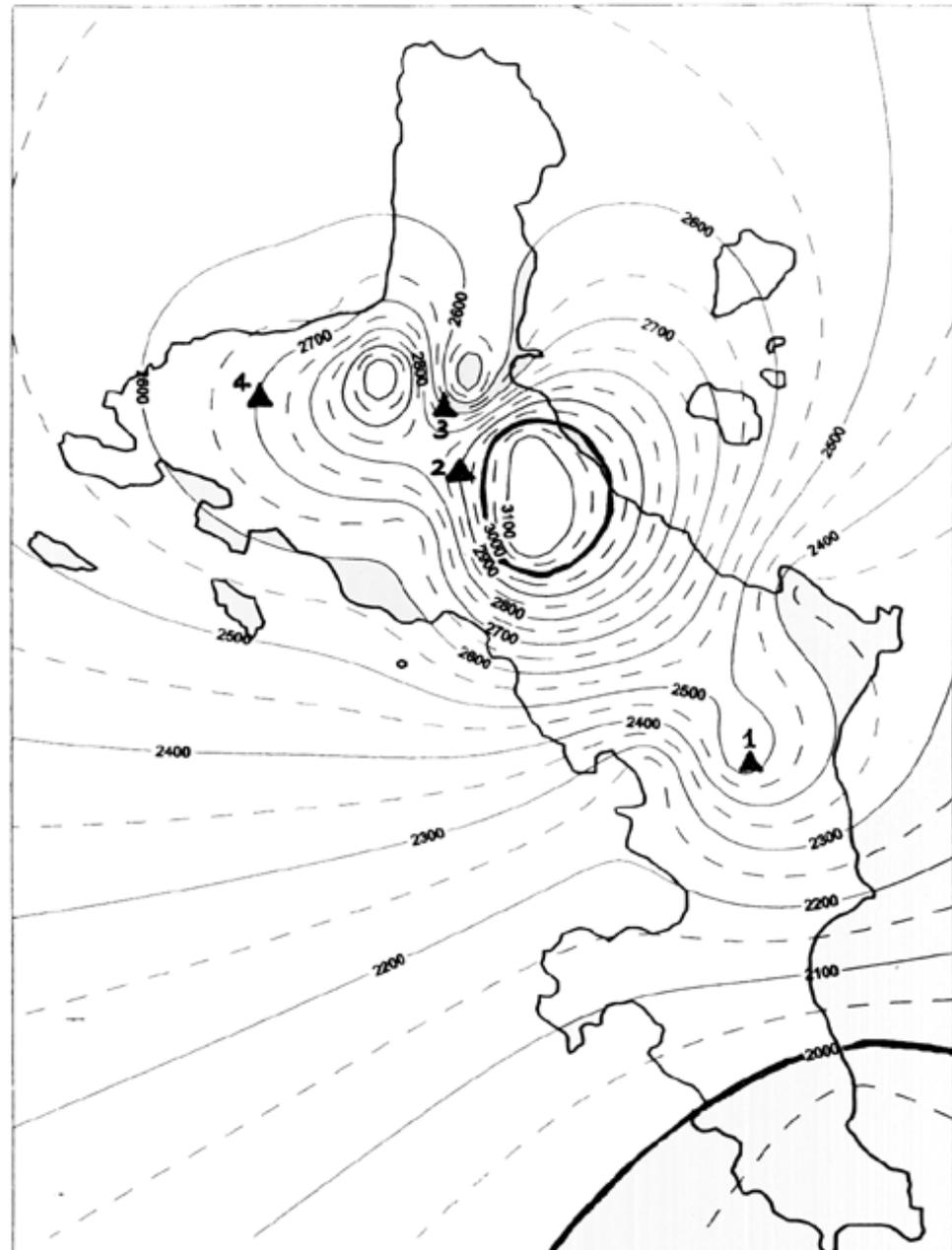
- 1) Shade your map (land areas only) to show the rainfall distribution over Mahé, using the key provided.
- 2) Using an atlas of Seychelles or a tourist map to help you, label the following peaks: Morne Seychellois, Trois Frères, Montagne Brulée, Mont Le Niol. Match *each* one with a number on the map (1-4).

Peak	Number	Height in metres
Morne Seychellois		<u>914m</u>
Trois Frères		<u>699m</u>
Mont Le Niol		<u>681m</u>
Montagne Brulée		<u>501m</u>

- 3) Identify your school/home on the map. Does the map reflect the rainfall amounts you normally experience? Compare these figures with data collected for the year by the school weather station.
- 4) Do you experience water shortages? What measures have been put in place to see you through the dry season? Suggest other ways in which more water could be saved.
- 5) Find out more about the two large reservoirs found on Mahé. Investigate their history. Were people displaced so that they could be built? Why are they both situated in the north of the island?



ANNUAL RAINFALL FOR MAHE ISLAND (mm)



Source: Climate Centre, National Meteorological Services
Climatological data based on 1976-1998 records

Key

	3000 mm and above	dark blue – very high rainfall
	2000 – 2999 mm	light blue – high rainfall
	below 2000 mm	pale yellow – lower amounts of rainfall
▲	Peaks	



SANITATION & WASTE

● Who is responsible for the provision of sanitation?

● How do we deal with our waste products?

● How can we reduce the amount of waste we produce?

We all need and use things to make our lives easier and more comfortable. To meet our basic needs we need food, water, clothes; to make life easier we use electricity to run appliances and transport to travel to work or school. In doing so we use up resources, many of which come from our immediate environment and from the global environment. As a result, we create waste products which include kitchen wastes, waste water, fumes, plastic bags and bottles, garden wastes. What happens to all the waste products we produce? How do we prevent them from becoming environmental problems which are **unsightly** and can affect our health?

Waste Management

A number of organizations have the responsibility for providing services which ensure clean and safe environments in our homes, schools, hospitals, streets, the community. They include the Public Utilities Corporation (PUC), Solid Waste and Cleaning Agency (SWAC) and the Société Traitement d'Assainissement Régionale (STAR) and the Ministry of Environment. They take care of sanitation which includes the hygienic removal and disposal of rubbish (solid wastes) and sewage, or waste water, from our homes and communities.

Types of Waste Produced

There are different types of waste produced as a result of the many different human and economic activities being carried out in the country.

Sewage includes **grey water** and **brown water** which originate from our homes and from industrial, commercial or agricultural sources. 60 % of the waste water goes into septic tanks (brown water) whilst another 30% is treated by PUC in sewage treatment plants. A small percentage of people still use pit latrines. On Mahé, sewage treatment plants are located near urban areas such as Victoria, Roche Caiman, Beau Vallon, Pointe Larue, and on Praslin there is one at Côte D' Or. Many hotels now also have to have their own treatment plants (*Refer to Tourism, Activity 1 Page 47*).

Why treat sewage? Sewage contains solids such as faeces and faecal bacteria which can pollute rivers and streams, underground water, flora and fauna and the marine environment where the water eventually ends up. It therefore has to be treated to a level which is acceptable before being put back in the environment. The PUC hopes to link 90% of homes to sewage treatment plants by the year 2010.

SANITATION & WASTE



Glossary

Green wastes - leaves, twigs and branches. **Hazardous** - harmful or dangerous. **Landfill** - site set aside for the disposal of rubbish. **Scavenging** - that feed on dead or decaying matter. **Leachates** - dirty, contaminated water.

Solid Wastes The table below summarises the wastes classified as solid wastes. They include plastic, glass and metals amongst other items thrown out with our weekly rubbish.

WASTE COLLECTED BY SWAC (tonnes=1000kg)						
Average per year	Domestic	Commercial	Green wastes	Mixed	Scrap metal	Waste oil
1999	984	480	252	1225	103	92
2002	1144	470	95	1322	42	97

What has happened to the amount of rubbish produced over the two years shown? Can you think of reasons for these changes?

Hazardous Wastes

These are products that may be harmful to humans and other organisms if swallowed, breathed in or end up in our water systems. They include oven cleaners, medicines, drain cleaners, bleaches, nail polish remover, hair dyes, toilet cleaners, glues, batteries used in torches and cars, floor and furniture polishes. We should perhaps be looking for more natural and cheaper alternatives instead. These may not always be easily available but there are a number of items that you can use to replace hazardous products with. You may like to try using some of the following: lemon juice or bilimbi, salt, steel wool (brillo), white vinegar, vegetable and olive oil. (See page 36 for recipes to try out at home)

What happens to the rubbish we produce?

Solid wastes are collected by SWAC and taken to a **landfill** at Providence where they are crushed and compacted by machinery every day. This is to reduce the volume, and therefore the space needed, and to keep out pests such as rats and **scavenging** birds which are a health hazard. Metals are crushed and exported to Mauritius and India. Used oil is stored and pre-treated before being exported to Reunion for recycling and disposal. Green wastes are made into compost by STAR.

The Providence landfill was opened in 1992 and is managed by the company STAR. It is built on reclaimed land found at 3 metres above sea level. *Can you think of disadvantages of having a landfill on such a site?*

There are plans to take the solid wastes to a new sanitary landfill in Anse Royale in the near future. This is a site that has been lined with special plastic to trap and prevent **leachates** from seeping into the ground. It also has a gas management system which allows methane and other polluting gases to escape from the landfill.





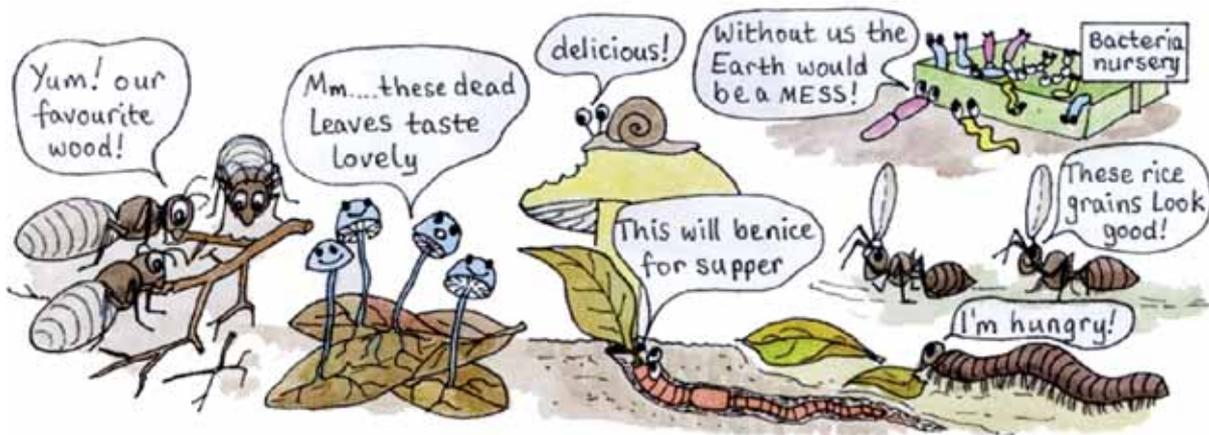
SANITATION & WASTE

Glossary

Organic - that was once plant or animal matter. **Humus** - fine material obtained from the remains of rotting plants or animals. **Decomposers** - organisms that help to break down organic matter. **Compost** - fertile materials resulting from the break down of kitchen or garden wastes. **Non-biodegradable** - that is not easily broken down naturally.

Nature's Recyclers

Humans dispose of wastes so that they do not accumulate to levels that are dangerous to health or become eyesores. Nature also helps us to get rid of **organic** waste products. A number of organisms such as bacteria, fungi, earthworms, millipedes, ants, snails and termites help to break down organic wastes like leaves, twigs, branches and dead animals into useful **humus**. Humus is used up by plants to continue the growth cycle. Termites, although a problem to humans, are important **decomposers** in nature as they have special micro-organisms in their gut which help them to digest tough wood fibres which are later turned into humus.



Turning Green Waste into STAR DUST

STAR is a local company now producing organic **compost** made from green wastes at their Providence plant. The materials collected are carefully sorted, shredded and allowed to rot for some twelve weeks or more before they are ready to be sold to farmers, gardeners and horticulturalists.

Benefits of using compost:

- It reduces the volume of waste by 30%
- It enriches the soil and is good for your plants
- It helps to improve the soil structure
- It adds moisture and air to soil
- It reduces the need for chemical fertilizers
- It does not pollute streams and rivers



Turning waste into useful products

When we choose to buy packaged snacks instead of a piece of fresh fruit, takeaway lunches in place of food brought from home, canned beers in preference to bottled beer, the more wastes are produced. We are at the same time contributing to the filling up of the dumping site. The landfill at Providence was estimated to last 15 years but is filling up after just ten years. *What can we do to reduce the amount of non-biodegradable rubbish we produce?*



Practice the 4R's

Reduce

Reduce consumption and waste. Reduce the amount of rubbish produced in your household by buying only what you need; use cloth or vacoa bags when shopping, buy bottled drinks instead of canned ones, avoid overpackaged foods. Reduce your use of water and electricity.



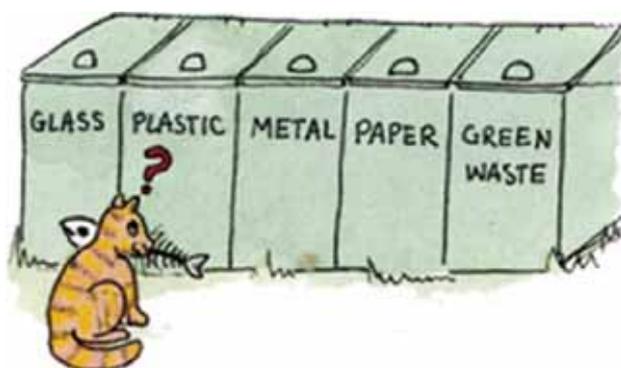
Reuse

Reuse just about everything you can - wrapping paper, glass jars for pickles and jams, plastic bags, yoghurt tubs, repair shoes and clothes to extend their lives.



Recycle

Recycle means to reprocess or rework an item e.g. old SeyBrew crates are ground into granules which are exported to Tanzania where they are recycled into new crates. At home you can recycle paper, food waste, wood and save your scrap metal for collection days.



Recover

Recover means to get back certain products like nutrients from composting, waste water, parts from cars and electronic equipment, silver from film and photographic paper.





SANITATION & WASTE

Did you know the source of these products and how long it takes for them to decompose when in the environment?

		You need	It takes.... to rot
T O M A K E	Paper e.g. note pads, envelopes, books	Trees Water Bleach Power/energy	2-4 weeks
	Plastic e.g. bags, containers	Petroleum (oil) Energy (power) Dyes	up to 100 years
	Metals	Minerals Energy (power) Water	100 years or more
	Aluminium	Bauxite Energy (power)	200-500 years
	Glass e.g. jars, bottles	Silica from rocks/sand Energy (power) Water	unknown
<p>Reuse and recycle as much as possible. By doing so you will help to:</p> <ul style="list-style-type: none"> * Save precious raw materials * Save Water * Save Energy * Conserve natural areas * Reduce solid wastes in the environment 			



Use Non-polluting Alternatives

To cut down on hazardous substances when cleaning your home, look in your cupboards for alternative products. Here are a few ideas:

Vinegar

Removes mould (*mwazi*), cleans inside coffee and teapots, glass, windows, paintbrushes

Bicarbonate of soda (or baking soda)

Cleans, deodorizes, polishes, scours, softens fabric, removes stains. You can use it on plastic, carpeting, sofa sets, inside refrigerators, and down drains

Salt

Has a variety of uses, from mopping up grease spots to unblocking drains





Tips For Today and Tomorrow

- **To mop up food stains on tablecloths** - sprinkle salt and wipe off immediately
- **Polish** - mix 15 ml (1 tablespoon) vinegar and 25 ml (2 tablespoons) olive oil, heat in a pan of hot water and apply to furniture
- **To clean your windows** - mix 10 ml (2 teaspoons) vinegar and 1 litre of water; use discarded newspapers to clean with
- **To clean your oven** - pour salt or baking soda onto fresh grease spots when warm and wipe immediately
- **To unblock drains** - pour 250 ml baking soda, 250 ml of salt, 125 ml of vinegar down the drain and leave for 15 minutes. Pour on a kettle of boiling water.
- **For stubborn stains on delicate fabric** - apply shampoo, leave overnight then rinse
- **To remove rust stains** - mash up bilimbi and salt, spread onto stains and leave exposed in sunlight
- **Air fresheners** - use flowers from the garden; boil cinnamon leaves with cloves and lemon grass
- **Weed killers** - hand pick weeds from gardens; use a mulch (a cover of plant material such as coconut husks) around the plant to prevent weed growth and retain moisture.



Pesticides

Try planting strong-smelling herbs such as garlic, basil, onion, and flowers like marigolds (*pisanli*) between your vegetables (*See Agriculture theme*).

To control:

- **Aphids** (*lipou*) spray plant with soapy water. To shine the leaves use diluted milk.
- **Ants** - sprinkle paprika or chilli powder on the ant hill or opening.
- **Snails** - sprinkle ashes in their trail
- **Rodent bait** - use rat traps with toasted coconut or bread as bait



- *Clean and healthy environments are essential to humans and other organisms.*
- *By meeting our basic needs we use up resources and create wastes.*
- *Wastes pollute and can be harmful*
- *By minimising our use of resources we contribute to waste reduction.*
- *We are encouraged to choose environmentally-friendly alternatives.*
- *There are many useful items that could be reused and recovered .*

Note to teacher

For other activities consult **Environmental Education for Sustainable Development, Activity Guide for Teachers** produced by the Ministry of Education - Pollution (page 51); How much rubbish (page 53); Reusing rubbish (page 55); Making Papier Mache (page 56); Recycling paper (page 57)



SANITATION & WASTE

Learning Outcomes

Curriculum Areas - Science, Maths, English, Social Economics

Knowledge and Skills

Investigate the natural resources used to manufacture things we need; understand that by consuming things we produce waste products that pollute; participate in waste reduction initiatives

Attitudes and Values

Appreciate that resources are finite; that using and reusing products helps in saving resources; use environmentally-friendly alternatives

Activities

1. What Happens to Rubbish Produced at Home?

- Work individually to complete the following. Then work in small groups to compare your answers. Some examples have been provided for you.
- Share ideas with others to see if there are better ways of dealing with our rubbish. Can we recycle food?
- Illustrate your answers on a flow chart by using collage.

Type of waste	What do I do with it?	Other uses of this product
Weekly rubbish		
Glass jars and bottles		
Plastic bottles		SeyBrew exports ground granules to China for recycling
Tomato sauce bottles		
Kitchen wastes e.g. vegetable peelings and soft fruit		
Cardboard boxes, old newspapers		
Old cards, wrapping paper		
Food scraped off plates		
Garden wastes such as leaves, rotting fruit		
Scrap metal e.g. old fan, cooker, fridge		Compacted and exported to Mauritius and India for recycling





2. Be a Recycler at Home or at School

- 1) Hold a class survey to find out how many people have a compost heap at home
- 2) Ask if there is a student who can explain how it got started?
- 3) Who looks after it? How easy is it to maintain the heap?
- 4) What are the benefits? Are there savings to be made?
- 5) Are there any disadvantages?

Start a compost heap

Note to the teacher

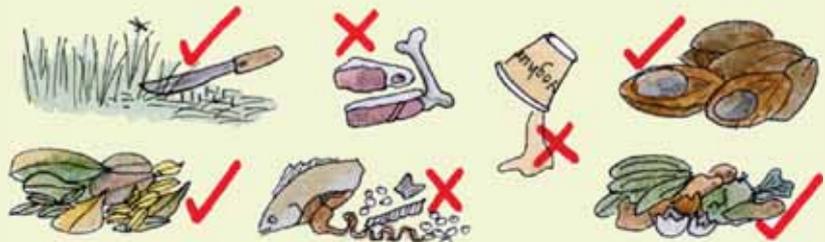
This activity can be undertaken as a class project if done at school. Different groups are assigned different duties such as bringing in the materials, starting the compost heap, maintenance of the heap, recording changes noticed over a number of weeks, use of the compost.

You will need:

- A discarded barrel or container with holes in the bottom
- A sunny, airy spot in the back yard away from the house or classrooms and water bodies
- Dry materials (leaves, dried grass, sawdust (*lapay galer*), paper, cardboard, coconut husks)
- Wet layers (vegetable peelings, overripe or rotting fruit, egg and nut shells, grass and garden clippings etc)
- A fork to turn over

Do NOT add

- Milk products
- Meat
- Bones
- Fatty foods
- Fish guts and scales
- Animal faeces
- Diseased plants



Steps

- Dig a hole approximately 1/2 a metre deep in the garden / fix barrel in place
- Arrange materials by alternating dry and wet layers
- Finish with a dry layer of cardboard, paper or coconut husks
- Cover so that animals do not dig up
- Turn over at least once a week to ensure there is flow of oxygen for decomposition to take place
- If the pile is dry, add water
- Observe any changes that take place over the weeks
- Report your findings to the class. Explain the process using a flow chart

Note: the whole process should take around 8 weeks given the right temperature and moisture content. Your compost is ready when it has turned dark in colour and has an earthy smell.



SANITATION & WASTE

Glossary

Toxic - poisonous to living things if eaten or breathed in. **Corrosive** - can cause irritation or burns to skin and eyes and endless environmental damage. **Flammable** - that catches fire easily. **Explosive** - that may explode under great pressure or produce deadly fumes.

3. Shop Wisely

- 1) Work in groups where each group makes an audit of products found in *each* room shown in the diagram below.
- 2) Place a tick in the first column if you have these products in the home
- 3) Tick in the second column if they have any of the symbols below
- 4) List the non-hazardous products available in your home that you could use instead

HOUSEHOLD HAZARDOUS WASTE AUDIT			
Toxic 	Corrosive 	Flammable 	Explosive 
	In use in my home	Hazardous?	Alternatives I can use
Living room solutions for cleaning DVD/VCR s, plant sprays			
Kitchen oven cleaner, flea powder, insect spray, rat poison, drain cleaners, floor polish			
Laundry Bleach, detergents, dyes, fabric softeners			
Bathroom Toilet cleaner, hair products, medicine, air fresheners, polishing agents			
Bedroom Perfume, nail polish remover, batteries, mothballs, shoe polish			
Garage/store Weed killer, insecticides, charcoal lighter, motor oil, benzene, car battery, paint, thinner, rust remover			

- 5) Make a shopping list of things you would need to clean your house with for one month.
- 6) Calculate how much it will cost you to buy the products listed above.
- 7) Compare these to non-toxic alternatives given on page 36
- 8) Which ones would you choose to use? Say why.





Further activities and actions

- Find out more about **environmentally-friendly products** on sale in Victoria such as *Ecozyme* products
 - 1) What are the different uses we can make of these products?
 - 2) What are the advantages of using such products over the ones we already use at home?
 - 3) Prepare a leaflet that will allow you to share your new-found knowledge with other students
 - 4) Distribute your leaflets around the school on Environment day (June 5th)

Here are some guidelines to assist in designing the leaflet -

- ▶ What is ecozyme (or other product being investigated)?
- ▶ How does it work?
- ▶ Instructions for use
- ▶ Where to use it in the home
- ▶ Cost of the product (s)
- ▶ Illustrations

- There are a number of local companies distributing water and soft drinks in **PET (or plastic) bottles**. Research the following:
 - 1) What raw materials are needed to produce the bottles?
 - 2) Where do we obtain them from?
 - 3) How much does it cost to produce one bottle?
 - 4) What is the environmental cost of producing PET bottles (consider effects of extraction of raw materials, production, pollution). Can we put a cost to it?
 - 5) Hold a debate on the benefits and disadvantages of using PET bottles as opposed to glass bottles for the distribution of soft drinks.



- **Practice the 4R's everyday**
 - 1) Bring in items to illustrate how you are reusing and recycling at home.
 - 2) Think of other ways in which you could reduce and reuse items at home
 - 3) Find out if there are any other examples of recycling going on in Seychelles.
 - a. Make a chart that summarises the processes.
 - b. Report on your findings to the class

- **Join the Eco-Home Competition**

- 1) Pick up leaflets from the Ministry of Environment and find out how to enter.
- 2) You may learn a few tips on how to do things differently or you may be pleasantly surprised to find that you are already putting into practice a lot of what is being proposed.





TOURISM

● What are the attractions of Seychelles to tourists?

● What are the effects of tourism development in Seychelles?

● Can we maintain the growing numbers of tourists?

The Tourism Industry

Tourism is the movement of people who travel for leisure and usually involves a stay away from their usual home. The tourism industry looks after the needs of tourists, helping them to travel to new destinations whilst providing them with things to do where they can enjoy themselves and enjoy a different pace of life.

Tourism is today one of the fastest growing industries in the world, employing a large number of people. Tourism emerged in the Seychelles after 1971, following the opening of the airport. This was also a time when the traditional exports of copra and cinnamon were facing tough competition on the world market. Throughout the 1980's tourism was the most important sector of the economy and today remains one of the most important pillars of the Seychelles economy, bringing in a large proportion of the foreign exchange earnings and employing close to 6,000 people (18 % of the working population).

Tourist numbers have steadily crept up to reach a high of 132,000 in the year 2002. The majority of tourists come from Europe (80%), Africa (11%), America (5%) and Asia (4%).

What do the Tourists look for?

Tourists travel to new and exciting destinations, often very different to their own environment, looking for pure escape from their usual routine and where they can also have fun. Many want to enjoy warmer climates whilst some take to the mountains for skiing holidays. Some enjoy Game Parks or Safaris whilst others prefer cultural holidays, spending their time visiting monuments and **sites**. Many tourists combine at least two of these on a holiday.



Sites - places of interest to visit e.g. Botanical Gardens, Mission Lodge, Jardin du Roi.

TOURISM



Glossary

Big game fishing - sport where fish such as marlin and sailfish are targeted. **Catch-and-release** - a sport where fish are caught for the excitement but then released into the sea. **Economic development** - changes in the prosperity of people as resources are made available or used.

What makes the Seychelles so attractive to Tourists?

A warm climate, tropical vegetation, white sandy beaches, clear and warm seas and a population where racial harmony prevails favour the tourist trade in Seychelles. Today tourists also seek adventures in the outdoors and sporting activities such as diving, **big game fishing** and **catch-and-release** fishing.



Location of tourism establishments

Tourism development in Seychelles has tended to take place on the coastal plain to take advantage of the natural environment. This has, however, led to increasing pressures being put on this narrow belt and the associated habitats such as coastal forests, marshes and mangroves. As a result of the rapid pace of development on the beach front, many of the coastal habitats on the granitic islands have been changed or lost in the last twenty years.



Principal Hotels on the coastal zone of Mahé

Tourism and the Economy

For many years the focus in tourism in Seychelles and around the world has been in earning money for **economic development** and in creating employment.

Study the table below which shows some figures relating to the tourism industry:

Earnings (in Million SR)	1997	1998	1999	2000
Tourism	612	584	596	598
Fish exports (canned, frozen, prawns)	329	461	568	675
Employment in tourism related fields	5179	5082	5324	5990

Source: MISD, Seychelles in Figures

What do these figures indicate about the importance of tourism in the economy?



TOURISM

Glossary

Boom - sudden growth. **Consumerism** - using up and buying more things e.g. cars, bigger houses. **Landfills** - places set aside for disposal of rubbish. **Amenities** - facilities, services. **Trekkers** - mountain climbers. **Compare** - look for similarities and differences.

The Blessings and the Problems

Tourism can bring many benefits to countries like Seychelles but these are often offset by disadvantages. Some examples of benefits and potential problems are listed below.

Benefits of tourism	Disadvantages to the environment
Creates employment	Little regard for environmental problems created
Boom to construction industry	Attractive landscapes get spoilt, beach sand extracted, coastal vegetation lost, turtles no longer nest here
Brings in money to the country	Consumerism accelerated, higher energy consumption
Higher standards of living	Lots of waste created, litter; need for new landfills
Improvements in transport e.g. roads, airports	Increased air pollution, habitats destroyed
Creates demand for locally produced food	Increased use of pesticides, more land required, loss of natural areas
Demand for locally produced souvenirs	Wildlife gets sacrificed e.g. turtles, shells
Local amenities which locals can use e.g. hotels, boutiques, bars and discos	Loss of cultural identity e.g. in music, dress, drunkenness, crime, violence
New schools, hospitals built	Ecosystems altered by development e.g. marshes filled in
New places to visit	More development, pressure on natural habitats

Tourism and Resource Use

Tourists are known to use up a greater amount of resources than the local population in many parts of the world where tourism is the most important activity.

Did you know?

- ▶ In Nepal for example, **trekkers** use three times more firewood than the locals.
- ▶ A golf course in Thailand uses as much water as 60,000 villagers!



Seychelles has a population of just over 81,000 and receives 130,000 tourists a year. *Think of all the things tourists will need while on holiday. Compare these to what locals need and use up. Can we meet everyone's needs?*



Glossary

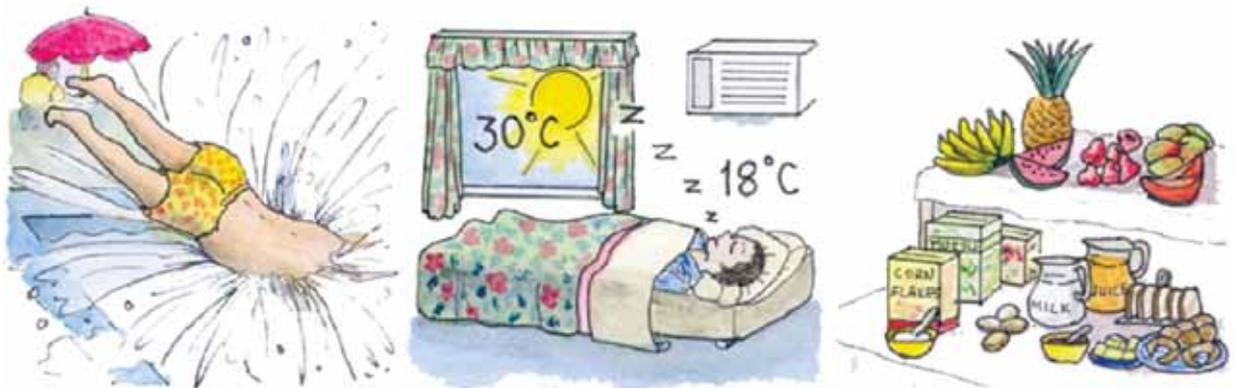
Carrying capacities - numbers that are able to support themselves.

In Seychelles, hotels spend a lot of money on energy and water bills each year (see *Energy Section*). Tourists use up a number of local resources while on holiday. These include:

Water: An average tourist uses up much more water in one day than a local person does. *What do they need so much water for?* Tourists visiting hot and humid tropical countries shower more frequently during the day. Many expect clean towels and bed linen every day. Food preparation and general hygiene around the hotels requires a lot of water. So does keeping the lawns and gardens green. Swimming pools have to be filled up on a regular basis and chlorine added to purify the water.

Energy: The high temperatures and humidity are often unbearable for many Europeans who form the bulk of our tourists. Consequently, hotels have to provide air-conditioning in most rooms to ensure the comfort of clients. These systems may be left running for hours and therefore use up a lot of energy.

Food: A variety and large number of items feature on the menu of hotels each day. *What percentage of the food is grown locally? How much of the food prepared is consumed in any one day? What happens to left over food?*



Planning For The Future

Local authorities and many hotel owners are now more concerned about the state of the environment and about keeping it attractive and healthy enough so that we can maintain the inflow of tourists. This has led to the commitment that “*tourism will be developed on a sustainable basis and not exceed carrying capacities, and the unique land and marine environment and cultural heritage of Seychelles will continue to be protected and conserved.*” (Mission statement, VISION 21) adopted as part of the Ministry of Tourism's new Vision for the next ten years.



Optimum - the best. **Sanctuary** - a safe place or refuge.

The Tourism Vision 2001- 2010

*Tourism in Seychelles shall continue to be developed to the highest standards for the **optimum** social and economic benefit of the Seychellois people while maintaining a commitment to the protection of the natural environment and biodiversity.*



The Move To Ecotourism

In 2003, the Ministry of Tourism launched its Ecotourism Strategy which will set guidelines to ensure that tourism development takes into account the need to protect and conserve the natural environment.

Ecotourism is an activity which:

- ◆ Contributes actively to the conservation of the natural and cultural heritage
- ◆ Includes the local people in planning and development and contributes to their well being
- ◆ Provides information about the natural and cultural heritage of the destination to visitors
- ◆ Offers services preferably to small groups as well as individual travelers.

(Quebec Declaration, Tourism Conference, June 2002)

Today ecotourism accounts for 20% of all international travel.

Local operators are promoting ecotourism ventures on Cousin, Bird Island and Curieuse. On Cousin, for example, tourists leave immediately after touring the island and therefore do not leave litter behind. Boats are moored 200 metres from the shore to prevent the accidental introduction of any pests to this bird **sanctuary**. Solar panels are used to provide energy for the wardens' houses.



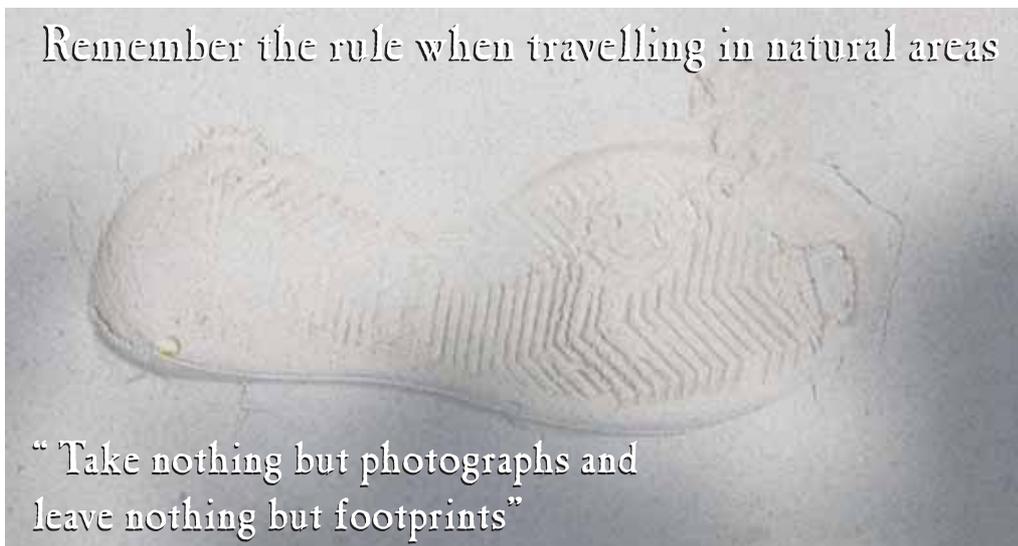
Ecotourism on Cousin Island



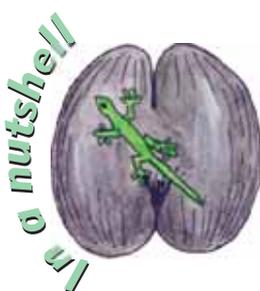
Other operators are promoting sporting activities such as scuba diving and snorkeling which have a lesser impact on the natural environment. Many hotel owners are now also eager to participate in projects that are more environmentally-friendly and some have even initiated some of their own (see Activity 1 on Page 47).



Remember the rule when travelling in natural areas



“Take nothing but photographs and leave nothing but footprints”



- Tourism is one of the largest and fastest growing industries in the world, making increasing demands on the environment.
- Tourists use up more resources than locals in the host country.
- We need to find ways to minimise the damage caused by the rapid growth of tourism in Seychelles.
- Ecotourism reflects greater awareness of the need to use natural resources wisely whilst benefiting local communities.



Learning Outcomes

Curriculum Areas - History, Geography, Science, Maths, English

Knowledge and Skills

Investigate the natural resources used by tourists; appreciate the impact of tourism on resources available; analyse and interpret statistics

Attitudes and Values

Appreciate that resources are finite; be responsible in sharing resources; finding solutions/alternatives to environmental problems

Activities

1. How 'Green' Are Our Hotels?

- 1) Choose a hotel near your home or school to carry out the following audit. Work in groups. Each group visits a different hotel in the region. *Ensure that you have their permission first.*
 - The following guidelines will help you assess how environmentally friendly the hotel is.
 - Rate the activities listed on a scale of 1-5, 5 being awarded to very positive things being done.
 - Add other examples that you discover whilst carrying out the audit.
 - Compare your results to determine similarities and differences in practices in different sized hotels.

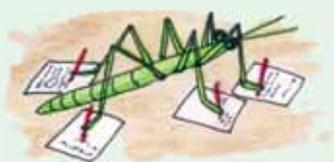
Initiatives taken by the hotel	Rating 1- 5
Use gas in place of electricity for cooking	
Use CFC-free refrigerators	
Buy organic food from local farmers	
Compost kitchen wastes or wastes go to local pig farmer	
Use solar panels for heating water	
Use energy saving light bulbs	
Central air conditioning system used/power turned off when client leaves room	
Promote use of showers instead of baths	
Have water-saving devices in toilets	
Use electric mosquito mats instead of coil	
Have their own sewage plant	
Compact their solid wastes ready for disposal	
Control rodents by minimising risk factors	
Beach vegetation planted	
Compost seaweed	
No motorized water sports allowed	
Keep bright lights on beaches to a minimum so as not to confuse turtle hatchlings	
Reuse envelopes and paper	
Encourage guests to go snorkeling/scuba diving	
Actively promote hikes to natural areas	
Encourage guests to walk to nearby village	
Support a local community project	
Others	
Total	



Interpreting your results

- ▶ A good rating is 100 marks and above and indicates serious efforts in safeguarding the environment.
- ▶ A rating of 50-75 means that conscious efforts are being made by this establishment.
- ▶ Less than 30 is a poor rating and reflects that more could be done to turn this establishment into a 'greener' establishment.

- 2) Write to schools on Praslin and La Digue to compare results of the audit carried out. Write a short report on your findings. Share your results with other classes or the Wildlife Club members.
- 3) Write a letter to the Ministry of Tourism to tell them about the findings of your research. Suggest what the hotels that have scored poorly on the audit could do to become 'greener'.
- 4) Design posters to depict the positive initiatives taken by different hotels. Place them around the school so that other students can learn about these initiatives.
- 5) Carry out a similar audit in your homes to determine how environmentally-friendly your practices are. What areas could you improve upon? How easy would it be to influence your family to do things differently?



Further activities and actions

- **Talk to grandparents** about how life was before the airport was built. Find out what kinds of jobs they had and the wages they earned. What changes has tourism brought to the islands? Classify them as *Positive* and *Negative*. Is there a balance between the two? Can these changes be maintained over the next 25 years?
- **Choose one of the Ecotourism sites** mentioned - Aride, Cousin, Curieuse, Bird Island or North Island. Find out what are the attractions of the site to tourists. How is Ecotourism being practised at this site? See *definition for Ecotourism on page 45*.
- **Tourist development** has expanded to Praslin and La Digue in recent years. Why do you think this has happened? What do you think are the benefits of tourism to the local communities? What are the detrimental impacts of an increase in tourism development? Enter your ideas in these columns. Which column has most impacts? Discuss why.

Benefits of tourism development	Negative impacts

Note to teacher: For other effects of tourism development consult: *Environmental Education for Sustainable Development, Activity Guide for Teachers* and try out this role play *To Build or not To Build* (pages 78-79).



BIODIVERSITY

● Why is Seychelles biodiversity important?

● What is the human impact on biodiversity?

● We CAN protect plants and animals if we want to.

Biodiversity means all living things - all of life on Earth - the great biological diversity we are part of ourselves, along with whales, birds, insects, worms, trees, ferns, bacteria, etc. What is happening to our biodiversity? Is it in good shape?

A single tree in a rainforest (e.g. in Brazil, central Africa or Indonesia) can be home to more than 1000 species of insect, as well as huge numbers of smaller plants such as mosses and orchids, and the tree may be visited by many birds, reptiles, amphibians and mammals who find food, shelter and breeding places in the tree.

"In the delicate world of relationships, we are tied together for all time."

John Steinbeck, writer

On the granitic islands of Seychelles, introduced plants outnumber native plants by five or six times.

A third of all fish species and a quarter of all mammal species are in danger of extinction.

The Earth's forest, freshwater and marine environments have reduced by 30% in thirty years.

A history of destruction?

The history of human settlement in Seychelles has not been a happy one for many of the native plants and animals. Several species have been lost, including the Seychelles giant tortoise, saltwater crocodile, Seychelles parakeet, and a few smaller plants. The forest was mostly cut down, the first time for timber and later to exploit the cinnamon, which also required vast amounts of wood for the fires needed to extract the cinnamon oil. Habitats such as marshes and mangroves were also destroyed. Coral was taken from the sea for construction. Now, many areas are threatened by invasive species and diseases introduced by humans. Is there still hope for the plants and animals of Seychelles? Yes!if we continue to take care of our remaining biodiversity.



Seychelles Habitats

Habitats are the places where animals and plants live and get their food, water, sunlight, space and other things needed to survive. Animals and plants are adapted to the habitat where they live, that is they have special requirements which they can find only in their special habitat.

BIODIVERSITY



The main **natural habitats** in Seychelles are:

- Land habitats - forests and glacia (and also soil !).
- Freshwater (wetland) habitats - freshwater marshes and rivers.
- Coastal (intertidal) habitats - mangroves, sandy beaches and rocky shores.
- Marine habitats - coral reefs, reef flats, seagrass beds, mudflats, sandflats, and the open sea.



There are also '**artificial**' habitats created by humans, such as plantations, gardens, open areas, road edges, and newly reclaimed land. All of these can be colonised by plants and animals.



In addition, there are small habitats (called **micro-habitats**) in which many of the smaller kinds of plants and animals live, such as rotting tree trunks, fallen leaves on the forest floor, tree bark, coral heads, seagrass leaves, inside the bodies of animals. These are miniature worlds with islands, tiny mountains, valleys, caves, lakes (at least to those tiny creatures that live there). Visit one of these miniature worlds with a hand lens, just to see what a variety of life there is if you care to look closely - and it all plays a vital role in the maintenance of our planet, keeping it healthy.



BIODIVERSITY

The more species that live in an ecosystem (e.g. a forest or a coral reef), the more productive and stable the ecosystem. The more biodiversity there is in a habitat, the more resistant it is to changes that may come from outside.

Why is Seychelles Biodiversity Special?

Seychelles biodiversity is special not just because it occurs in our country. It is special within the world too. Millions of years ago Seychelles was part of a very large land mass called Gondwana, which included Africa, India, Australia, South America and Antarctica. Some of our very special plants and animals have their origins in that far off time. When Seychelles granitic islands became separated from these other land masses, the plants and animals evolved into unique species, many of which are found nowhere else in the world. These are known as endemic species. Examples are coco-de-mer, *latannyen fey*, Seychelles pitcher plant (*potao*), Seychelles scops owl (*syer*) and Philibert's beetle.

The problem for biodiversity on small islands is that when there is a big change, such as the arrival of humans, the plants and animals have nowhere to go. They have adapted to life in a small place, often losing their ability to fly or disperse. Other islands are far, far away. What could a giant tortoise do to escape humans? How could a coco-de-mer seed float in the sea to a new island when it is so huge and heavy? (only empty dead ones can float). How could even a tiny frog float to another island on vegetation if one splash of sea water will kill it? This means that island biodiversity is very sensitive to sudden change. If we lose even one species, it is gone for ever - and we will never know, for example, what useful chemical properties it had; we shall never know if it was valuable to humans or not. We still have so much to learn about Seychelles biodiversity and its interactions.



HIPPO

What on earth do hippos have to do with Seychelles biodiversity? Not much! Except that HIPPO can help you to remember the main **threats** to biodiversity:

- H** for Habitat loss,
- I** for Invasive species,
- P** for Pollution,
- P** for Population growth,
- O** for Over-consumption.

For there is not just one reason why the Earth is losing biodiversity, there are many reasons. These are explained in more detail on the next page.



Habitat loss

Biodiversity is disappearing all around the world because of habitat loss. People clear land for houses, fill in wetlands, cut down forests - each time this happens the inter-relationships between the species break down and the habitat cannot perform its usual services for the environment, such as recycling nutrients, purifying water, controlling floods.



For example, forests in Seychelles capture rainwater and purify it before the water gradually runs off into rivers, marshes and to the sea. Also, most of the nutrients in a forest are found in the trunk and leaves and roots of the trees. The fertility of the soil depends on constant recycling by decomposition of leaves, branches, small dead animals and their wastes. When the forest is cut down, the soil is quickly depleted of nutrients because there is no input of leaf material. Also the soil becomes fragile because there are no roots to hold it, so it usually dries up and/or erodes away in heavy rain. It is no longer suitable for forest trees.

People also fragment (break up) habitats. For example, a road built through a forest may cut off one part of the forest from the other part. Larger animals may be able to cross the road (although they risk being killed in the process), but smaller animals may never make it to a new food source or a mate. The road also increases the likelihood of alien species introduction into the forest (see next paragraph).

Invasive species

Species that have been introduced by humans are known as exotic or alien species. Examples in Seychelles are almost all fruits and vegetables, garden flowers, rats, cats and the tenrec (*tang*). If these species stay where humans put them, they may not be a problem, but if they invade (spread into) the surrounding natural environment they can become a serious problem because they feed on native species, or compete with them and displace them.



Pollution

Pollution is mentioned in several other sections of this book. Many substances can cause pollution problems: in the air, in soil, in river water and the sea. Examples are aerosols (in spray cans), car exhaust fumes, pesticides, excess fertilizer, sediments (such as fine mud) which fall on coral reefs. Pollution and sedimentation change the conditions in a habitat and prevent it from being able to carry out its environmental services properly. Plants, animals and bacteria can all be affected. Some species may even be killed.



BIODIVERSITY

One of the biggest challenges now facing us is global climate change, brought about mainly by pollution in the air. This pollution is affecting the ability of the Earth to maintain a steady temperature, which may have serious consequences (see *Climate Change* theme).



Population growth

Early humans had little impact on their surroundings. The effects we had on the environment increased as our use of energy and resources grew, and also as our populations grew larger. Human numbers have grown faster and faster and the speed at which we have developed technology has matched this growth. But can we go on growing for ever? Our growing impact on the environment could bring about disaster for us. All the other problems mentioned here are made worse by increased human populations and demands on the environment.



Over-consumption

Some species have been hunted to extinction, for example the dodo in Mauritius. But there are many other species that are threatened with over-harvesting, not just elephants and rhinoceros but also our fish stocks. If demand for fish keeps increasing and fishermen do not allow fish to grow to a large enough size to reproduce, then our fish will disappear. Dynamiting coral reefs and clear-cutting forests yield fast profits in many areas of the world but these activities are unsustainable. *Why?*



Can We Do Something About HIPPO?



Do all of these problems mean that the world will end in disaster? Does it mean that there is nothing we can do? Not at all. Luckily there are plenty of good ideas around, practical solutions that will help us to slow the pace of change and clean up some of the mess humans have made of their environment. As long as we do something very soon and not delay, much of biodiversity can still be protected. Read about two success stories on the next page.



Two Seychelles Conservation Success Stories

Turtles

Turtles are threatened worldwide. In Seychelles, both green turtles (*torti-d-mer*) and hawksbill turtles (*kare*) were killed in the past, for their meat or for their patterned shells. They were taken in huge numbers for many years. Then, in the late 1970s and early 1980s several protected areas were set up, and later the government banned the sale of hawksbill shell. These measures did help to protect turtles, but they were not enough. So, in 1994 a law was passed, providing complete protection for turtles. People who used turtle shell for craft work received assistance to find other work. An education programme helped people to understand why turtles need to be protected. We have to remember that turtles take a very long time to mature - the females are 30 or 40 years old before they can start to lay eggs. Nowadays, the number of turtles that come to beaches to lay eggs seems to be increasing in the areas where the turtles have been protected for some years. If they continue to be protected, there is hope for our Seychelles turtles!



The Seychelles brush warbler

The brush warbler (*ti merl dezil*) used to live on several islands when people first settled in Seychelles. It prefers to live in lowland forest habitat, but humans cleared the forest and then established coconut plantations. Rats and cats must have been their enemies also. By the 1960s only about 30 birds remained, on the island of Cousin which is free of rats and cats. After Cousin became a protected area in 1968, coconut trees were removed from the island and the original forest was allowed to re-grow. By 1982 the population of warblers had reached between 300 and 350 birds. This seems to be the maximum number of warblers that can live on Cousin (this is known as the carrying capacity). Then studies were done to see if the brush warbler could survive and breed on other islands which were free of cats and rats. Some birds were taken to the larger island of Aride in 1988, and by 1998 there were more than 1500 birds there. A similar story happened when warblers were taken to Cousine island in 1990. By 1997 there were 150 birds and the carrying capacity of this island now seems to be about 300 birds, similar to Cousin.



So, it IS possible to do something positive to help at least some species to recover from the effects of human interference in the environment.



Note to teachers:

There is a good resource already available in schools, which contains much useful information and numerous activities that can be used in association with this section on Biodiversity. It is a teaching and learning unit called **Native Plants of Seychelles** and comprises a field guide, teachers handbook, students workbook and six posters of Seychelles habitats. There are sections on interdependence, the effects of humans and conservation, as well as habitats and adaptations.



BIODIVERSITY

Learning Outcomes

Curriculum Areas - Science, Geography, History, English

Knowledge and Skills

Understand the importance of biodiversity;
understand human impacts on biodiversity;
research information.

Attitudes and Values

Appreciate biodiversity; be aware of the need to
conserve biodiversity; value interdependence.

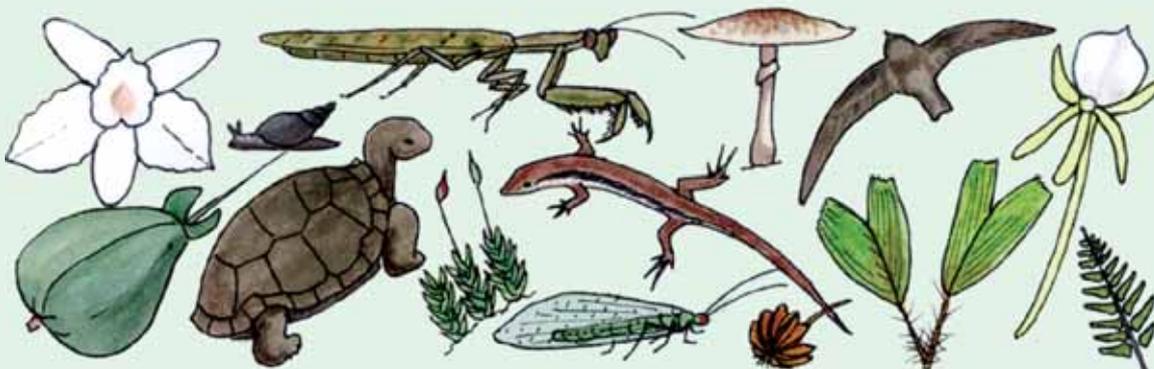
Activities

1. Nature Links

All plants and animals in the world (and humans too!) are interlinked in a huge “Web of Life”. There are many ways in which they can be interlinked. Below is a list of some of those links. Can you give examples of each kind of linkage?

Work in pairs. Try to answer as many of these as you can from your own knowledge. If you cannot think of an example, go to books or people to find out more information. You can write several examples if you can think of them!

1. A 'wild' animal that lives in or near your home (i.e. not a pet or domestic animal).
2. A plant that is useful to humans.
3. An animal that needs plants as food.
4. An animal that carries a disease which harms humans.
5. A plant that grows on another plant (such as a tree).
6. An animal that feeds on other animals.
7. An introduced plant or animal that has caused problems for native species.
8. A plant that depends on animals in some way.
9. An animal that carries pollen from one plant to another.
10. An animal that lives or has its home in a tree.
11. A plant that is disliked by animals because it has a nasty taste or some other form of defence.
12. An animal that feeds on dead material and helps to decompose it.
13. A plant that provides something useful, other than food, for an animal.
14. An animal that looks like a plant (as a form of camouflage).
15. Two organisms (species) that depend on each other in some way.
16. An organism (species) that moves to a different habitat for reproduction (e.g. to lay its eggs).





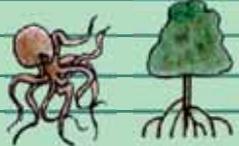
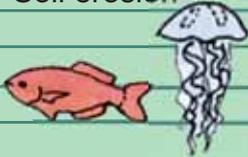
Discuss your answers with the rest of the class. Remember you may need to explain how each link works. Would the plant or animal survive without the link?

Turn your class examples into a large display, using pictures of some of the animals and plants (or making plasticine models).

This activity and activity 3 are based on exercises in *“Windows on the Wild - Biodiversity Basics”* Acorn Naturalists/World Wildlife Fund, 1999

2. Marine Habitat Web

Here is a list of 4 marine habitats, 24 creatures (including plants) and 4 threats to biodiversity:

Marine habitats	Creatures			Threats
Coral reef	Seaweed	Coral polyps	Rabbit fish	Overfishing
Seagrass bed	Seagrass	Clam	Parrot fish	Pollution
Mangrove	Phytoplankton	Octopus	Tuna	Rising sea level
Open sea	Zooplankton	Lobster	Shark	Soil erosion
	Mangrove tree	Starfish	Whale shark	
	Sponge	Sea cucumber	Green turtle	
	Jellyfish	Fiddler crab	Dolphin	
	Worms	Small fish	Sooty tern	

Work together as a class. Use books to discover more about each of the creatures, habitats and threats. Then:

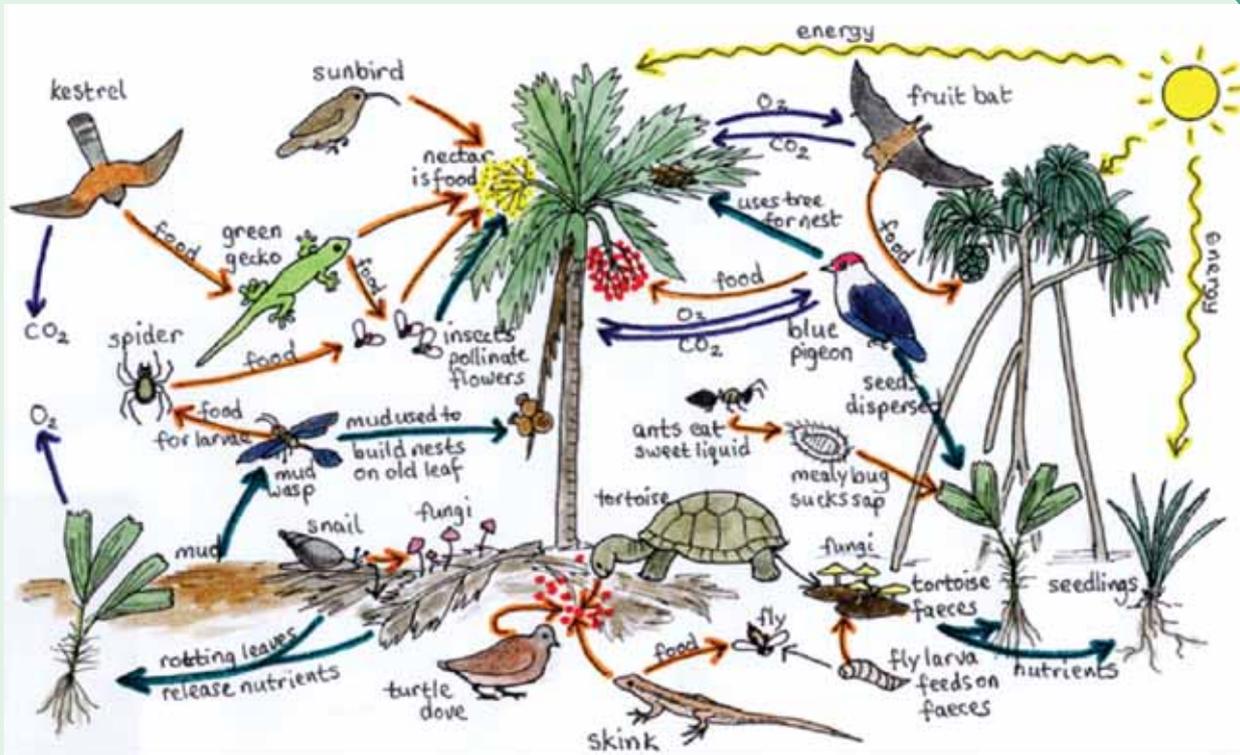
- 1) Using paper or card, make one label for each of the listed habitats, creatures and threats.
- 2) Attach one label to each student in the class. Each student becomes a 'habitat', a 'creature' or a 'threat'.
- 3) Using string or thread, link each 'habitat' together (because each habitat interacts with the other habitats). Then link each 'creature' with the 'habitat' in which it lives (or maybe more than one habitat!). Next make links between 'creatures' that you think interact in some way (e.g. uses the other creature as food, or as shelter). Now you have a nice biodiversity web!
- 4) Next, get one 'threat' to gently shake one of the 'creatures' that might be affected by this threat (e.g. 'tuna' by 'overfishing'). How many other 'creatures' also feel the shaking? Who are they? Now shake a bit harder - does it make any difference to the number of 'creatures' affected? Is the habitat affected?
- 5) Try each of the other 'threats' in the same way and see what effects there are.
- 6) Then get all the 'threats' to shake at the same time. What happens?
- 7) Discuss the effects and consequences with your teacher.

Note to teacher

There are simpler forms of this nature web game in *Environmental Education for Sustainable Development* page 49 (Web of Life), and in *Birds are Brilliant!* Page 23-25 (Food Chain Game, Web of Life).



BIODIVERSITY



3. HIPPO Questions!

HIPPO is an easy way to remember the main threats to biodiversity:

Habitat loss; **I**nvasive species; **P**ollution; **P**opulation growth; **O**ver-consumption.



Note to teacher:

This activity can be done by the class as a whole: Give each student 5 small pieces of paper. On each piece of paper write **one** of the letters of HIPPO, large, (they can use Pop for Population growth to distinguish it from P for Pollution). Read out the statements one by one and ask the students to hold up the letters that they think are the main threats for each one.

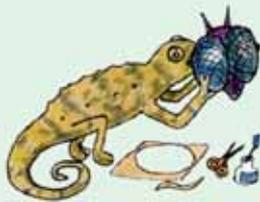
Look at the statements listed below. Each statement refers to a species or natural habitat found in Seychelles. Decide which of the HIPPO threats is the main problem for the species or habitat mentioned in each statement. More than one threat may be important. (Answers are given at the bottom of the next page.)

1. In the 1700s Seychelles giant tortoises were easily caught and provided meat.
2. There have been several events when large numbers of fish were found dead, floating in rivers or the harbour.
3. The increased demand for flat land for building and agriculture has reduced freshwater marshes.
4. Cinnamon spread throughout the granitic islands after its introduction in the 18th century.
5. Coconut palms were planted all over many of the outer islands.th
6. There was a huge demand for turtle shell in Japan during the 20th century.
7. Corals and sea shells are popular curios for tourists to buy.



8. Rats and cats are predators of seabirds and small birds on many islands.
9. Coral bleaching (and death) is caused by sea temperatures that are higher than normal.

How many of the problems are still with us now? Are the effects still being felt? Is there anything we can do to reduce the threats? Suggest some actions YOU can take.



Further activities and actions

- **Make masks or costumes** of Seychelles endemic animals and plants. Use recycled materials wherever possible. Use the masks or costumes in the following activity.
- **Write a short play** which gives imaginary reactions of endemic plants and animals to the coming of humans to settle in Seychelles. Remember that humans brought with them many new species of plants and animals as well.
- **Write a poem** about biodiversity. One way to do this is to write the letters of the word BIODIVERSITY down the side of your paper. Start each line of your poem with one of the letters. Try to show what biodiversity means to you. Here are two simple examples, using DOG and COW:

Danger sensed, the barking begins
On the gate, resting his paws,
Growling as the stranger walks away.



Calm, chewing slowly,
On the grass
While the hot sun beats down.



- **Visit** the Natural History Museum, Biodiversity Centre, and/or one of Seychelles' protected areas (e.g. Vallée de Mai, Cousin, Curieuse, Aride, Ste Anne, Veuve Reserve), to see the biodiversity of different habitats.
- **Find out more** about one of the **endemic species** of Seychelles and prepare a poster or display to show others what you have discovered and to help them realise why it is important to protect this species.



AGRICULTURE

● Good soil is vital for good agriculture

● Can agriculture be more efficient?

● How can farmers help the environment?

We all need to eat! Agriculture is the way we use nature to produce our food needs. In Seychelles nowadays, agriculture is mainly for food production; although in the past, agricultural crops were exported to provide money for the country (see Box). Our population is growing and more tourists are arriving. Land available for agriculture is limited. What can we do?

Good Soil - The Secret Of Success

Without good soil, most crop yields will be poor and we will not get enough food for ourselves or for our animals. For good plant growth, soil needs to have:

- The ability to absorb water for plants to use.
- Good drainage to allow excess water to flow away.
- Air spaces so that plant roots can breathe.
- Nutrients that will allow plants to grow.
- Good structure so that plant roots are well supported.

Seychelles red soils absorb water well but they are poor in nutrients. Sandy soils are loose in structure and do not retain water. Does this mean that we cannot grow good crops? Of course not! But it does mean that farmers in Seychelles have to keep their soil in good condition by caring for it well. All soils need to contain **organic matter**. All of the properties of soil are improved if there is plenty of organic matter present. Organic matter gives better structure to all soils. It increases the water-absorbing capacity, and allows for better drainage and aeration. It provides nutrients and also helps plants to absorb nutrients from the soil.

One of the main reasons it can do all this is because it is full of life! One teaspoon of soil may contain more than 5 million individual organisms and several thousand species. Not just earthworms and millipedes, but tiny insects, insect larvae, **nematodes**, snails, mites and numerous others. Many of these animals, together with fungi and bacteria, break down dead plant and animal material, releasing the nutrients within them into the soil. In the tropics, organic matter breaks down very fast - in as little as three months. In our forests, the organic matter is replenished by a continual supply of dead leaves, small branches, animal droppings, etc., but a farmer has to find other ways to keep his or her soil in good shape!



Organic matter - material that comes from plants or animals. **Nematodes** - very tiny worm-like animals.

Export crops in the Seychelles



From about 1840 until the early 1970s, coconuts provided Seychelles with its most important source of income. Large coconut plantations covered much of the flat land and lower hill slopes. Other crops were planted in the past, such as cotton, rubber and sugarcane, which were exported to other countries to provide money. Vanilla, grown mostly by small planters, was important during the late 19 century. Cinnamon was also very important during the early 20 century; but can you say it was an agricultural crop if the trees were growing wild in the forest? *What do you think?*



Can We Produce More Food?

Seychelles is a small country. We do not have the vast areas of flat land that are found in Europe or America. The large-scale agriculture found in these countries is not suitable for Seychelles and it can be very destructive to the environment (see Box). Small-scale farming, such as we have today, is more suitable for Seychelles, and it can be environmentally friendly.

World agriculture - what are some of the problems?

In the last fifty years, global crop production has more than doubled, mainly because of new types of seeds that produce better harvests under the right conditions. So, why do 1 billion people still go to bed hungry? There IS enough food in the world to feed everyone, but poverty and an increasingly unequal world result in some people eating too little and others eating too much.

Large-scale commercial farming (that is, farming as a big business) requires a lot of chemicals such as fuel oil, chemical fertilizers and pesticides that pollute our world. It has led to terrible soil erosion, overuse of water resources, and loss of wildlife.

In intensive livestock farming, it takes 3kg of chicken-feed to produce 1kg of chicken, 15kg of feed to produce 1kg of beef. The plants that are used to make the feed could be eaten by people instead, couldn't they? Also, drugs are used to make the animals produce more meat or more milk. We do not know enough about the effects of these drugs on humans who eat the meat.



In Seychelles we can grow certain crops, such as tomato, cucumber, papaya, banana. Other crops, such as rice, wheat, apples, potatoes, we cannot grow. *Why is that so?*

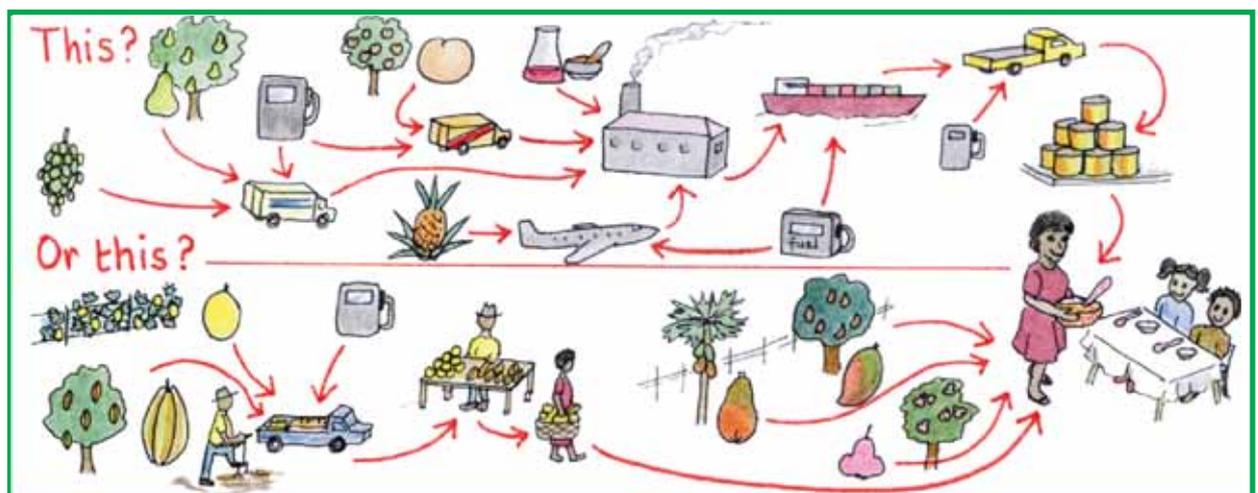
How much of what we eat do local farmers produce? This is shown below:

100% of eggs	80% of poultry meat (chickens, etc.)
60% of pork meat	60-65% of fruits and vegetables

Look at the following figures showing the imports of fruits and vegetables in **millions of rupees**.

Year	1997	1998	1999	2000	2001
Imports	52.8	52.3	47.1	50.2	56.8

Do we need to spend so much money on importing fruits and vegetables when we can produce them ourselves?





AGRICULTURE

To be truly sustainable we should be producing ALL our food. But we cannot produce rice and flour, so we have to import these items. Also, not only is the population growing, we also have to feed the tourists who visit our islands. Therefore we have to aim for sustainable production of those crops and animals that we CAN produce.

How Farmers Can Increase Production While Helping The Environment

1. Mixed cropping

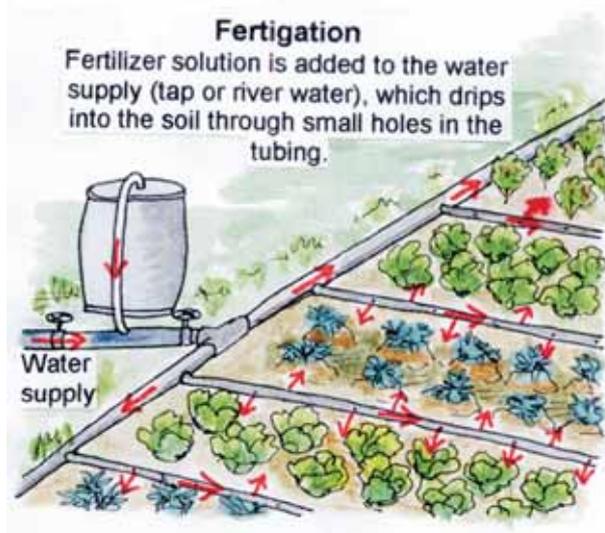
Mixed cropping means growing different crops together (including trees), or growing them one after the other. The choice of crops helps conserve moisture, enrich and maintain the soil, and keeps the number of pests and weeds at a manageable level. Trees provide shade, and a home for birds, spiders and useful insects which can help to reduce pests. Falling leaves add organic matter to the soil.

Mixing and rotating crops also encourages the natural enemies of pests. Some plants have natural scents which insects don't like, so they keep away, e.g. *pisanli*, garlic.



2. Organic (natural) fertilizer and fertigation

If organic matter is used as fertilizer, soil is improved in many ways (see page 59). Organic matter can be applied as compost (decomposed plant and animal material), manure (animal dung or droppings), or as a mulch (fresh plant material that is put on top of the soil around crops).



Chemical fertilizers, on the other hand, are often made from non-renewable resources. They are expensive, they pollute the environment, and soil often becomes degraded after long-term use. Is there a way we can use them more efficiently? **Fertigation** is a way of supplying the plants with chemical **fertilizer** and water (**irrigation**) at the same time. The minimum amount of fertilizer and water is used, and it is done at the best time, so that the plants get maximum benefit. Farmers can save money and there is almost no run-off of polluting fertilizers, but it is still important to add organic matter to the soil.

3. Anti-erosion practices

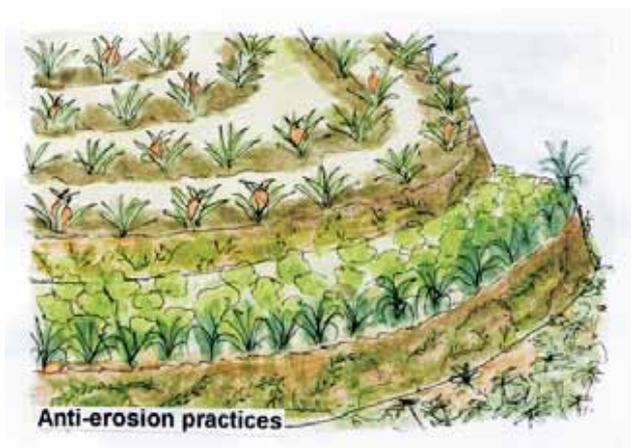
Practices that help to reduce soil erosion are very important in Seychelles because of the heavy tropical rainfall. One method is to plant crops along the contours of sloping land (see picture). Another method is to construct terraces, and then plant grass over the face



of the terrace, or use vetiver (a type of grass) at the edge of each terrace. The use of mulch to cover the soil, instead of leaving bare soil, is also important.

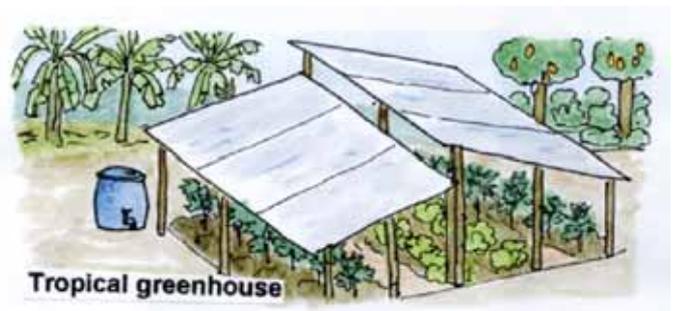
4. Integrated pest management

Pesticides are poisonous to both humans and the environment. So, it is important to use the minimum amount of pesticide, for example by using a limited amount at exactly the right time. Good management is better (see number 1 above), and there are also alternatives to pesticides. For example, soap solution gets rid of some insect pests; certain plants such as chilli, garlic, onions and neem produce oils that can be sprayed on crops. Soil pests can be removed by adding chicken manure to the soil and then covering it with clear plastic sheeting (the sun's heat kills the pests and good organisms soon return). Marigolds (*pisanli*) planted between crops also help to keep soil pests away.



5. Protection of crops

Crops also need to be protected from damage by heavy rain. This can be done using a tropical greenhouse which shelters the crops, allows circulation of air and also reduces the amount of moisture on and around the plants, so that diseases are less of a problem in the rainy season.



6. Permaculture and organic farming

Permaculture is short for permanent agriculture. It is a small-scale method of farming which is organic, produces a lot of different foods and is really sustainable. The aim is to feed people, avoid pollution, and save energy. Permaculture combines as many different food plants, fruit and nut trees, and animals as possible. Plants are grown close together to squeeze out the weeds. Only organic fertilizer is used. All wastes are recycled. Keeping plants that attract pollinating insects ensures that crop flowers will get fertilised. By converting plants that people cannot eat (and crop remains) into useful energy, domesticated animals can provide a valuable contribution to the human diet. So, animals such as





AGRICULTURE

Glossary

Additives - chemicals that are added to food to preserve, colour or add extra taste to them.
Pollination/pollinated - the fertilisation of plants by pollen.

chickens and ducks are reared among the plants. Their droppings improve the soil, and they eat any weeds that appear. Rainwater is collected and used for irrigation and fishponds. The diversity provides stability and food security, and helps farmers to cope with changes in the weather. This kind of farming could become important in Seychelles.

Things You Can Do

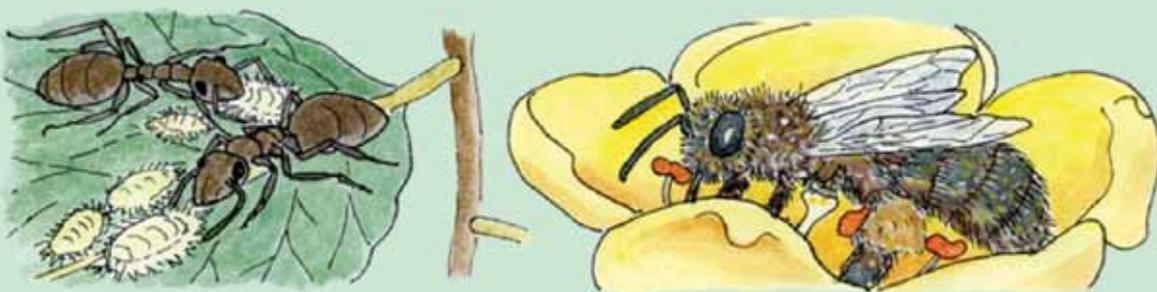
- Buy locally grown, locally packaged and locally processed food as far as possible.
- Beware of perfect-looking imported fruits and vegetables - they may contain pesticides!
- Grow some of your own food if you have a garden. You can grow plants such as chillies, thyme, tomatoes and green peppers in large pots, even if you don't have a garden!
- Make a compost heap and use the compost to fertilise your garden.
- Process some of your home-grown food into scrumptious tasting jams, pickles, dried fruit.
- We get hooked on the sugar/salt/strong taste of manufactured food in bright packaging. Food doesn't have to be full of **additives**. It is good to grow food together, cook food together and eat together, rather than using convenience foods a lot of the time. Seychellois are good at this - don't lose it!

Farming and Nature

Did you know that there are some ants that keep “cows”? If you find a plant that has mealy bugs (*lipou blan*) or aphids (*lipou*) on it, look for black ants as well. If you watch carefully you will see that the ants take drops of a sugary fluid from these insects. This is the “reward” that the ants get for protecting the mealy bugs from predators.



There are some crops that are **pollinated** by the wind, e.g. wheat, rice. But most crop plants depend on insects for their **pollination**. Many depend on bees to take pollen from one flower to another. The flowers are specially adapted to attract the bees, with bright coloured petals and sweet nectar to drink. When the bee visits a flower it collects both nectar (which is turned into honey) and pollen (which is fed to the larvae). The bee often gets a lot of pollen on its hairy coat, and when it visits the next flower, pollen brushes off and allows the flower to form seeds and fruit. Local bees are often better pollinators than honey bees because they collect more pollen.





In a nutshell!!



- *Seychelles was once dependent on commercial crops.*
 - *Good soil is necessary for healthy crops - soil therefore needs caring for.*
 - *Organic matter is the most important material a farmer can add to soil to improve it.*
 - *Small scale farming is more appropriate for the Seychelles than large scale commercial farming.*
 - *Seychelles can produce sustainably a higher percentage of the food that we consume.*
- *Insects are important pollinators of food crops.*
 - *Farmers can help the environment by adopting good management practices such as mixed cropping, use of organic fertilizers, fertigation, anti-erosion measures, use of a tropical greenhouse, integrated pest management, permaculture.*

“For those of us lucky enough not to be poor, hunger lasts only as long as it takes to get to the kitchen or the food shop. But for millions of poor people around the world, hunger means days, months, years, or even a lifetime of suffering. All hungry people have a right to eat.”



AGRICULTURE

Learning Outcomes

Curriculum Areas - Agriculture, Maths, PSE, Social Economics, English

Knowledge and skills

Understand the importance of food production; assess food cultivation and use in the home; debate issues about food production

Attitudes and Values

Be aware of environmentally friendly methods of farming; value locally produced fresh food and locally processed food

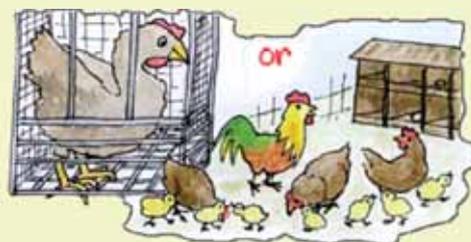
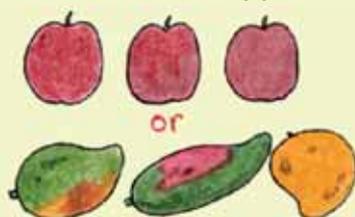
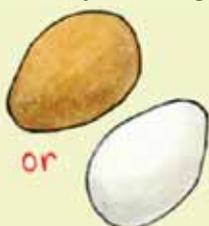
Activities

1. What Do YOU Think?

- 1) Work by yourself on this section, because it is important to know first what YOU feel. Look at each statement in the left column. Do you agree with the statement, or disagree with the statement? How strongly do you feel about it? Give each statement a rating by ticking in one of the columns on the right.

Statement	Agree strongly	Agree	Undecided	Disagree	Disagree strongly
Brown eggs are more nutritious than white eggs.					
We should not use pesticides in Seychelles.					
All of us should become vegetarians.					
Farming is a job for students who don't do well in school.					
Fruits and vegetables should look perfect and be all the same size.					
Keeping chickens in small cages is cruel.					
All hungry people have a right to eat.					
People in poor countries are hungry because they are lazy and do not produce their own food.					

- 2) Discuss your responses to the statements with a group of friends in your class. Try to think WHY you agree or disagree with each statement. Have your views been learnt at home, at school, from your friends? Are they based on fact or hearsay? Can you provide evidence to support your view?
- 3) Have a class discussion so as to get a wider variety of views. If you think differently from other people in your class, is it important or not important? Can you change your mind if you are given evidence to support another view?





2. How Many Pigs?

Work out the following calculations to see if there will be opportunities for Seychelles pig farmers in the future.

- 1) In the year 2000, Seychelles produced 8,600 pigs, which provided 70% of our pork meat requirements (for the local population and tourists). The other 30% of pork meat had to be imported.
 - a. If the average weight of a pig was 70kg, how many kilograms of pork meat was produced in Seychelles in the year 2000?
 - b. How many kilograms of pork meat had to be imported?
 - c. If ALL of the pork meat requirements (i.e. 100%) had been produced in Seychelles, how many kilograms of meat would have been produced?
 - d. How many pigs would have been needed to produce that amount of meat?
- 2) The local population and the number of tourists increase year by year. In 2010 it is expected that we will need 960,000 kilograms of pork meat to meet requirements. Farming will improve, so that the average weight of a pig will be 75kg. How many pigs will we need to raise in Seychelles to produce 100% of the pork meat we require in 2010?

Using the results of your calculations, hold a class discussion. What are the advantages and disadvantages of producing pork meat in Seychelles? You could also discuss the production of other types of meat, such as beef, poultry, goat and rabbit.

Note to teacher

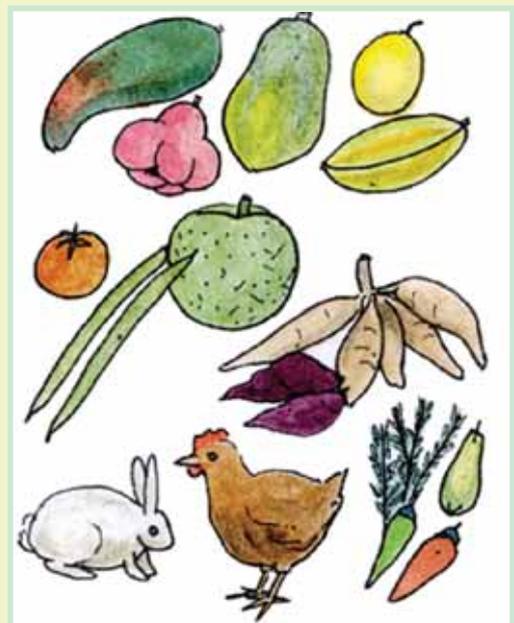
Allow the use of calculators; convert kg to tonnes if appropriate; be sensitive to religious differences.

3. Local Food - What Does Your Family Do?

If the students in your class live mostly in a rural area, do exercise A. If the students in your class live mostly in flats and houses without gardens, do exercise B.

Exercise A - Growing some of your own food

- 1) Make a list of all the different foods that are grown at your home. It is best if you divide your list into groups, such as Fruits, Vegetables, Root crops, Animals, Spices.
- 2) What do you do with this food that your family produces: Do you eat all that you produce? Do you give some away, or share it with friends and neighbours? Do you sell some of your produce? Do you preserve excess food, for example by salting meat, making jams (*konfitir*) or pickles (e.g. *asar*)? Write a paragraph to describe what you do with the food you produce.



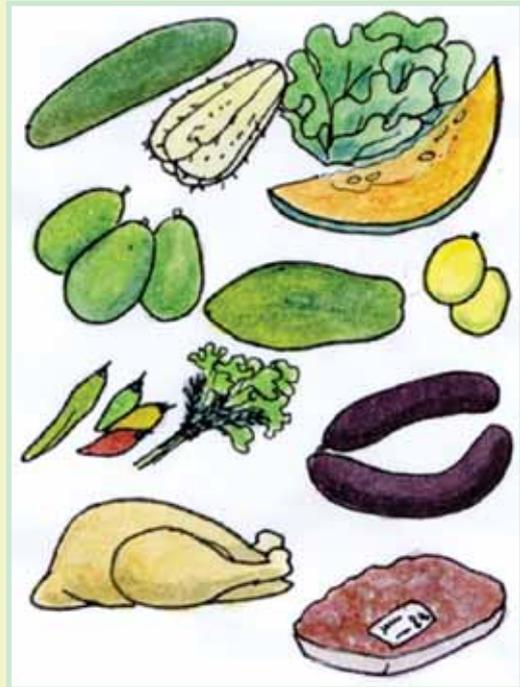


AGRICULTURE

- 3) Hold a class discussion to find out what other families produce and what they do with their food crops and animals.
- 4) The class could draw a table showing the number of families producing each of the different crops and animals. You could also draw a chart with pictures showing what people do with their food.

Exercise B - Buying most of your food

- 1) Make a list of what your family buys in the way of fruits, vegetables, spices, meats and other food that is produced locally.
- 2) Find out where your family gets these foods - for example, the market, food stalls by the roadside, local shops, a supermarket, gift from friends or other people.
- 3) Make a list of fruits, vegetables, spices and other foods that have to be imported into Seychelles because they cannot be produced here.
- 4) Hold a class discussion about the places where Seychellois buy their food. Can you get the fresh, locally produced food that you want in these places? Look at the list of imported foods - should we be importing these into Seychelles? Should we be producing more of our own food? Should we import all of our food and use agricultural land for other purposes?



Further activities and actions

- **Save some seeds** from a fruit or vegetable, for example mango, pumpkin, avocado, passion fruit, papaya, jackfruit. Plant the seeds in a large pot or old milk tin, making sure that there are holes in the bottom of the container and that the soil is fine and crumbly. Watch the growth and development of the seeds. You could keep a diary, measuring and drawing pictures of the small plants as they grow. When the plant is large enough, plant it outside in the garden or give it to someone who can plant it somewhere useful.
- **Hold a competition** at school for the best tasting guavas or mangos or tomatoes or beans (or some other vegetable or fruit). Find out if the winner has a special variety (obtained from the Agriculture Division for example), or whether he or she uses special growing practices (e.g. using compost, watering every day, a tropical greenhouse). Exchange ideas and pass on knowledge!



- Local fruits and vegetables are rich in **nutrients** (vitamins and minerals). Imported fruits and vegetables lose some of their nutrients while being transported and stored. **Research** this topic. Then display your information as an exhibition to encourage people to buy and use local fruits and vegetables.
- Find out which students or local people keep **small animals** at home, for example rabbits, guinea pigs, chickens. Could they bring one to school for the class to see? Or could the class visit them to see how the animals are kept?
- Quite a lot of **fruit** in Seychelles is wasted because people allow the fruits to fall to the ground instead of picking them. This fruit could be turned into something good to eat, like jam, pickles, or various desserts. Learn how to do this from people in your district, ask them to visit your school to show you how; or use recipes from your Social Economics class or books. Produce your own recipe book. Get permission to set up a project to turn fruit into useful products that you could sell and use the money for a charity or for the school.
- **Biotechnology** (for example the production of Genetically Modified plants and animals or GM foods) is said by some people to hold the answer to many of the world's food and agriculture problems. But GM crops and foods are produced, sold and controlled by a few large multinational corporations (very large businesses). They also have unknown effects on the environment. So, other people say that the world's food supply will be in the hands of only a few people, and that it will destroy the diversity of life. Find out more about GM foods and hold a class debate about their advantages and disadvantages.



FISHERIES & MARINE RESOURCES

● What are the fisheries and marine resources of Seychelles?

● What are the effects of the exploitation of these resources?

● What is being done to preserve these resources?

Fisheries in Seychelles

Fisheries refers to the industry by which we catch fish and other marine organisms such as octopus and lobsters. This industry has formed an important part of the life of the Seychellois people and continues to make important contributions to the **socio-economic development** of the country.

Importance of the Fisheries Sector

Fishing has traditionally been a sector employing a significant number of persons and has been an important source of food, providing the population with essential animal proteins. Today it forms an important component of our exports and brings in foreign exchange to the country.

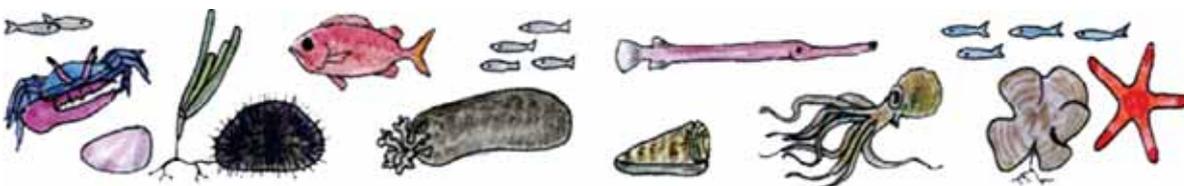
What makes fishing an important economic activity in Seychelles?

Seychelles has a marine Exclusive Economic Zone (EEZ) of 1.4 million square kilometres. The EEZ is an area legally managed by a country from which resources may be exploited for up to 200 miles (370 kilometres). The EEZ encompasses shallow plateau areas (0 - 75m) and banks around the granitic islands as well as deep oceanic areas (1000-4500m deep) further out, providing habitats for many marine organisms.



Compare this area to the land area of 455 km². How many times bigger is our marine territory?

This vast oceanic area comprises a variety of habitats such as extensive areas of coral reefs, seagrass beds, mudflats, rocky and sandy shores, and some of these areas are now protected by law. Seagrasses provide a spawning area for small fish, prawns and other marine animals. They also provide habitats for sea cucumbers (*bambara*), **molluscs**, shrimps and a large variety of fish. Many marine animals such as *karang*, *zob*, sharks, octopus, lobsters live in and around coral reefs, whilst others like hawksbill turtles come to graze on the sponges growing on the coral surface. Rocky shores are home to many molluscs such as limpets (*bernik*), nerites (*bigorno*), and crabs such as the sally light foot crab (*karkasay*).



Socio-economic development - changes in the prosperity of people as resources are made available or used. **Molluscs** - soft bodied animal, most with a shell for protection.

Glossary



Glossary

Demersal - associated with the sea bottom. **Pelagic** - feed near the surface of the water. **Long lines** - lines with hundreds of hooks, up to 50 km long. **Non-targeted** - unwanted. **Market** - place where the product is brought for sale.

Fisheries Resources of the Seychelles

Fishers catch fish by setting traps and using handlines, commonly referred to as **demersal** fishing whilst **pelagic** fish such as tuna and bonito are caught by the industrial fisheries using nets and **long lines**. Demersal fish include *kordonnyen*, *kakatwa*, *kaptenn* which are commonly caught using traps (*kazye*) whilst *bourzwa*, *vara vara* and *karang* are caught using handlines. This activity is, however, hampered in the SE monsoon (May-September) when many fishers are forced to work in the inshore areas because of strong winds and rough seas.

Mackerel are caught inside sandy bays using nets (*lasenn*) which are pulled in by small boats.

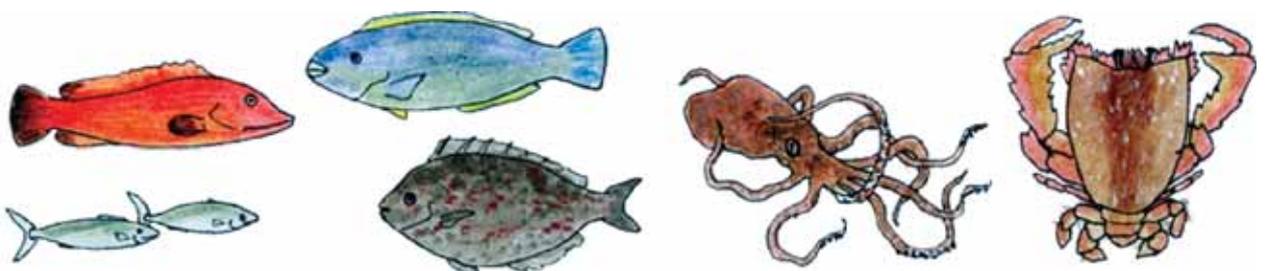
Octopus is caught mostly by local fishermen who go out on foot on coral reefs or in shallow inshore waters, and also by divers, who land some 50 tonnes a year. Local fishermen have reported a reduction in the size and availability of octopus. Demand for this resource by far exceeds supply, being a culinary favourite with locals and tourists.

Sharks were traditionally caught using gill nets and by hook and line further offshore. Today they are caught using long lines only. This measure was introduced to encourage more sustainable use of this resource and reduce the number of other **non-targeted** fish or turtles being caught.

Lobsters are harvested at night by hand and in traps. This fishery is however limited to a few months a year (November 1st - January 31st) in order to protect the resource; fishers need a license in order to operate and the maximum harvest allowed is approximately 5 tonnes a year. This is regulated by the Seychelles Fishing Authority (SFA), the body that monitors the fisheries of Seychelles. SFA closed the fishery between 1996 - 2000 as too many lobsters were being taken, affecting their ability to reproduce.

Spanner crabs or *krab ziraf* are harvested in the daytime on the Mahé Plateau using hoop tangle nets and traps and are sold on the local **market**.

Prawns are raised in large ponds on Coetivy Island and are destined for the export market.





FISHERIES & MARINE RESOURCES

Glossary

High-value - that brings in a lot of money.

These resources are harvested by using traditional or artisanal techniques practised by local people. Artisanal fishery has, however, changed considerably since the mid 1980's. Prior to that fishermen used simple technology to position themselves in order to locate fish. Today they use modern fishing equipment, larger and better equipped vessels with improved safety facilities on board. *Which technologies are being used? Can you think of any advantages and disadvantages of this change in technology?*

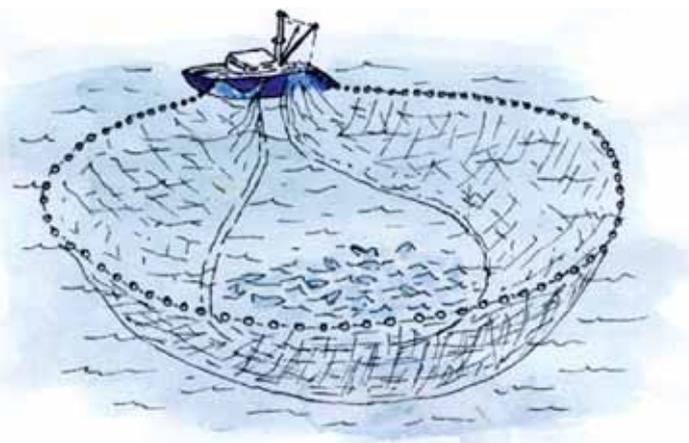
Other Types of Fishing Operations

Semi industrial fishing

Semi industrial fishing uses bigger boats which are Seychellois-owned and are equipped with more advanced technology so that they are able to stay out at sea for longer periods of time. They target **high-value** fish such as tuna and swordfish using long lines and these are exported.

Industrial fishing

Industrial fishing uses large, foreign vessels such as purse seiners and longliners which bring in large amounts of tuna (yellowfin, skipjack, bigeye) and bonito mostly. Tuna is processed in the canning factory for export to European markets whilst the bonito is used mostly as bait. Foreign vessels have been operating in our EEZ for many years now and are monitored using a Vessel Monitoring System (VMS). They also have to pay license fees to fish in our waters.



Economic Contribution of the Fishing Industry

Fisheries is today one of the fastest growing industries in the Seychelles and employs a large number of people (14% of the workforce). The canning factory alone employs 2,000 people.

Earnings (in Million SR)	1997	1998	1999	2000	2001
Tourism	612	584	596	598	770
Fish exports (canned, frozen, prawns)	329	461	568	675	1,100

Source: MISD Seychelles in Figures 2001

What do these figures indicate about the importance of fisheries in the economy of Seychelles?



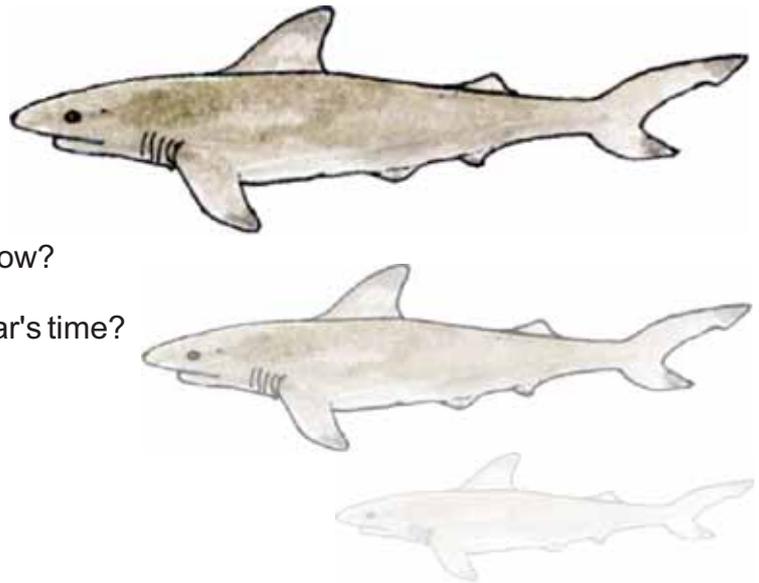
Glossary

Cod - a cold water fish which provided *delwil fwad mori*, an oily extract used as vitamin supplement in the past. **Continental shelf** - relatively shallow water between land and ocean depths. **Trawlers** - boats that drag nets on the sea bed. **Quota** - amount/number allowed to be caught or taken.

We must, however, be careful how we use our marine resources if they are to last for many more years and continue to be enjoyed by local communities. The following poem illustrates how overfishing can result when we continuously exploit a resource.

Save the sharks

How many sharks were there?
'Millions' said Grandpa
How many sharks were killed?
'Thousands' said Grandma.
How many sharks are left today?
'Hundreds' said Dad
How many sharks will be left tomorrow?
'Few' said Mum
How many sharks will be left in a year's time?
'None' said Uncle
'Oh', we all said
So let's start protecting them today!



Marcus Mondon
Takamaka School

A Lesson Learnt - Overfishing in the North Atlantic

Cod fishing had provided a livelihood for many communities on both sides of the Atlantic Ocean for over 400 years. People in Greenland, Norway, Canada and South East USA had their culture, diet, lifestyle influenced by fishing especially along Canada's Atlantic **continental shelf** which provided ideal habitats for fish.



In 1992, 19,000 people who had earned their living directly from the cod fishery were suddenly out of work. This was a result of the ban put on the fishery because of the very low level of stocks resulting from severe overfishing. This measure was seen as a means to allow the fish populations to recover.



How did this happen? Foreign **trawlers** allowed to fish in the Atlantic Ocean were known to have taken five times their **quota** of fish between 1985-1988, while local fishermen were blamed for taking large numbers of juvenile fish. Unfortunately there are no signs of recovery of the Canadian cod despite the fishing ban since 1992.

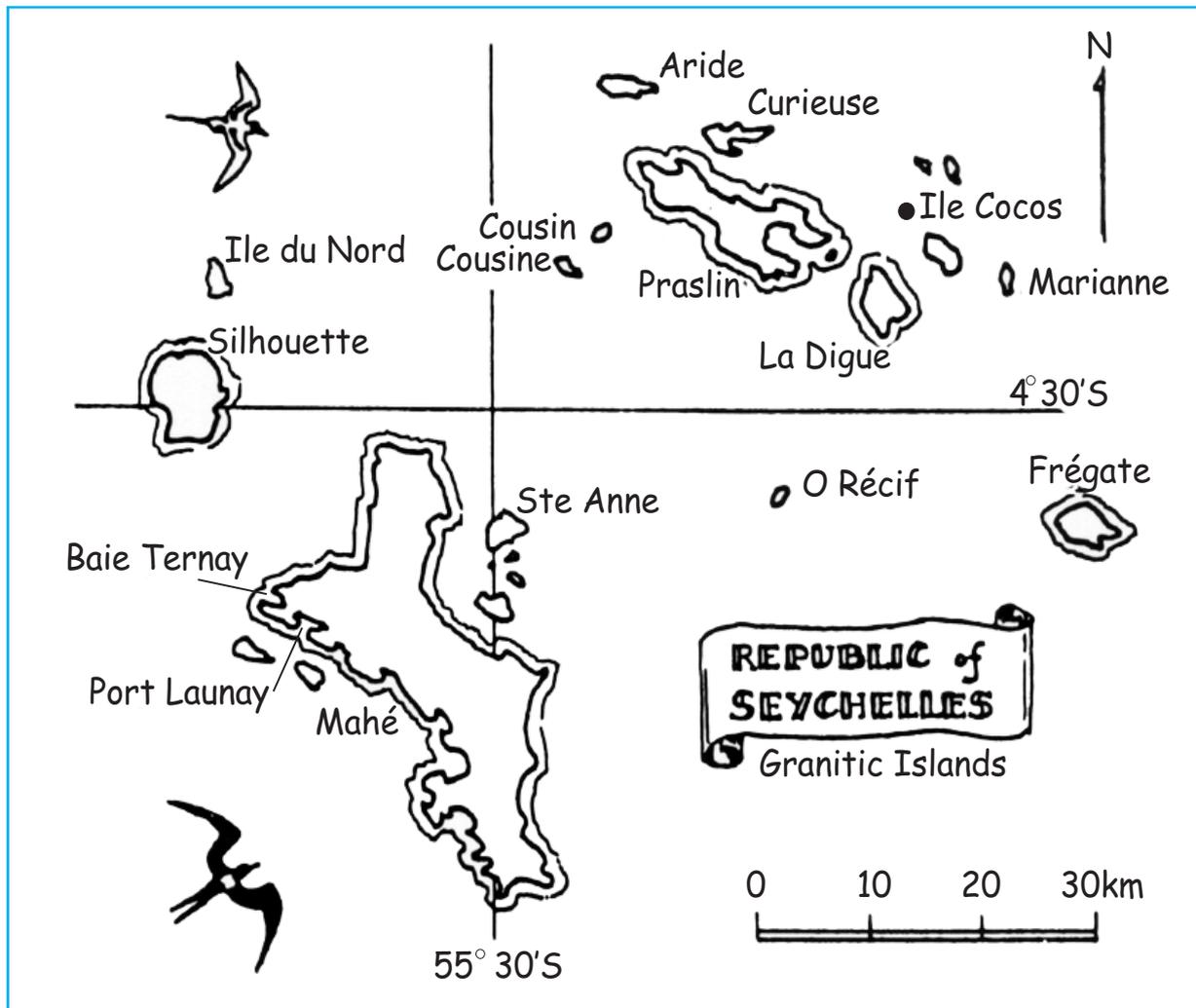


FISHERIES & MARINE RESOURCES

What is Being Done to Protect The Fisheries Reserves?

Seychelles has 23,000 hectares of protected reefs and marine areas. They include eight Marine Parks and Special Reserves where marine life is protected.

The Marine Parks include Ste. Anne Park (the first to be set up in 1973), Port Launay, Baie Ternay, Curieuse, Silhouette, Ile Cocos (set up in 1997).



Marine Parks are increasingly being developed around the world, and in the Indian Ocean, a number have been set up in the last five years in an effort to preserve fish stocks and other marine life. (See *Wildlife Clubs Magazine Issue 5, Protected Areas*)

The **Special Reserves** include Cousin and Aride, where fishing is prohibited or unlawful in a 400m radius around the island. Aldabra is a Strict Nature Reserve where fishing is not allowed within the lagoon and for one kilometre around the atoll.

There are also four **Shell Reserves** where the collection of shells (molluscs) is prohibited, that is, you are not allowed to take shells except for *tek tek*, *bernik* and octopus. There are two Shell Reserves on Mahé - one at North East Point and one at Anse Aux Pins. There is also one on Praslin (Pointe Zanguilles to Pointe Boudin) and one on La Digue (La Passe to Cap Bayard).



Glossary

Sanctuary - safe place. **Migratory** - that move to new areas for biological purposes.

Fisheries Reserves and Managed Areas (MRMA) are being set up in the outlying islands where fishing quotas and permits will be required to fish in these areas. These measures are aimed at protecting our marine resources and ensuring that they are not wiped out by overfishing. Fishing boats will also be equipped with a Vessel Monitoring System (VMS) which will allow the SFA to track their location and allow for better monitoring of these remote fishing banks.

Management Plans

The SFA is in the process of drawing up management plans for resources such as lobsters, sea cucumbers and reef fish caught by traps in order to ensure that stocks are not overexploited, and to plan for the future.

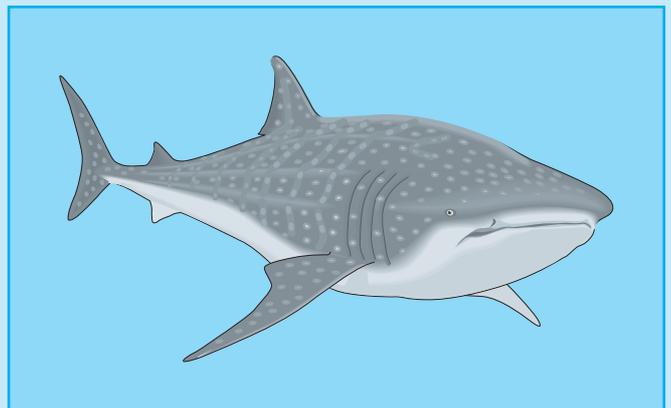
Legislation

A number of regulations give protection to marine species in Seychelles. *The Wild Animals and Birds Act* protects whalesharks (*sagren*) and turtles. The whaleshark is now listed as an endangered species and it is therefore illegal to fish or kill whalesharks in Seychelles waters; turtles have been protected since 1994. The Government has also banned the use of shark nets which were traditionally put across bays to trap sharks. This is to help protect shark populations which were being taken in increasingly large numbers.

The whaleshark or *Sagren* now a protected species

The whaleshark or *sagren* was officially declared a protected

species in Seychelles in January 2003. Whalesharks are commonly seen in the shallow waters around the granitic islands and are a marvel to divers. Seychelles is following in the footsteps of India, Australia and the Philippines in creating a **sanctuary** for these **migratory** species.



The whaleshark is the world's largest fish, 12 m long and feared by many because of its sheer size. It is, however, a harmless creature feeding on plankton by opening its wide mouth - but beware of its powerful tail! It lives in tropical waters, feeding near the surface where it sometimes takes small fish and jellyfish.

Sadly whalesharks are being caught accidentally in fishing nets and are also killed for their fins and meat by fishermen in South East Asia. Such an action would cost you up to SR 500, 000 in fines in Seychelles! Fortunately for the whaleshark it is, since 2002, being protected by an international agreement (CITES) which prevents the trade of endangered animals such as the whaleshark and turtles.



FISHERIES & MARINE RESOURCES

Sharing our fish with seabirds

Even birds depend on healthy fisheries to survive. This was highlighted in July and August 2002 when a large number of lesser noddy (*kelek*) chicks on Cousin, Cousine, Aride and Bird islands starved to death; brown noddies (*makwa*) and sooty terns (*golet*) were also affected. It is believed that they starved to death as there were less fish than usual for them to feed on during those months.



What is the link between seabirds and fish? Seabirds feed on the same small fish as tuna and swordfish. The Seychelles Fishing Authority confirmed that there were less tuna and swordfish in that same period; the sea temperatures had also fallen just before the death of the chicks. Is there a link between the two? This situation goes to show that any change in the food chain can have a number of consequences both for us and for other living creatures (See **Native Plants**, *Students Book*, Page 79).



- *Fish and other marine products are renewable resources if managed well.*
- *Fisheries is today the most important industry in Seychelles overtaking tourism in foreign exchange earnings.*
- *Fisheries provides an important source of proteins in the local diet and young people are encouraged to review their eating habits.*
- *Fisheries in Seychelles has become more mechanised and sophisticated and this may have a negative effect on fish stocks.*
- *Marine resources have to be used wisely if they are to sustain local communities and the economy.*
- *Every effort must be made so that overfishing does not become a problem.*



Learning Outcomes

Curriculum Areas - Geography, Science, Maths, PSE, Social Economics

Knowledge and Skills

Investigate the natural resources harvested by fishermen; understand the impact of continued fishing on resources available; analyse and interpret statistics

Attitudes and Values

Appreciate that fisheries resources are renewable but not infinite, and the role of fisheries in providing a healthy diet; understand the need for regulations that protect marine resources and assist in their protection

Activities

1. How Healthily Do We Eat?

- 1) Carry out the following class survey to determine how much fish/seafood we consume in meals in our families today. Use the grid below to record the information:

Meals eaten in one week			
	Lunch	Dinner	Style of cooking
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			
Saturday			
Sunday			
How many meals included fish/seafood		____ / 14	
How many meals included meat and meat products		____ / 14	
Which of the two groups was eaten more frequently			
Find out the reasons why		<ul style="list-style-type: none"> ▪ ▪ ▪ 	
How many meals would you classify as		Healthy _____ Fat/greasy _____	

- 2) Research the benefits of eating fish instead of meat products such as bacon, sausages, pork chops.
- 3) Present your findings as a wall chart, depicting the meals on plates and adding labels that highlight the goodness and the disadvantages to health of the different components of the meal.

(See Population and Health/Healthy Eating, and Agriculture theme)



FISHERIES & MARINE RESOURCES

2. Study the statistics below regarding catches in metric tonnes (MT) for the following **artisanal fisheries resources** over the five year period shown.

Catch in MT	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Snapper <i>bourzwa</i>	8	5	13	10.1	8.7	14.1				
Rabbitfish <i>kordonnyen</i>	8	4	4	5.1	3.4	2.1				
Grouper <i>vyey</i>	3	3	3	3	3.2	2.5				
Trevally <i>karang</i>	35	38	30	30.4	37	30				
Octopus <i>zourit</i>	32.5	19.2	39.7	78	28.7	53.3				
Lobster <i>oumar</i>	0.6	7.2	10.2	5.5	14	5				

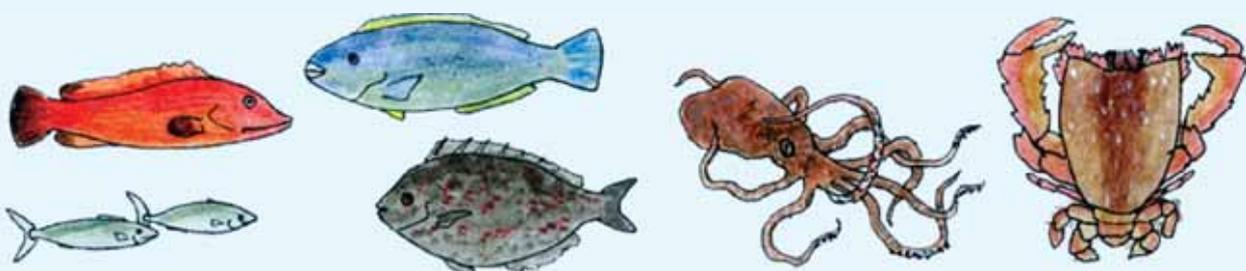
Source: SFA, Annual Report 2001

- Contact the SFA to see if you can obtain statistics to complete the table.
- Plot the information on a line graph. Use different coloured lines to represent each resource. Use a key.
- Which resource(s) has been steady in supply over the years?
- Which resource(s) has shown a decline? Can you account for that?
- How do you explain the trend shown by the lobster harvest?
- Are our marine resources being used sustainably? What can be done to ensure that we use them more sustainably?

3. Contact the Tuna Canning factory (Old Port) and the Animal Feed Factory (Bois de Rose Avenue) to help you with the following research topic:

- Find out the amount of **fish landed** by one of the vessels (in MT) when it comes into port. What percentage of the catch is actually utilised for canning?
- What happens to the waste products?
- How much is sent to the Animal Feed factory?
- What are the processes that it undergoes before it is ready to be sold to farmers?
- Present your findings as a flow chart that traces the fish from the fishing bank to a farmer. Illustrate your chart and use it as a class display.

' Give a man bread, he eats for a day; teach him to fish he eats for a lifetime'





4. **Talk to fishermen** in your community or members of your family who go out fishing about their work. Use the following worksheet to enter your findings. You could include the following guidelines and your own ideas:

Fishing a way of life

Name----- Age -----

At what age did you take up this job? How did you get started?

What special skills must a person have to become a fisherman/woman?

What special equipment must you have on board?

How do you locate the fishing banks?

How far do you go out? Do you now have to go further out?

What is your catch made up of?

Do you feel that fishing brings you a decent income?

What has been your most exciting experience when out at sea?

What has been your most challenging experience when out at sea?

Would you recommend this job for young people just starting out?

Write up your findings as a story told by the fisherman/woman. Give your story a title.



Further activities and actions

- **Artisanal fisheries:** In 2001 it was reported that an estimated 4,290 tonnes of fish were landed by the artisanal fishermen and most of it was consumed locally.
 - 1) Calculate how many kilogrammes of fish were consumed *per person* (if 1 tonne=1000 kg and the population was 81, 202?)
 - 2) Carry out a class survey to find out which fish are the most commonly eaten at home. Plot this on a chart/graph.
 - 3) Find out from SFA which are the most important fish species caught. Is there a link between the two? What happens to the other types of fish least preferred by consumers?
 - 4) The largest amounts of fish landed by artisanal fishers were in June and lowest catches were in September. Can you think of reasons why the lowest catch was in September?



FISHERIES & MARINE RESOURCES

■ Choose one of the **Marine Parks** mentioned

- 1) Research its history, what the attractions of the park are and why this area is a protected site.
- 2) Organise a day out to a Marine Park closest to where you live to see marine life first hand. Use checklists so you can record your observations (*See Note To Teachers on page 80*).
- 3) Talk to the Park rangers about their work. How do they handle poachers and other offenders?
- 4) Role play a situation where two fishermen are caught fishing illegally in the Ste. Anne Marine Park by a park ranger. Allow the fishermen and the park ranger to argue their positions. What are the consequences for such actions? Find out by contacting the Ministry of Environment or the Police. (*Refer to Laws and Regulations theme*).

■ **Invite a guest speaker** from the Seychelles Fishing Authority to explain its policy on:

- 1) Lobster harvest controls
- 2) Shark harvest
- 3) The Fisheries Reserves and Managed Areas being set up in the outer islands
- 4) Write up notes on a wall chart which you can put up in class or around the school for World Oceans Day (June 8th)

■ **Expansion of fishing activities**

Fishing activities in Seychelles have expanded over the last 15 years. Find out:

- 1) What are the reasons that have led to this expansion?
- 2) What do you think are the benefits to the local communities?
- 3) What are the impacts of such an expansion to the marine environment/resources?
- 4) Enter your ideas in these columns. Discuss your results.

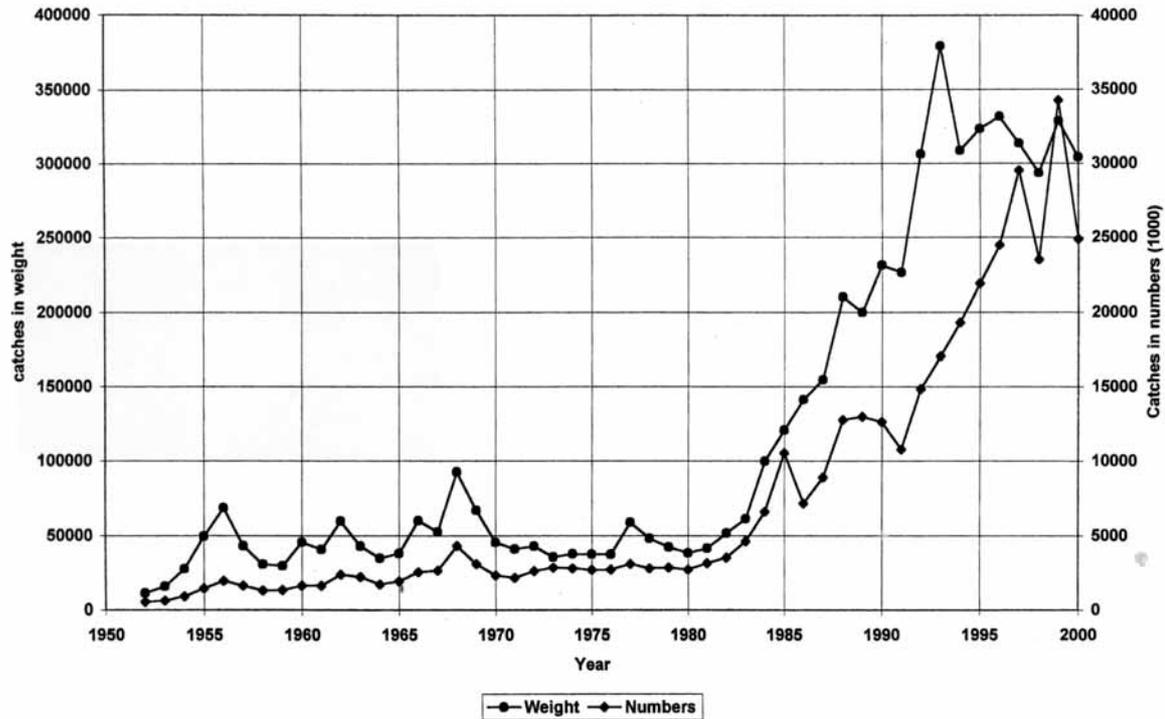
Reasons for expansion	Benefits	Impacts/problems



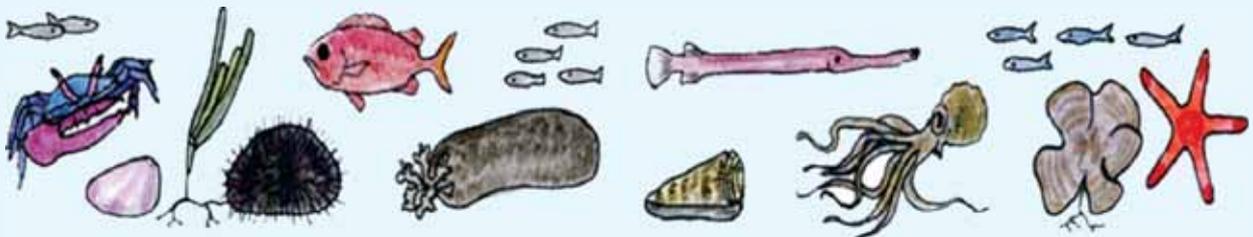
Glossary

High-value - that brings in a lot of money. **Overexploited** - larger numbers than can be replaced are being taken. **Juvenile** - fish not yet reached maturity.

- Study the graph below which shows what has been happening to the yellowfin tuna catches over the last few years:
What does the graph show about the **weight and numbers** of this resource?



There are signs that the yellowfin tuna, a **high value** fish, may presently be **overexploited** and the authorities are being advised to closely control harvest levels. It has also been noted that **juveniles** are being taken in increasing numbers. This may have an impact on the entire population if they are not being allowed to reach maturity.



Note to teacher

Consult *Environmental Education for Sustainable Development, Activity Guide for Teachers* for additional activities on fishing:
Marine Park Game (Page 27); Eating habits (Page 37); Marine Resources (pages 65-65), Marine Conservation (pages 66-67); and *Wildlife Clubs Magazine*, Issue 5, Protected Areas.



ENERGY

● How can we reduce the negative effects of energy production?

● How can we use our energy sources more efficiently?

● What renewable energy sources can we use in Seychelles?

Seychelles energy use in the past

In the early days of settlement, the only fuel available for cooking and heating water was wood. Increased efficiency could be obtained by making the wood into charcoal. For lighting, people burnt brushwood, used candles and coconut oil lamps, and later on used hurricane lamps. *What do YOU use when there is a power cut?* Boats, horses, bullocks and mules were used for transport, but people-power was the most important! (Refer to Further Activities and to the Land Transport theme)



Energy use in the World context

If you live in a house with electricity, and often travel by car or bus, consider yourself lucky. The energy from petroleum oil that we enjoy today only became readily available about 100 years ago. Will it last for another 100 years? As the world population grows, more and more energy is needed, but who is USING the most? In North America the average person uses twice as much energy as the average West European, 60 times more than the average South Asian, and 400 times more than the average Ethiopian. A lot of cheap electricity and petrol is wasted in rich countries. *What are the rich countries doing about this? What is the rest of the world doing about this?* (Cross link to the Climate Change theme)



Energy Production In Seychelles

Almost all the energy used in Seychelles is produced from refined crude oil. This includes fuel oil and diesel oil for electricity production, petrol for cars, aviation fuel for aeroplanes, and liquid petroleum gas (LPG) for gas cookers. All of these products must be imported from other countries. Remember that crude oil is a **fossil fuel** and is therefore a NON-renewable energy source. Much of the energy we use for domestic, civil and commercial purposes is in the form of ELECTRICITY. (Energy used for transport is studied in the Land Transport theme.) Electricity generators are run by the Public Utilities Corporation (PUC) on Mahé, Praslin and La Digue. Other islands have their own smaller generators, for example, Silhouette, Denis, Coetivy, Assumption. The hospital and some hotels have back-up generators in case of power failure.

Electricity production in Seychelles

Year	1995	1996	1997	1998	1999	2000	2001
Electricity generated (million KWh)	128.5	135.2	147.6	159.0	172.4	189.1	210.4

Notice that the production of electricity keeps going up. This is because the DEMAND for electricity continues to rise. *What might be the reasons for the continuing increase in demand for electricity?*

Fossil fuel - oil, natural gas, coal, formed from the remains of ancient plants and animals over millions of years.



Glossary

Greenhouse gases - any gas that increases the greenhouse effect (trapping the sun's heat close to the Earth's surface). **Sludge** - very thick oily remains. **Incinerate** - to burn rubbish or other materials in a special oven.

Households supplied with electricity in Seychelles

Year	1977	1987	1994	1997
No. of households	12,664	15,118	17,107	17,878
No. of households with electricity	5,465	11,454	15,330	16,488
% of households with electricity	43.15%	75.76%	89.6%	92.23%

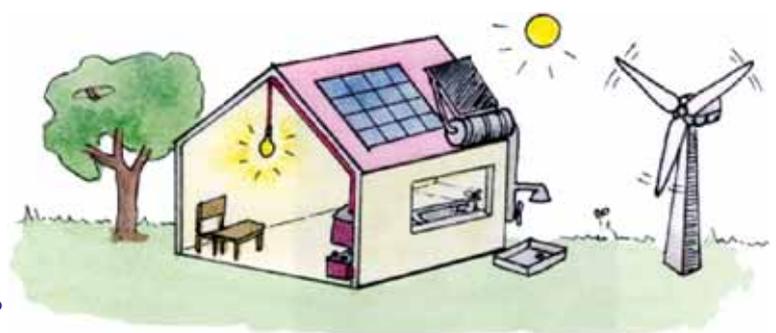
You can see that over the last 25 years a high percentage of people have been connected to the electricity supply. But it is not like this in some other countries. 93% of Kenyans are still WITHOUT access to electricity. Even in South Africa, less than 60% are connected. Compare that with Germany, where more than 99% of households have electricity.

Electricity Production Causes Pollution

- o **Greenhouse gases** and other air pollutants are produced as a result of burning fuel or diesel oil when electricity is generated. These pollutants go into the air that we breathe. In 1990 carbon dioxide (CO₂) emissions from the Seychelles energy sector were 88,604 tonnes; in 2000 they were 156,852 tonnes (i.e. they almost doubled in just ten years!).
- o Another problem associated with the use of petroleum products to generate electricity is the waste oil **sludge** that is left over. What can you do with it? For many years the waste oil was mostly kept in storage, but currently the accumulated sludge is being exported to Réunion, where it is **incinerated**.
- o There is also the possibility of oil spillage from the huge tankers (ships) that carry the oil. *What happens if an oil-spill results in oil being deposited all over our beaches?* Aldabra is very close to one of the world's major oil routes. *What are the problems of cleaning up an oil spill near to Aldabra?*

An Alternative: Renewable Energy Resources

Renewable energy resources include **biomass** (using firewood and other plant or animal materials to produce heat or power), **hydropower** (using water trapped behind dams to generate electricity), **geothermal power** (using the Earth's internal heat), **solar power** (using the sun's energy), **wind power** and **sea power** (using the energy of waves, tides and temperature differences in the ocean). Only a few of these are feasible in Seychelles.



What types of renewable energy are shown in this picture?

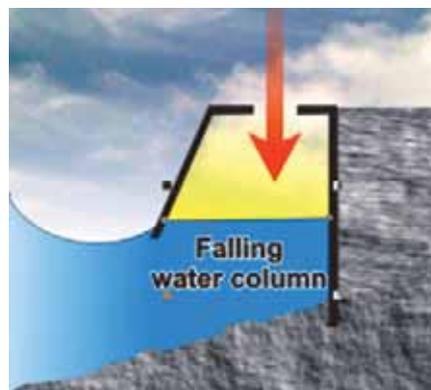
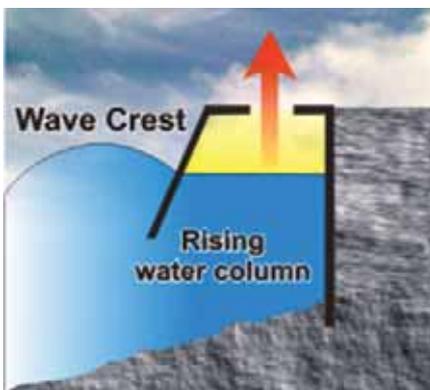


ENERGY

Glossary

Insulate - insulation is a method of preventing the movement of heat (or sound or electricity).
Photovoltaic cells - electronic device that uses the sun's energy to produce electric currents.

- **Firewood** is a renewable resource, as old as history itself, but burning it contributes to the CO₂ load in the atmosphere. Much of our forest is already protected. If trees are to be cut for firewood, then an equal number of trees must be planted to make it sustainable. Other options are considered more suitable for Seychelles.
- **Solar power** (in the form of heat) is already being used in Seychelles for heating water in hotels and houses. A solar water heater is a glass-topped box containing black plastic water pipes, which absorb the sun's heat. The hot water is stored in an **insulated** tank.
- **Solar power** (in the form of light) can also be converted into electricity, using **photovoltaic cells** (solar panels) on the roofs of buildings. The electricity is stored in batteries similar to those found in cars. On Cousin and Curieuse solar power is produced in this way and used for lighting and small appliances. More use could be made of solar energy in our climate, and it does not cause any direct pollution.
- **Wind power**, using wind turbines to generate electricity, was once unsuccessfully tried on Ste Anne island. However, there is now newer technology which has the potential to be used in Seychelles in the future. Wind power is also pollution-free.
- **Sea power** includes the possibility of harnessing the energy of waves (think of the power of waves crashing on the rocks when the South East wind is blowing). The technology is being developed so that it can be used on a large scale. Other technologies are still in the early stages of development but could be a real possibility for Seychelles in the future.



Seychelles is aiming for sustainable energy production and use, but until these alternative energy resources are developed further, we must try to use energy efficiently. Then we will not have to import so much oil and at the same time pollution will be reduced. You can learn more about how we USE energy in the Activity pages. **Energy saving** is really important.



Glossary

Protists - single-celled living things. **Plankton** - tiny living things that float in the water.

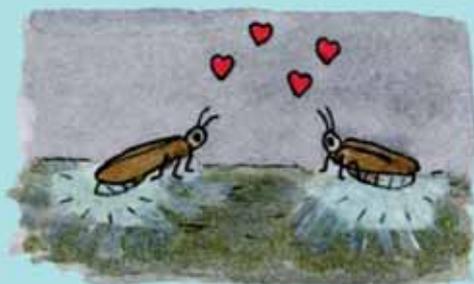
Nature's Super-Efficient Energy Production System: Bioluminescence



Almost all living things on Earth depend on the heat and light of the sun's energy. Plants use the sun's light energy and convert it into chemical energy (sugars) for the plant to grow. This is the process called photosynthesis. Plants are eaten by animals, which use the stored chemical energy to grow and move. When animals and plants die, decomposers use the stored energy for their own growth and development.

During ALL energy-producing processes some energy is lost. For example, when charcoal is used for cooking, the process is only about 25% efficient, whereas when LPG gas is used, the process is about 60% efficient. But there are living organisms that can produce light in such a way that the process is almost 100% efficient! This is called bioluminescence, sometimes known as "cold light". It would be good if humans could develop such efficient processes!

Various kinds of fungi, bacteria, **protists**, insects, squid and fish can produce light from a chemical called luciferin (loo-sif-er-in). An example you might be familiar with in Seychelles is phosphorescence of the sea at night, which results from boats passing through water containing certain kinds of **plankton**. Fireflies (*mous fe*) are beetles found at night in the forest. This beetle has a light organ on the underside of its body which produces short flashes of light, so that it can send messages to a mate. There are also mushroom-like fungi on the forest floor, which glow with a bluish light at night.





How Much Energy Do We Use?

Much of the energy we use in our homes, offices and businesses is in the form of electricity, although other energy sources may be used for cooking.

Here are some figures for you to interpret and think about.

Energy use in hotels and homes

Hotel	No. of beds	Average occupancy **	No. of beds occupied each month	Electricity used (kWh per month)	Electricity used per person per month	Gas (LPG) used (kg per month)	Gas used per person per month
Large hotel *	334	60%	200	100,000	500	1,000	5
Medium hotel*	129	70%	90	90,000	1000	900	10
Small hotel	23	65%	15	1,500	100	60	4
Small hotel	20	50%	10	900	90	20	2
Home	4	100%	4	260	65	6	1.5
My home							

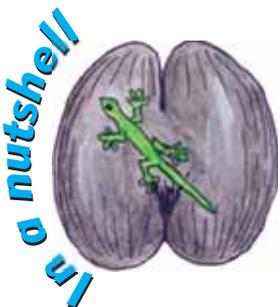
* Larger hotels often have a restaurant open to the public.

** Occupancy is the percentage of available beds that are occupied by guests at any one time. This may change from month to month. Average occupancy is therefore the average for one month taken from the figures for the whole year.

Find out the figures for your own home and add them to the table: How many beds are there in your home? How many people sleep in them? Are they always there? Look at an electricity bill for your home - how many units does your family use in one month? Ask your family to help you calculate how much gas you use each month (if you use gas for cooking). What is electricity used for in your home?

What activities is electricity used for in a large hotel? Who else uses electricity in the hotel besides the guests? Why is there such a difference in the amounts of electricity and gas used by one person in a hotel and one person in a home?

(Refer also to the Tourism Theme)



- Almost all fuel for energy production in Seychelles is now imported.
- Energy demand continues to increase year by year.
- People in rich countries use much more fossil fuel energy than people in developing countries.
- Fossil fuels are non-renewable and their use causes pollution.
- Renewable energy sources that use natural energy flows (sunlight, wind, waves, tides, plant growth) are an alternative to fossil fuels.
- Seychelles is aiming for sustainable energy production and use.
- Nature has a very efficient method of producing light, called bioluminescence.
- Tourists appear to use more fossil fuel energy than local people.
- It is important for people to recognize how much fossil fuel energy they use each day.
- There are many ways in which families can reduce their use of electricity.



Learning Outcomes

Curriculum Areas - Science, Maths, PSE, Social Economics

Knowledge and Skills

Understand how we use energy; interpret data; assess energy use in the home; make responsible decisions about energy saving.

Attitudes and Values

Adopt positive attitudes to energy use; learn to value and manage energy resources appropriately; learn the benefits of using renewable energy.

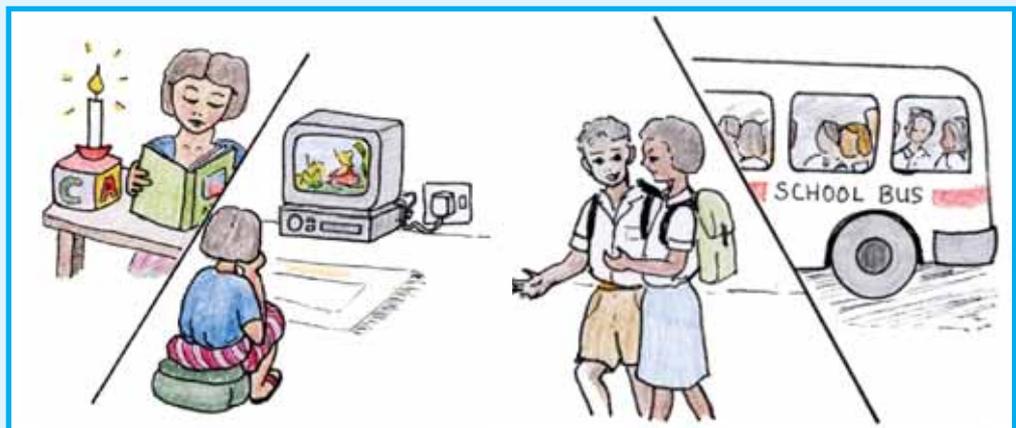
Activities

1. An Energy-Free Day!

Imagine that your whole family (or community if you prefer) chooses to do without any form of energy produced from non-renewable resources for one day. No-one must use electricity, gas, petrol or batteries.

Plan your energy-free day:

- 1) First, think of all the things YOU do on a normal weekday - wake up, have a shower, eat breakfast, travel to school, activities at school, jobs at home, food preparation, homework, leisure activities (especially in the evening), communicating with other people, etc.. How will your actions have to change if you cannot use electricity and other forms of energy? Plan what you will do. How will the energy-free day affect the rest of your family?
- 2) Share your ideas with your family and other students in your class.
- 3) Write an Energy-free Action Day Plan for your family (or community).
- 4) How do you FEEL about the changes that would be necessary? Would it require major changes in your lifestyle?
- 5) Put a star next to any changes that your family would find really difficult.
- 6) Put a flower next to the 1 or 2 actions that your family would feel quite happy about giving up or changing.





- 7) Talk to people of the older generation in your family or community. How do they feel about the changes that have happened in energy use since they were children? Which energy uses do they feel have been of most benefit to our society? Write a short report on your findings.

2. Saving Energy At Home

Work in small groups. Share information.

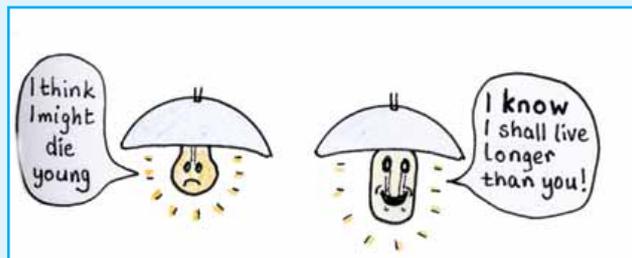
- 1) What energy sources are used (or could be used) to give LIGHT in your home? Try to name at least 5. Which energy source do you think gives the BEST light?
- 2) How do you HEAT WATER in your home? What do you use hot water for in your home?
- 3) What energy source do you use to COOK FOOD in your home?
- 4) How many ELECTRICAL APPLIANCES do you have in your home? (make a list)
- 5) Find out how much electricity COSTS per unit. Is it always the same, no matter how much electricity you use?

Energy saving ideas

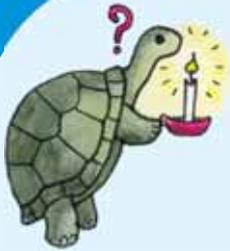
If you can save energy in your home you will be saving money and helping to save the environment as well. There are some ideas below, to start you off. Think of more. Put them into practice!

The following actions may only save a little bit of electricity by themselves, but if EVERYONE did them, it could make a big difference (e.g. in 2002 companies wasted £90 million because they did not turn off their computers; as a result 2.8 million extra tonnes of CO₂ went into the environment!)

- Use energy-saving light bulbs (compact fluorescent light bulbs or CFLs). They cost more at the start but they use 70% less electricity than ordinary light bulbs and last 10 times longer.
- Turn off the fan and the light when you go out of a room (unless you are using energy-saving light bulbs).
- Put a lid on the pan while you are cooking (heat stays in the pan instead of getting lost).
- Do not overcook food (it saves nutrients as well as energy!).
- Boil only the amount of water that you need (to make tea or coffee for example) unless you can save the extra water for drinking or in a thermos).

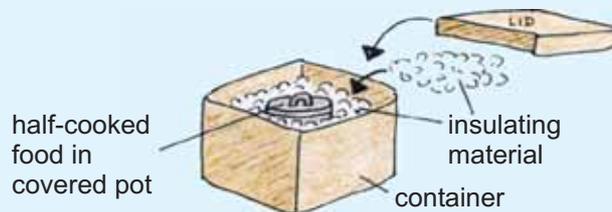


- Turn off the TV or radio or VCR (especially if no one is really watching or listening!), rather than leaving it on "standby".
 - Turn off the iron while you are ironing the last garment in the pile. There will still be enough heat in the iron to finish it properly.
- Have you heard about wind-up torches and wind-up radios? If you ever get a chance to purchase one, you will no longer have to spend lots of money on batteries.

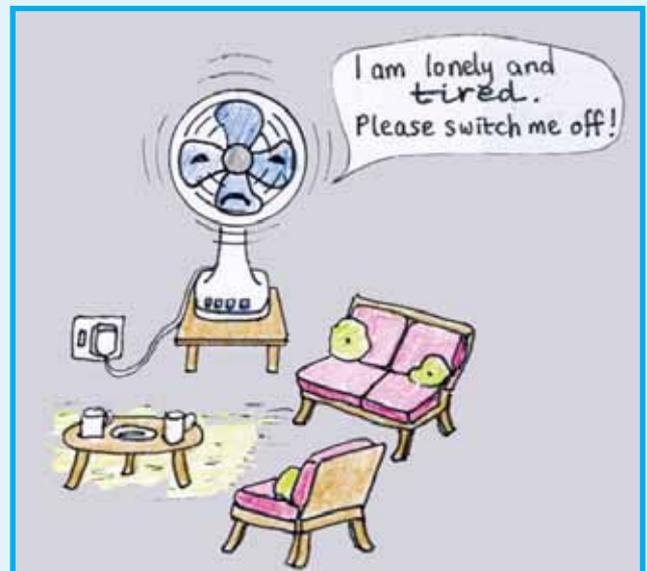


Further activities and actions

- In your home, see what YOU can do to **help your family save energy** (and therefore help to protect the environment from pollution) and at the same time save money.
- Design an **information leaflet** to put forward your energy saving ideas and/or set up a display at school, so that others can learn from your example.
- **Visit the History Museum** in Victoria to find more about the equipment that was used for cooking, lighting and bathing in the old days.
- **Design a hay box.** This is a container packed with insulating material that keeps a cooking pot hot and allows cooking to continue slowly by itself. It can save energy! Experiment with different materials and containers to see which is the most efficient. Find out how much time is needed for the food to be fully cooked.



- **Design cartoons** which illustrate energy-saving ideas or subjects related to energy use. A few examples are given below. Exhibit your cartoons - they can be a good way of helping others to understand issues about energy use.





LAND TRANSPORT

● How can pollution from vehicles be reduced?

● Improving road construction

● How can traffic flow be improved?

Transport In Seychelles

We all need to get from one place to another. We also need to transport things from one place to another, whether it is furniture or cabbages or a new refrigerator. In Seychelles the sea has always been important for transport. For example, most **commodities** arrive by sea in large ships, and ferryboats provide regular services between the main islands. Air transport has become increasingly important as tourism has developed, and many Seychellois also travel by aeroplane. At the current time however, it is land transport which is causing most concern, because of the effects of pollution, increased traffic on the roads, and road construction.

Early land transport in Seychelles



In the early days, people used their feet to get around, or they had to use a pirogue. There were a few horses, but no horse-drawn carriages (there weren't any suitable roads!). Some people were carried in a chair (*fotey*) tied to two poles with rope, and held on the shoulders of four strong men. A sick person might be carried in a hammock (*lanmak*), held in the same way. In 1893, rickshaws (*pous*) were introduced in the town area, pulled by one man. The first car arrived in 1926. *Kanmyon* were used for public transport before buses were introduced in the 1960s.

Road Transport

The number of registered vehicles in Seychelles has been increasing slowly, year by year. By 1997 there were 9,150 vehicles. In 2000 there were 9,508, of which about 67% were privately owned. Public transport has also increased significantly. In 1995 about 28,000 passengers were transported in buses on Mahé and Praslin every day. By 2000 the number of passengers had increased to 48,000 daily, including 6,500 school children.

The World of Cars: Did you know?

Year	Number of motor vehicles
1910	Less than 1 million
1930	About 50 million
1955	More than 100 million
1985	500 million
1995	777 million



- In 1990, 10-30% of all metals used in USA were made into motor vehicles. About 50% of the rubber used was made into tyres.
- 29 tons of waste is produced for every ton of car produced.
- Vehicles produce about 20% of carbon dioxide **emissions** into the air.
- Cars kill about 400,000 people annually.



Commodities - useful things, products, e.g. rice, flour, radios. **Emissions** - waste products that are sent out or released.

LAND TRANSPORT



Glossary

Greenhouse gas - any gas that traps the sun's heat close to the Earth. **Emissions** - waste products that are sent out or released. **LPG** - Liquid Petroleum Gas; the same fuel is used for gas cookers.

The Pollution Problem

If you have walked along a busy road you will know that cars, buses, lorries and pickups can make a lot of smoke and bad smells. This is known as air pollution. In large cities the air can become so polluted that people suffer from lung problems. The substances that are released into the air result from burning fossil fuels (petrol or diesel) in the engine of the vehicle. These substances are:

Carbon monoxide CO	A gas	<i>Poisonous</i>
Hydrocarbons	Complex substances containing carbon and hydrogen	<i>Some can cause cancer</i>
Nitrogen oxides NO, N ₂ O, NO ₂	Gases	<i>Cause disease e.g. bronchitis</i>
Carbon dioxide CO ₂	A gas	<i>The main greenhouse gas</i>
Lead	Normally a solid	<i>Poisonous, especially to children. Can cause reduced mental ability</i>
Soot (carbon)	Solid particles	<i>Gets into the lungs and causes health problems</i>

Name some other air pollutants found in Seychelles. How could we reduce our use of the substances that create these pollutants?

a. What is being done in Seychelles to reduce the vehicle pollution problem?

- **Vehicle Testing Unit.** Every vehicle must be tested annually, to check whether it is fit and safe to drive on the road. This has really helped. Soot pollution has been reduced significantly, even though there are still problems with some buses and large trucks. Much of the pollution from **emissions** is due to poor maintenance of vehicles.
- **Speed limiters.** If these are fitted on buses they control the speed at which the bus can be driven. This helps to reduce fuel consumption.
- **Introduction of unleaded petrol.** An increasing number of vehicles are able to use this type of fuel. Although carbon dioxide is still produced, other pollutants are reduced, particularly lead.

b. New technologies

Seychelles is looking seriously at other forms of transport that have fewer or no emissions of polluting gases. Examples are electric cars and pickups, solar-powered vehicles, and cars fuelled by compressed natural gas, hydrogen or methanol. **LPG** vehicles have been





LAND TRANSPORT

Glossary

Embankment - a bank of earth or stone at the edge of a road. **Shrubs** - woody plants, smaller than a tree.

undergoing tests in Seychelles. Electric golf carts are already used in some of the large hotels. One problem with electric cars is that the electricity still has to be generated in Seychelles using imported fossil fuels. La Digue could become a model island where no fossil fuels are used in vehicles - an example to the world!

Vehicles Need Roads!

Type of road	1997	1998	1999	2000	2001
Surfaced	315	343	370	390	400
Unsurfaced	58	54	54	53	53
Total	373	397	424	443	453

Improvement of road construction methods

Soil erosion can be a big problem, both during the construction of a new road and after construction, especially if there is heavy rain (see Activity 1) and if large construction vehicles are used (e.g. a JCB). A correctly designed and built road should not create soil erosion problems. So, what can be done to improve our roads?

1. Surveys: For a new road, a survey should be done to decide, for example, the best placement of the road, whether **embankments** are needed, the type of road to be constructed, e.g. what kind of surface, and the type of drainage needed.

2. Embankment design: In 1997 there was unusually heavy rain during the month of August (usually a dry month), and a number of embankments alongside mountain roads collapsed, causing landslides that blocked the roads. Climate change is expected to increase such unusual events in the future (see *Climate Change theme*). Research has shown that a change in the slope of the embankment may help to reduce the risk of slippage, and planting certain kinds of grasses or small **shrubs** in the soil of the embankment helps to reduce erosion and hold the soil in place.



Embankment planted with grass

3. Drainage systems: Rain can be very heavy in Seychelles, and much of the rain may run off the land. When designing a road, the type of drainage method that is used at the sides of the road or underneath the road should allow for the maximum runoff expected. For example, on steep roads, the runoff may be at a speed of 3m/sec, while on a gentle slope, the runoff may be at a speed of only 0.7m/sec.

LAND TRANSPORT



Glossary

Leaf litter - fallen leaves on the surface of the soil. **Humus** - rotted remains of dead plants and animals.

One factor affecting the amount of runoff is the kind of land cover in the surrounding area:

- Concrete and asphalt/*koltar* (i.e. buildings and road surfaces) absorb almost no water from rainfall. Almost all of the rainwater runs off.
- Bare soil absorbs some water, but the amount depends on the type of soil and how dry the soil is. Red soil absorbs more than sandy soil. Dry soil absorbs more than wet soil (unless it has been baked hard by the sun, in which case it becomes like concrete!).
- Low vegetation or grass-covered soil absorbs more rainwater than bare soil.
- Forested land, with a thick layer of **leaf litter** and **humus**, absorbs the most rainwater.

Supposing a main road was built long ago in a forest area, with a drainage system that was adequate at the time. The area then slowly developed into a housing area, with lots of houses and many smaller roads leading onto the main road. This means that the drainage system now has to cope with a lot more runoff than before. *What is likely to happen after heavy rainfall? Why?* (See also Activity 3)



Nature needs transport too!

Plants are usually fixed in one place, so they need transport for their pollen, seeds or spores. Flowers with colourful petals and sweet scents attract insects or bats that carry the pollen from one flower to another. Fruits and seeds may use wind power, water currents or animals to transport them to a new site where the seeds can grow. Most animals move around by themselves, using their own muscle power, for example by running, flying, swimming, crawling or creeping. But they also make use of air currents and sea currents to help them on their way.

Some animals need to “hitch a lift” on other animals. Here is a rather specialised example: cow dung (*kaka bef*) forms a very nice habitat for several species of beetles and some tiny worms. Every now and then these animals need to “move house” and find some new dung to live in. The beetles can fly by themselves, but the worms are too tiny. So they use the beetles as buses! They climb under the beetle's hard outer wings, lots of them altogether, and get a free trip to the next dung patch. Even disease organisms need transport to get from one host to another, whether they use a sneeze to get propelled through the air, or whether they use a mosquito or a snail to get from one human to another.





LAND TRANSPORT

In a nutshell



- Land transport in Seychelles has increased slowly but significantly over the past years.
 - The numbers of people travelling on public transport has increased more rapidly.
 - Air pollution from vehicles is an environmental problem.
 - Possible solutions are being investigated, such as environmentally friendly fuels and vehicles.
 - Changing the use of land affects what happens to rainwater, especially after heavy rain.
- Poor road construction causes soil erosion.
 - Proper surveys and construction methods can help to reduce erosion and prevent disastrous land collapse.
 - Proper drainage is very important for Seychelles roads because of the high rainfall.
 - Town traffic needs to be regulated to prevent congestion and ensure safety for pedestrians.



Learning Outcomes

Curriculum Areas - Science, Geography, History, English, PSE

Knowledge and Skills

Analyse problems of the land transport situation in Seychelles; carry out an experiment; solve problems using creative and lateral thinking; participate in debate.

Attitudes and Values

Be aware of the causes of environmental problems associated with land transport; value the importance of finding and discussing solutions to problems.

Activities

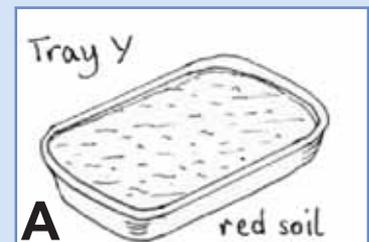
1. Rainfall Run-Off Effects On The Land

Note to Teacher: please refer to the note about this experiment at the end of the whole Land Transport theme)

Work in small groups. Each group may be asked to perform this experiment in a slightly different way. Your teacher will tell you.

Preparation

- 1) Prepare two trays as follows (see diagram A):
 - a. Tray Y is filled with red soil, which is pressed down firmly. Dampen the soil with water (do not over-wet the soil) and then smooth the surface.
 - b. Tray Z is almost filled with red soil, which is pressed down firmly. Dampen the soil with water and then cover it with a layer of turf (soil with grass already growing in it).
- 2) Prepare a tin with holes in the bottom. There should be 50-70 holes, evenly spaced, in about four circles (made by hammering a 2mm wide nail into the metal and pulling it out to leave a hole). (See diagram B) The tin should not be wider than the width of one of the trays. You will use this tin to produce "rain".



The experiment

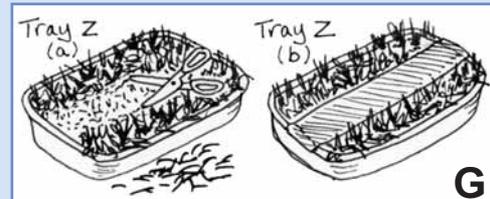
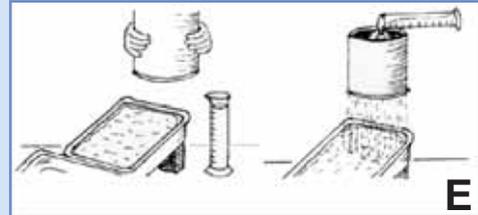
- 1) Place Tray Y at an angle or slope by putting it on wooden blocks (see diagram C). Your teacher will tell you what angle or slope to use. The slope will be either gradual or steep - see diagram C.





LAND TRANSPORT

- 2) Place a clean tray at the bottom of Tray Y (see diagram D). This will collect any “rain” that runs off Tray Y in your experiment.
- 3) Measure 1 litre of water in a measuring cylinder. Hold the tin over the top end of Tray Y. Empty the water into the tin, so that it falls through the holes as “rain” onto the tray (see diagram E).
- 4) Measure the amount of water that has collected in the empty tray (=run-off) using the measuring cylinder. Record your results in the Results Table.
- 5) Next, make a straight “road” leading from the top to the bottom of Tray Y, using a 10cm wide piece of rubber cut from the black inner tube of a car tyre (see diagram F). NOTE that the soil in tray Y might need re-smoothing before you add the “road”. Repeat the procedure (experiment steps 1-4). Record your results in the Results Table.
- 6) Repeat steps 1-5 with Tray Z. Set the tray at the same angle or slope as before (either gradual or steep) and NOTE that you will need to cut the grass in tray Z underneath the “road” (see diagram G). Record your results in the Results Table.
- 7) Exchange your results with another group of students who used a different angle or slope from yourselves. Discuss your results. What do your results suggest to you about erosion, road building and the need for good drainage in Seychelles? Write a paragraph.



Results Table: Water collected (=runoff) from the two trays

Slope of the trays (gradual or steep)	Tray Y		Tray Z	
	Run-off (ml)	Colour of water	Run-off (ml)	Colour of water
Results from your experiment:				
Trays set at a _____ slope				
Trays set at a _____ slope with a “road”				
Results from another group:				
Trays set at a _____ slope				
Trays set at a _____ slope with a “road”				

You may want to try other variations, such as putting a “house” (upside-down plastic box) at the top of the slope, or adding “drains” at the side of the “road” to see if it makes a difference. You could even try constructing a zigzag road. Consult your teacher before commencing.



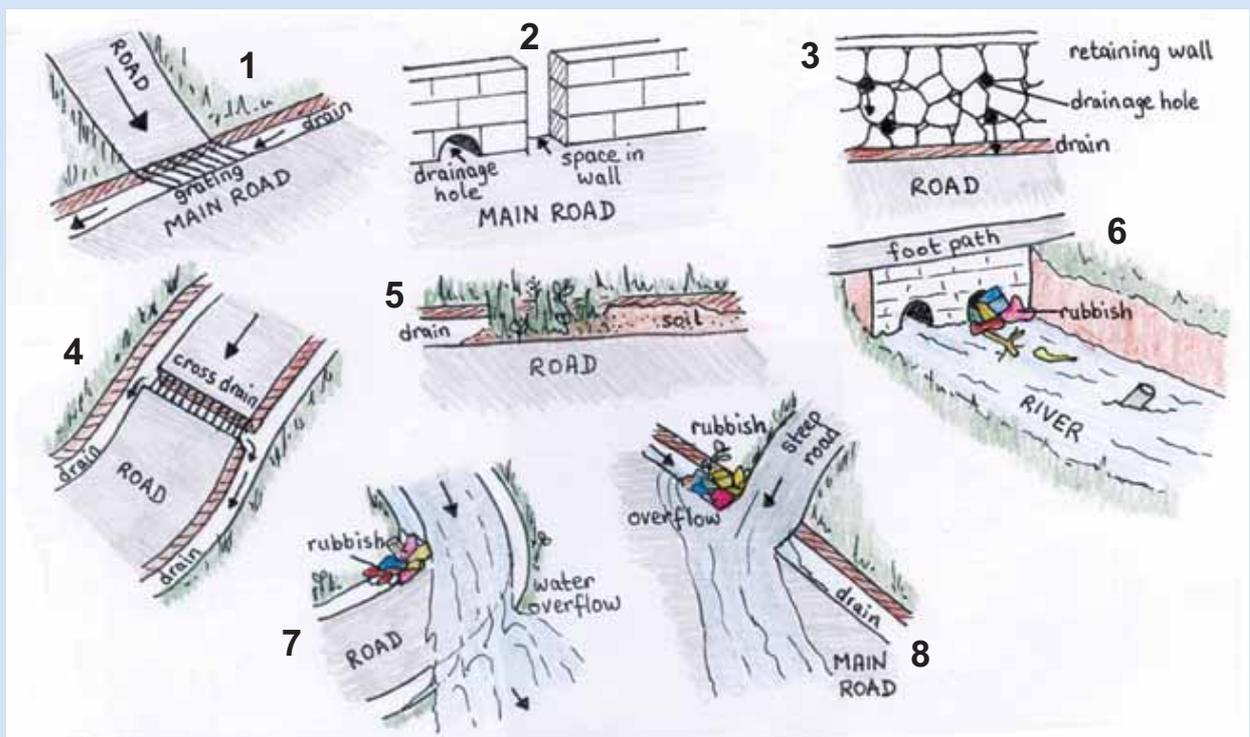
2. Drainage Or Flooding? Absorption Of Water Or Erosion?

2a. Walk around your house (or block of flats, or school). Ask yourself these questions:

- 1) What kind of soil is there around your house - sandy soil or red soil? Is there concrete around the house, or is there hard baked ground swept clear of all leaves, or is there vegetation cover? Will the soil around your house absorb much water?
- 2) Where does the rain go when it runs off the roof? Does it go somewhere useful (like a water barrel or *bay delo*) so that you can use the water later? Does the runoff go into a nearby river? Does it flow away into a drain? Does it flow off the property and cause problems for someone else? If it is raining when you do this activity, follow the water to see where it goes (make sure you stay dry yourself, though!)
- 3) Do you get problems around your house when there is very heavy rain? What kind of problems? Is there soil erosion? Why? Is there flooding? Why? If the water is coming from somewhere else, where is it coming from?
- 4) What can you do about these problems? For example, can you divert the water so that it goes into a drain instead? Can you plant vegetation around your house?
- 5) Note that it is useful to collect rainwater from your roof, as long as you can store it in a container that is mosquito-proof (otherwise many mosquitoes will breed in the water!) This will help to reduce water shortages in the dry season (see *Water theme*). Too much of the rain which falls on our islands goes straight to the sea, when it could be collected and used (as long as plenty is left to keep our rivers and marshes alive and healthy!)

Write a short report about the drainage around your house (or school).

2b. Here are some drawings of a number of drainage systems. You may have seen some of these in the area around your home, or in your district.





LAND TRANSPORT

Work in small groups. Go for a walk around your home or school area and look for as many different kinds of drainage systems as you can. Also note where there are likely to be problems with flooding (you may know this from your own experience of times when there has been heavy rain). For example, sometimes drains get blocked with rubbish or soil or plants (see drawings 5,6,7,8 above). Sometimes there are no drains at the side of the road at all. If you think that something needs to be done about these problems, work out what is necessary to solve or fix the problem. Perhaps your class could visit the District Office to tell them about the problems, or write a short report, giving your ideas. Make sure that you give positive suggestions of how to solve the problems, not just a list of complaints!

3. Adapting A Town To Increased Traffic (or “Playing God”!!)

On page 99 is the map of a small town. It is built on flat coastal land, with mountains behind it (to the East). The population of the town has increased and there are more vehicles on the road. More accidents have been reported. What can be done?

Activity 3 a.

Work in small groups, using the map.

1) How easy is to get from place A to place B? Why? (Put a tick in either the “Easy” or the “Difficult” column).

Place A	Place B	Easy	Difficult	Why?
Port	Factory			
Port	Storage area / small industry			
Market	Bus stand			
The South of the island	The East of the island			
Fire station	The South of the island			

- 2) Where are there most likely to be traffic jams (blocks) at rush hours? Why?
- 3) Where would you put zebra crossings for pedestrians (especially children)?
- 4) Where would you put traffic lights?
- 5) Which roads would you widen? Why?
- 6) Pavements are only found on the widest roads. Where else would you put pavements for pedestrians?
- 7) Follow the road that school children must take when walking from the new housing area South of the town to their nearby school. How safe is this journey for the children? Why? Make a special footpath for the children that goes more directly between the housing area and the school, so that they can walk more safely to school (what will you need to do?).

LAND TRANSPORT



Activity 3 b.

This is an activity for the whole class. The class represents the citizens of the town shown in the map.

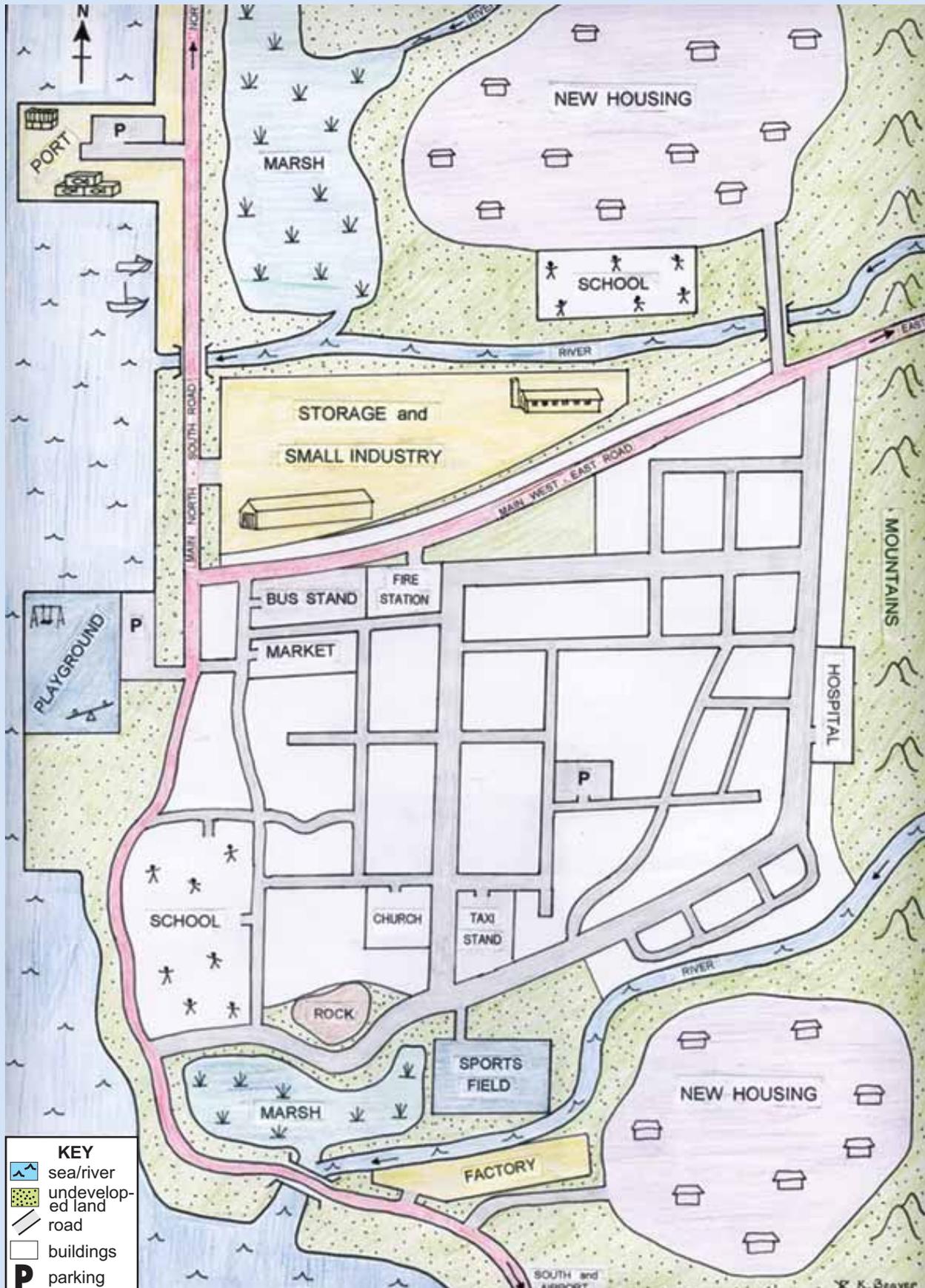
- 1) First, give the town a name.
- 2) Next, elect a mayor and two councillors for the town (many countries use this system for town management, Victoria also has a mayor).
- 3) These three persons must then choose a team of 3 to 5 people who will be responsible for improving a) traffic flow in the town, b) making the town safer for pedestrians. This plan may include changes to the town (see the list below for ideas).
- 4) The team should prepare a plan for the changes it proposes, together with a map to show what the town will look like after the changes. (*link to Land Use theme*)
- 5) The rest of the class (who live in the town) should decide who they are, where exactly they live, what work they do, whether they have children, a car, etc.
- 6) When everything is prepared, a meeting is called by the Mayor and his/her councillors to discuss and debate the town improvement proposals.
- 7) The team presents and explains its plan for the town. The citizens must put forward their points of view (e.g. what will you say if your house has to be knocked down to make way for a wider road?!)

Suggestions for town improvements:

- Traffic lights
- Zebra crossings
- Pedestrian bridges
- Pedestrian-only areas
- Footpaths
- Bicycle-only lanes
- Safety barriers on busy roads
- Bus-only lanes
- One way system for traffic
- Widen roads
- Knock down buildings to widen roads
- Build new roads
- Ring-road around the town
- Highway
- Reclaim land?
- Move certain facilities (e.g. school, sports field) out of town
- Car parks (pay parking?)
- No-parking areas
- Park-and-ride system (park outside town and enter on a bus)
- Car-pooling (sharing)
- No cars can enter the town unless they have a full load of passengers at rush-hours
- Pay to enter the town at rush-hours



LAND TRANSPORT





Further activities and actions

- Find out more about **New Technologies** for fuelling cars and other vehicles (see page 90). What fuels could be used in Seychelles? What would be the advantages and disadvantages of using the new technology?
- **Hold a debate** about the use of bicycles in Seychelles. Bicycles are not used as much in this country as in some others. It may help to think of the reasons why. Here are some words and phrases to help with your debate: Availability. Safety on the road. Steep hills. Hot climate. Winding roads. Rain. Cycle tracks. Convenience. Straight roads. Smooth surface. Cost. Pollution. Carrying bags. Mechanics. Personal image. Energy. Fitness.
- Find out more about the **history of transport in Seychelles**. For example, pictures of the kinds of transport used in the past, the dates when the first car or motorbike or aeroplane was introduced, or find out which is the oldest car still being driven on Seychelles roads. Put together some kind of display to show the rest of the school, and maybe the local community (for example, at a school open day). Resources: try talking to older people in the community; consult the Transport Division, National Archives, or history books such as “Once in Seychelles” (the S2 history book) and “The Way We Were - Life in Seychelles 1770-1920” by Denise Johnstone.
- **A simple experiment** to show pollution from road traffic. Pieces of sellotape (adhesive tape) about 5cm long are placed onto buildings or onto leaves close to the edge of a road, so that any material on the surface sticks to the sellotape. A similar number of pieces of sellotape are placed on buildings and leaves that are well away from any road traffic, so that the two sets can be compared. An alternative experiment is to place damp filter paper in similar positions, to compare the amount of polluting dust and other materials in the air.

Note to teacher about Activity 1: Equipment can be found in the school laboratory. Get the Lab Technician to help set up the experiment, which is best done out-of-doors if you don't want sinks and floors covered with soil! Note that red soil is better for this experiment than sandy soil. If the trays are set at too steep a slope, the soil may slip off the tray, so advise the students. If time is a limiting factor, some groups of students could work with Tray Y (red soil alone) and others with Tray Z (red soil plus turf).



LAWS & REGULATIONS

● Why do we need laws?

● What happens if you disobey a law or a regulation?

● Are there other ways of influencing environmental issues?

Seychelles Laws

Seychelles has many laws and regulations concerning the environment. They cover everything from the protection of individual species (e.g. *vev*, *pi santez*, turtles, cocode-mer), to the use and disposal of pesticides; from the protection of national parks and reserves, to the dumping of waste; from the protection of river banks, to the control of air pollution; from the protection of our health, to the way in which land is developed.

Most of these laws were introduced during the 20th Century, one of the earliest being the Breadfruit and Other Trees Protection Act (1917). Breadfruit is protected because it is an important source of food. During the First World War (1914-1918) there was a real possibility that food imports might be cut off. *Imagine: if it becomes impossible for boats to bring us rice anymore, what will we eat instead?*

One of the most important recent laws is the Environment Protection Act (EPA, 1994), which covers many aspects of our environment, including pollution (of air, water, soil, and by noise), waste disposal, coastal zones, and **Environmental Impact Assessments (EIA)**.

The Difference Between An Act And A Regulation

Boundaries are set by regulations



An Act has to be approved by the Government. An example is the National Parks and Nature Conservancy Act, under which the Ste Anne Marine National Park was set up in 1973. The Act defines different types of conservation area, allows for their demarcation and for regulations (rules) to be made. These regulations ensure that people know what they can do and what they cannot do within the conservation area. One of the regulations states:

“It shall be lawful to secure a boat on the sea floor provided that any person who damages any coral shall be liable to a fine of one thousand rupees or imprisonment for three months.”

Environmental Impact Assessment (EIA) - an analysis of a project, showing the effects it will have on the environment.

Early environmental laws in Seychelles

In the 1780s, not long after the colonization of Seychelles, Jean-Baptiste de Malavois introduced regulations regarding the conservation and protection of tortoises, turtles, forests and the soil. In addition, Cinquante Pas de Roi (or Pas Géométriques) protected the coastline by law. (It is interesting to note that these attempts at protecting the environment were not very successful! Perhaps you should ask why.)



LAWS & REGULATIONS



Glossary

Loophole - a way of avoiding the law, even if it has been broken. **Enforcement** - ensuring the regulation or rule is followed. **Conventions** - international agreements. **Global perspective** - as viewed by the world.

What Happens If You Violate (disobey) A Law?

Many laws and regulations prohibit certain actions. If you are caught, you are usually fined or penalised in some way (as is shown in the example given on page 101 about anchoring on the sea floor in Ste Anne Marine Park). However, there are sometimes **loopholes** in the law, which means that it may be difficult to penalise you unless the right evidence is found. The trouble is that this is not good for the environment, even if it may be good for you! Remember that environmental laws are introduced for good reasons. Breaking them will harm us all in the long term.

*Look again at the Ste Anne regulation given on the previous page. What are some of the problems that could arise with the **enforcement** of this regulation?*



Often, when laws and regulations are written down, no explanation is given as to why they are necessary. Sometimes people see laws and regulations as being TOO restrictive. They do not understand WHY they cannot do something. *Think of some examples of regulations in sports, in your school and in Seychelles. How can we understand better why there are laws and/or regulations in these situations? What might happen if there are no laws or regulations at all?*

One of the issues in the Environmental Management Plan of Seychelles (EMPS) is the question of improving enforcement of the environmental laws of Seychelles. *What do you think could be done to improve enforcement?*

Seychelles in the World context

Seychelles has signed a number of international environmental **conventions**, which means that there are certain international obligations that it has to fulfill. This puts the country into a **global perspective** with regard to its actions. Examples of such conventions are CITES (Convention on International Trade in Endangered Species) and CBD (Convention on Biological Diversity).

Although Seychelles is a small country it CAN have a positive impact on the way the rest of the world acts - for example, by showing that it IS possible to live in a truly sustainable way!



Other Ways Of Altering Behaviour That Affects The Environment

People sometimes think that laws and regulations are a very negative way of controlling human behaviour. *Think of one regulation in your school that has a penalty if you disobey it. Try and think of a different way of stopping students from disobeying the regulation, a POSITIVE way. For example, could the school reward students for doing the correct action?*



LAWS & REGULATIONS

Glossary

Concession - for example, making something cheaper than it normally is. **Prosecution** - legal proceedings against someone.

It may be possible to find positive alternatives to undesirable behaviour or actions:

- For example, with the Ste Anne Marine Park regulation (given on page 101), a positive solution could be to provide mooring buoys (which are permanently fixed to the sea floor), and then people would not have to put an anchor down at all.
- In some areas of work, “codes of conduct” have been introduced as a positive alternative to regulations. These codes encourage people to act in a better way. Rewards can be given.
- Another alternative is to devise standards and to reward good practices. An example could be giving a “green” label to hotels that have many environmentally friendly features. *(Cross link to Tourism theme)*
- A Government can make tax reductions on environmentally friendly equipment (such as solar water heaters), or it can give **concessions** to people using sustainable practices (for example, to farmers who are using organic farming methods), thus encouraging people to live more sustainable lifestyles.
- One way of encouraging good practice under the Environmental Protection Act is to allow a certain time for repairing damage or for correcting a fault. If the repair is not carried out or the fault is not corrected within the time allowed, only then will there be a **prosecution**.



- *Laws and regulations are there to set boundaries for certain kinds of behaviour (relating to our lives and to the environment).*
- *Laws and regulations are there to help maintain the environment in a healthy state, for both planet Earth and us.*
- *There are many environmental laws and regulations in Seychelles, covering a wide variety of issues.*
- *Law enforcement may be difficult in a small island state because of the small size of the population and the multiplicity of enforcement authorities.*
- *It helps if people know WHY laws and regulations have been put in place, by understanding the environmental consequences of certain actions and behaviour.*
- *Laws and regulations with punishments may not be the only way of controlling undesired behaviour relating to the environment.*

LAWS & REGULATIONS



Learning Outcomes

Curriculum Areas - PSE, Social Science, English

Knowledge and Skills

Understand more about the reasons for having laws; lateral thinking; analyse the causes of environmental problems; discuss issues.

Attitudes and Values

Be aware of the consequences of actions; appreciate the value of positive initiatives.

Activities

Both the following activities should be done only AFTER an introduction to the topic, for which you can use the information on the previous pages. Copies of Seychelles laws should be available at the National Library, the National Archives and the Ministry of Environment.

1. Actions And Effects - Why Are There Environmental Laws?

Environmental laws and regulations may be introduced for one of the following reasons:

- People see that something in the environment is going wrong.** For example, too many turtles have been killed and their population has decreased to a very low level; so a law is introduced to protect turtles.
- People have the foresight to look ahead to the future and see that a particular practice could result in great damage to our environment.** For example, road construction methods that result in soil erosion can be stopped, and regulations introduced to ensure the use of safer construction methods that protect the soil.
- People realise that the environment sustains our life on this planet and it needs protecting.** For example, coral reefs and seagrass beds are important breeding grounds for many fish that we eat, so it is good to set up marine protected areas where the fish can breed without disturbance.

Take a look at the Table on the next page.

The actions described in the boxes on the left of the Table can have a negative effect on the environment. In the boxes on the right of the Table are the possible negative consequences of these actions.

1. Firstly, match each action to its possible effect. (You could photocopy the page, then cut out the 20 rectangles and match the actions and the effects.)
2. Discuss HOW and WHY each action has had the negative effect.
3. Find out if there are laws or regulations about each of these actions. If there are laws or regulations why were they introduced, do you think? (To help you, look at the three possible reasons: a, b, and c, given at the beginning of this activity.)

Please note that Activity 2 is on page 106.



LAWS & REGULATIONS

ACTIONS	POSSIBLE EFFECTS
Too much fertilizer is used on crops.	Many dead fish are found floating in the sea near the river mouth.
Freshwater aquarium fish are imported and later released into a local river.	A large fire destroys an area of coco-de-mer forest.
Someone cuts down all the trees and shrubs between his house and the beach.	A fish disease causes the death of many <i>gouzon</i> (endemic small fish) in our rivers.
Pesticides are sprayed close to a river and the empty container is thrown in the river.	There is severe erosion of the beach after a storm.
All berried lobsters (female lobsters with eggs attached) are taken, as well as males.	There is an outbreak of diarrhoea amongst people coming to a certain beach.
On Praslin someone throws a lighted cigarette out of the car window.	There is an increase in the amount of seaweed in the bay below the crops.
Someone coming from Mauritius walks through the Green channel at the airport, even though he has young plants with him.	After ten years there are very few fish left to catch in the area.
A company drains a freshwater marsh and builds a hotel on the area.	The number of lobsters caught in the following years gets smaller and smaller
Fishermen use nets with a mesh that is smaller than the regulation size.	A new disease destroys many of our fruit trees.
Someone keeps pigs too close to the sea in a place where people come to swim.	There is widespread flooding of the flat coastal land in the adjacent area.



Further activities and actions

- An activity suitable for this theme is found in ***Native Plants of Seychelles - Students Workbook*** (published by the Ministry of Education), on page 87-88 ("Consequences"). Find out if there are laws or regulations about the situations shown in the pictures.
- **Use posters, slogans, displays, debates, etc.** to help families, the school and the local community to know about particular environmental laws and regulations.
- **Write a play** about an incident involving an environmental law and perform it at a variety show or to the school.
- **Look at the school regulations.** Which ones are followed and which ones tend to be disobeyed? Why? Are there any that relate to the environment? Why is it, for example, that regulations about putting litter in bins at school are not followed when students leave the school (often throwing their litter onto the road!). Students can try to design a better way of controlling undesired behaviour at school.

LAWS & REGULATIONS

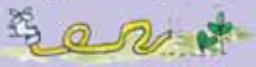


2. Laws And Regulations For Sustainable Living

Photocopy the table below. Cut out the 28 rectangles as individual “cards”. Each card shows an action. There are laws or regulations about all of these actions in Seychelles.

Work in small groups. Decide which of the 28 actions are positive (HELP us and the environment in some way), and which of the actions HARM ourselves and the environment in some way. There are 14 helpful actions and 14 harmful actions.

When you have separated the two groups, decide WHY and HOW each action is helpful or harmful to people and the environment.

<p>You stop children using a catapult to hit blue pigeons.</p> 	<p>You report your fish catch to Seychelles Fishing Authority.</p> 	<p>Your boat discharges petrol or oil into the harbour.</p> 	<p>You repair your car so that it does not produce smoky smelly exhaust fumes.</p> 
<p>You persuade someone to return a living triton shell (“lansiv”) to the sea.</p> 	<p>You use a hose to water your garden during a drought.</p> 	<p>You take birds' eggs (sooty tern / “golet”) from Aride island.</p> 	<p>You get permission to cut a breadfruit tree on your property.</p> 
<p>You throw rubbish out of your car window onto the side of the road.</p> 	<p>You explain to a tourist that he cannot water ski in the Marine Park.</p> 	<p>You obtain a licence for your fishing boat.</p> 	<p>You use explosives to catch fish on the coral reef.</p> 
<p>You capture and kill a turtle on the beach.</p> 	<p>You keep a terrapin (“torti soupap”) in captivity as a pet.</p> 	<p>You leave empty bottles and cans on a beach.</p> 	<p>You realise that your septic tank is leaking and call someone to fix it.</p> 
<p>Your friend gives you a gift of fruit at Nairobi airport. You explain that you cannot bring it into Seychelles.</p> 	<p>You report to the police a man taking sand from the beach.</p> 	<p>You wash out an empty insecticide container in a river.</p> 	<p>You take takamaka timber from Mahé to one of the outer islands.</p> 
<p>You cut a large tree next to a river.</p> 	<p>You ensure that all drains around your house are kept clear.</p> 	<p>You obtain a licence to sell coco-de-mer nuts produced on your property.</p> 	<p>You take female lobsters with eggs attached to them.</p> 
<p>Many mosquito larvae are found in empty containers around your house.</p> 	<p>You cut down a “palmis” without permission.</p> 	<p>You put your empty “Take-Away” box into a litter bin.</p> 	<p>You report to the Health Inspectors that there are very many rats around your house.</p> 



LAND USE

● What do we use land for?

● Why is the coastal zone so important?

● What impacts do we have on the land?

Early settlement in Seychelles

I expect you know that the first settlers in 1770 lived on the island of Ste Anne. When people settled on Mahé, they chose the coastal areas, which were accessible by boat. *Why was it difficult to live in the mountains?* Along the east coast however, large areas of mangroves blocked easy access, so they were cut down and the crocodiles that lived in them were killed. People made use of natural resources such as forest trees, freshwater in rivers, giant tortoises, and also changed the environment by draining marshes and growing crops. This is the impact that humans have on the environment.



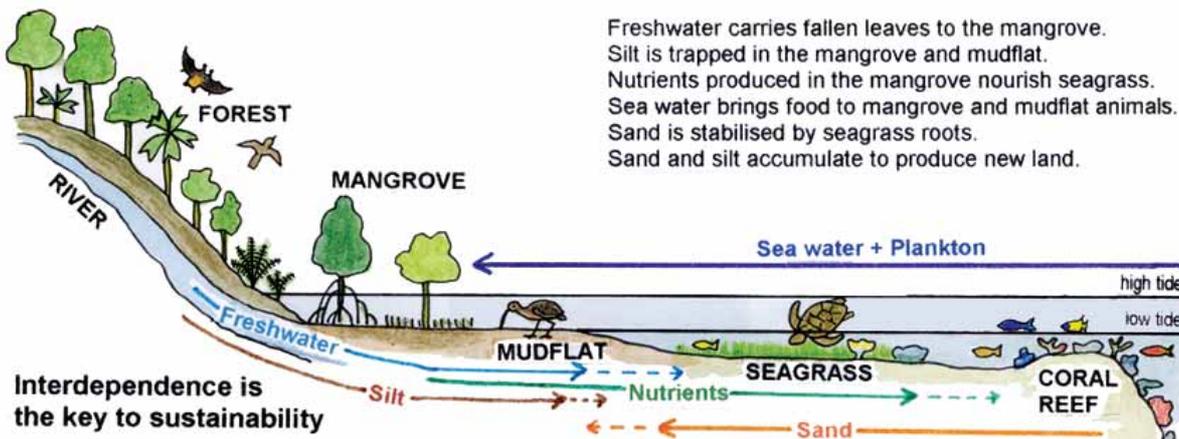
When the population on an island is small, there is plenty of land for everyone to use for building a house, growing food, etc. But when the economy develops and the population increases, there is competition for land. What is the best way to use land? Who gets the best land? Who gets the benefits? What are the consequences of developing the land for human use? The uses will change according to the type of land, and according to the needs of the human population. And there are MANY answers, not just one!

Write down all the different uses for land that you can think of, both in Seychelles and in other parts of the world.

The Importance Of The Coastal Zone

The coastal zone is the place where land meets sea. There are very important interactions between the sea and dry land, which keep the coastline in a healthy state. If these processes are disturbed, the whole coastline may be affected. For example:

- Removing the vegetation at the back of a beach (e.g. to provide a nice view) also removes the roots that hold the sand and soil. Result: the beach erodes away, especially during stormy weather.
- Remove an area of mangrove and the natural trapping and filtering process (of soil and debris) stops. Result: the nearby coral reef is affected by sedimentation, pollution, etc.
- Place walls or groynes along the coastal edge so that the natural movement of sea and sand is altered. Result: abnormal loss of sand and coastal erosion.
- Drain or fill in a freshwater marsh and the natural sponge effect (absorption of excess water after heavy rain and slow release of water during dry periods) is lost. Result: flooding of the area, or extra-dry soil.
- Remove a coral reef or reef flat (for example by dynamiting a channel or reclaiming land) and the protection that the reef offers against storm waves is reduced. Result: erosion of the coastline.





Reclaiming Land From The Sea

The reclamation of land from the sea on the east coast of Mahé, on Praslin and other islands has been an important development in Seychelles over the last thirty years. The granitic islands have relatively little flat land (most of it on the coastal plateaux). Flat land is much easier to develop than mountainous land. *Can you think why?* Reclamation produced more flat land that could be developed, firstly to provide an airport and then to provide land for port development, small industry and business, and for housing and sport.

However, reclamation of land from the sea is also a controversial issue because it causes the destruction of marine habitats such as reef flats, seagrass beds, sand and mudflats, which are an important (but often forgotten!) part of the coastal ecosystem. In addition, the process of reclamation can cause fine sediments to fall on nearby corals, affecting their growth and survival. The new land also alters the flow of sea currents, which may result in coastal erosion and other changes to the coastline.

This is the kind of situation where decision-makers have to weigh up the benefits and drawbacks of their decisions. Who benefits? How much environmental destruction can be tolerated? Most development is measured in terms of social and economic benefits to humans. Being able to give a money value to the environment thus becomes an important way of balancing the long-term positive and negative effects of development (*refer to Money and the Environment theme*). For a development to be sustainable, it must not affect the long-term ability of the environment to provide necessary services such as protection from wave action and sea-level rise, areas for fish reproduction, and clean beaches.



What Is Environmental Degradation?

Degradation is a process whereby something is spoiled or damaged. When this happens to the environment it may mean that soil is lost, or deposited in the wrong places, water dries up, poisons are added, plants and animals are harmed or even disappear.

Examples of environmental degradation

- **Deforestation:** when trees are cut down and large areas of forest are cleared, the soil quickly dries out and loses its fertility, or it gets washed away (soil erosion). Plants and animals that lived in the forest cannot survive. (*see also Biodiversity theme*)
- **Fire:** in Seychelles fires are often started deliberately, but may get out of control and spread to nearby land. The soil is left bare. It may erode away, or bake hard in the sun.
- **Pollution:** this can be caused by dumping of wastes in rivers or on the land, by over-use of fertilizers or pesticides, by liquid leaking from septic tanks or from animal farms (e.g. pigs, chickens). Plants and animals may be killed, or affected in other ways.



LAND USE

Glossary

Compensated - given money to make up for loss or damage. **Deforestation** - the cutting or destruction of trees over a wide area.

- **Poor agricultural management:** if farmers use inappropriate methods for cultivating their land or keeping animals, soil erosion or pollution can result, and the soil may lose its fertility. Land below the farm is also affected.
- **Poor construction methods:** when roads and houses are built, if the land is completely cleared before construction begins, vegetation is lost. Without the protection of vegetation soil bakes hard and/or washes away.
- **Poor siting of constructions:** buildings that are constructed too close to the sea may result in beach erosion. Buildings on steep slopes may cause landslides. Buildings sited on freshwater marshes or mangroves result in the complete destruction of the habitat.

Read the information in the Box below. Then answer the questions on the following page.

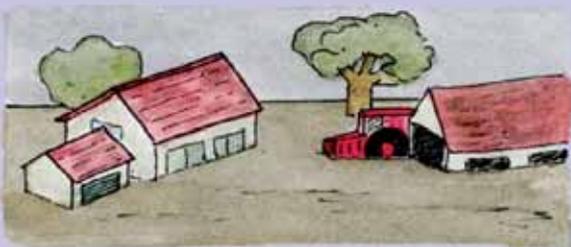
Flooding - natural or un-natural?

The flood plains of large rivers have very fertile soil and provide valuable agricultural land. The rivers flood frequently and tend to change their course. Look in an atlas to find the following two examples: the Mississippi River system in USA and the river system of Bangladesh (where the Ganges, Jamuna and Meghna rivers meet and form a huge delta).



Jeremy lives near the Mississippi River. His family has been farming in the area for generations. The local people wanted the river to remain in one place so that they could farm and be free of floods. So river banks were raised and dams built to control the river. Wetlands (marshes and ponds) were drained and used for agriculture. Land around the river was converted into towns and farmland. Then one day it rained heavily for several days and the river flooded. Jeremy's family lost almost everything their crops were destroyed and their house spoilt by floodwater. Fortunately the government **compensated** the family. But people were angry and demanded that the government protect their land. They demanded higher river banks and more flood controls.

Padma's family also farms, in the fertile soil of Bangladesh. Every year, during the monsoon (rainy) season, the water level normally rises several metres above sea level. The new layer of soil brought by the flooding river is rich in nutrients for plant growth, so crops do well. However, Padma has lost several members of her family in such floods. **Deforestation** in India and the Himalayas has made the flooding worse, and sometimes there are terrible cyclones which cause more damage. But life goes on. Padma's family have few possessions and they do what they can with what they have. They have been living with these floods for generations. The government has little money to repair the damage or to build defences against the flooding. It relies a lot on aid from the rich countries.





What is your reaction to these two stories? Anger at the unfairness of the two different situations? Dismissal of the Bangladeshi's situation as 'that is what happens in poor countries'? Something different?

If the government supplies the means to control the flooding, is this the right answer? What about the situation in Seychelles? Many of our wetlands have been drained, converted into agricultural land or housing or hotels. Is this short-sighted? What happens when there is very heavy rain? How do people react? There are no right answers to these dilemmas but we do need to be more aware of the power of nature, we do need to try to work with nature rather than against nature.

How Can We Use Land Sustainably?

Environment and development must go hand in hand. If we overuse resources such as water, soil, land, sand, trees, they may disappear or become damaged and unable to provide us with things we need. If we spoil the environment by putting dangerous chemicals into it or by upsetting the natural balance of plant and animal species, it is us humans who will be affected in the long run. So we must find ways of using and developing land in a truly sustainable way so that it continues to provide us with resources and with the services which ensure that life can continue to thrive long into the future. We need creative solutions!

Making Sure The Environment Is Included In Planning

Fortunately in Seychelles there is already some awareness of the importance of the environment in our lives. However, for sustainable land use, we need to think long-term. We need to think about the future for our grandchildren and beyond. There are a number of things that can be done:

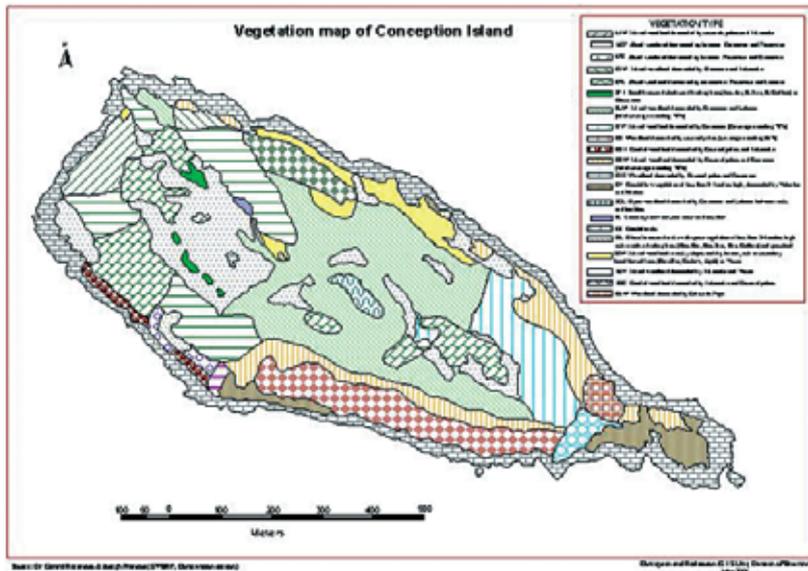
- **Land Use Plan:** A proper Land Use Plan is vital for sustainable development, and needs to include the outer islands and the newly reclaimed land as well as the inner islands. Unfortunately there is still no legally binding Land Use Plan in Seychelles. The present system allows too much flexibility. Developers sometimes have too much power, and environmental issues are given last place. It is easy then for development to become unbalanced (*refer to the three-legged stool concept on page 6*). District Land Use Plans are being developed, in which the local community has a greater chance to be involved and to make comments. This is important.





LAND USE

- Geographic Information System (GIS):** Much information about land use can be put into a computer, for example maps, positions of houses and water pipes, soil, farmland. Many details can be included, such as owners, boundaries, special plants, etc. The computer can process this information to produce a map showing the relationships between selected information. This is a very important tool for planning.



- Sensitive area atlas:** This is an atlas of the areas in Seychelles that should be valued for their contribution to our lives, whether as beauty spots, for the special biodiversity or for supplying us with water, fish and other resources. These include mist forests, mangroves, coral reefs, seagrass beds, etc., as well as beautiful beaches. We often forget how important these areas are in our lives. Don't let them disappear!

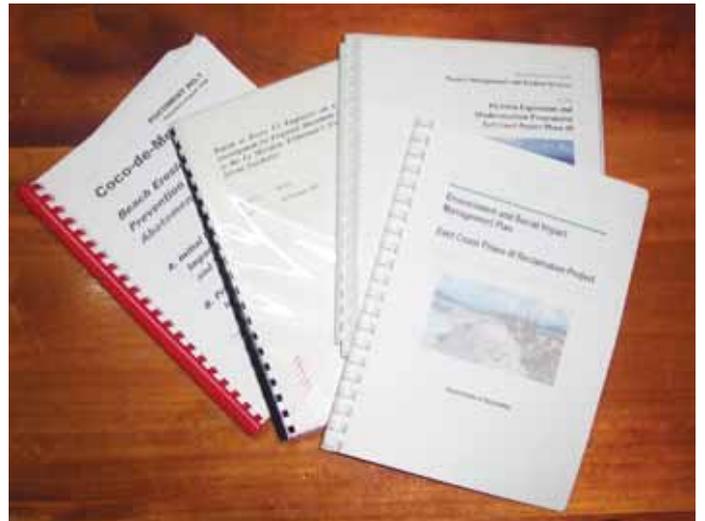


- Protected areas:** Some sensitive areas are already protected as National Parks, e.g. Morne Seychellois National Park, Curieuse Marine National Park. Other areas are Special Reserves, e.g. Cousin Island, Veuve Reserve. There are also Shell Reserves and River Reserves and a number of other categories of protected areas. This is an important way of caring for our environment.





- Laws and regulations:** the Environmental Protection Act was introduced in 1994. It provides the means to protect and improve the environment, control activities which harm the environment, and set standards for technologies, levels of pollution, etc. (see *Laws and Regulations* theme).
- Environmental Impact Assessment (EIA):** An EIA is a report about a proposed development which may affect a sensitive area. It looks at the plans, shows what the social, financial and environmental impacts will be, both positive and negative. It also suggests ways to solve or reduce any environmental problems. People who may be affected by the development can look at the EIA and make comments. Unfortunately many developers see the EIA as a hindrance rather than a useful process. Also many people either cannot easily understand the complex language of the EIA, or they believe the development will go ahead anyway, so they do not comment. Once an EIA is approved, it is important that the progress of development is checked to ensure that all the environmental recommendations are followed.
- Conflict resolution:** Resolving conflicts over land ownership and land use can be difficult. New techniques are being developed to help in such disputes. Perhaps Seychellois need to develop such skills.



In a nutshell



- All use of land by people causes changes to the environment.
- Increasing human population creates pressures on the land.
- In Seychelles the coastal zone is very important because of the interaction between all land and marine habitats.
- Land reclamation, like all land use, provides development at the expense of natural habitats.
- Environmental degradation is damage to the environment, often caused by human activities.
- Rich and poor countries differ in their ability to work with nature or to control nature.
- Sustainable use of land can be achieved if we have the right tools/methods.



Learning Outcomes

Curriculum Areas - Geography, History, PSE

Knowledge and Skills

Understand the importance of including environmental issues in land use decisions; understand the consequences of actions taken.

Attitudes and Values

Appreciate the complexity of land use decision-making; value the environment as part of land use planning.

Activities

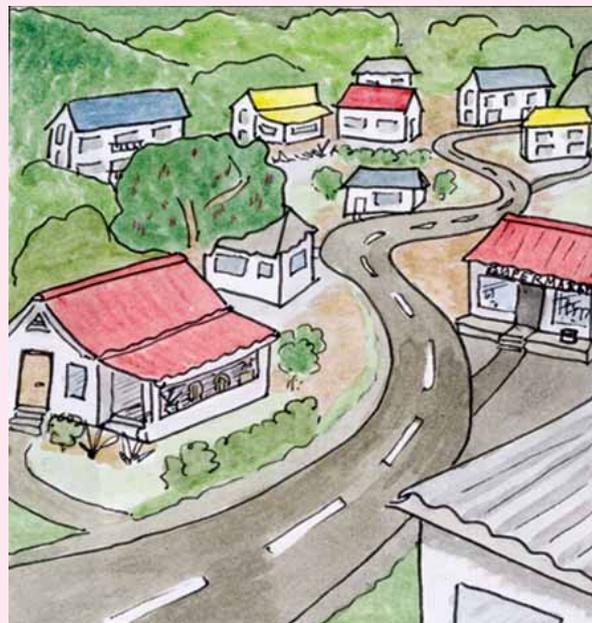
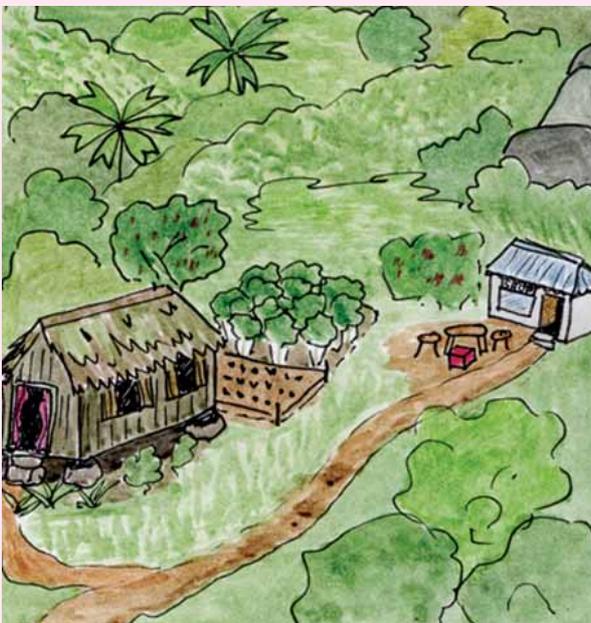
1. Changes In My Community

Work in small groups.

- 1) Interview older people in your family and in your community. Find out what changes have occurred to the land and the environment in your area.

Here are some examples of questions:

- Has the number of houses in the area changed (increased or decreased?)
 - Are there new buildings now? Or sports facilities?
 - Are there more paths or roads? Have some disappeared?
 - Has the amount of water in the river changed? Is it cleaner or more polluted now?
 - Has the amount of agricultural land increased or decreased?
 - Have there been changes in the numbers of trees, or kinds of trees?
 - Have any habitats (e.g. freshwater marsh, mangrove, beach, mudflat) disappeared?
 - Have any special plants or animals disappeared?
- 2) Make two maps or drawings of the area showing how it was in the past and how it is now.
 - 3) Display it at school or in the community centre (ask for permission first!).





2. Where To Build?

A children's playground, a new small hotel and a new landfill (dump for waste/rubbish) have to be sited in the area shown in the map on page 115. You will help the developers to decide on the best location for the three developments.

Work in small groups.

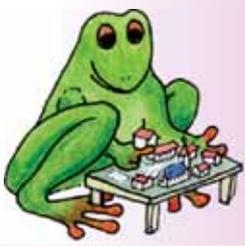
1) You may need to make three tables like the one shown below, one for each development.

Development:

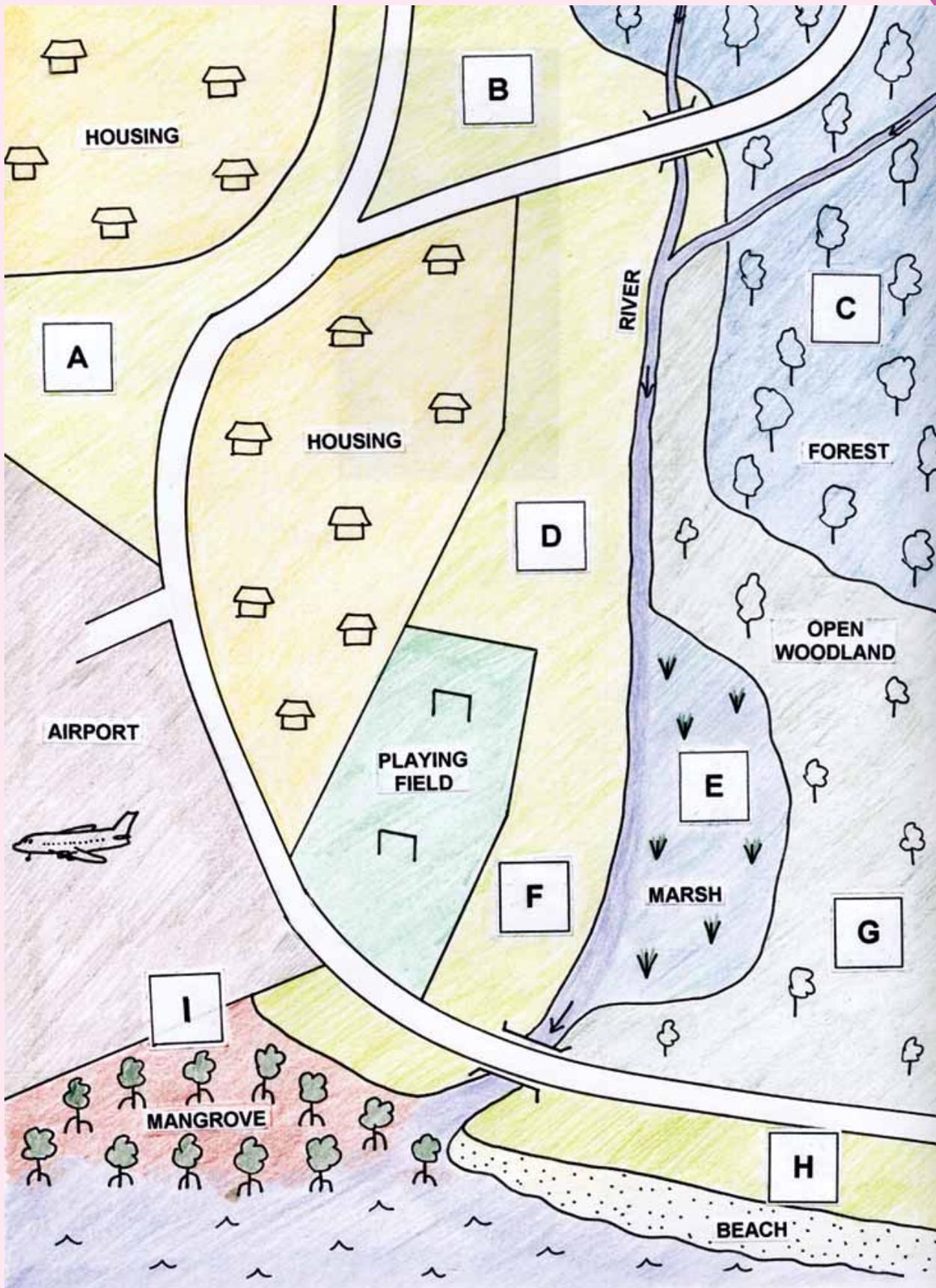
Site	Suitable	Unsuitable
A		
B		
C		
D		
E		
F		
G		
H		
I		

2) In each case, consider the locations indicated on the map (on page 115) and give reasons WHY you would choose or reject that location. Think about how the development will affect people and the environment at each site. Remember there are no right or wrong answers!

3) Afterwards debate your answers with the rest of the class.



LAND USE





Further Activities and Actions

- There are useful exercises in the *Environmental Education for Sustainable Development - Activity Guide for Teachers* produced by the Ministry of Education:
 - Page 29 - “The Ideal Environment” (a visualisation exercise).
 - Page 69 - “Land Use” (land use and its impacts on the environment).
 - Page 78 - “To Build or Not to Build” (a role play).

- Other activities can be found in *Native Plants of Seychelles - Teachers Handbook*, produced by the Ministry of Education:
 - Page 108 - “Consequences” encourages students to predict what might happen in situations where development and conservation are in conflict. (See also the Students Handbook page 87)
 - Page 110 - “Two Role Plays”: Role Play 1 allows students to explore and debate issues surrounding land development. (See also Students Handbook page 89)
 - Page 113 - “Island Life”: Activities 3 and 4 allow students to imagine how an island could be developed and raises issues of sustainability. (See also Students Handbook page 92)

- Perform an **environmental audit** at your school. Use the information in *Birds are Brilliant!* produced by Birdlife Seychelles. Page 40 - “Activity 13 - Environmental Audit” tells you how. Make an Action Plan. You can make a difference - go for it!



MONEY & ENVIRONMENT

● How do we value things?

● What is the environment worth?

● Is globalisation good for us?

Money And Values

Start with this activity:

- 1) At the present time, it is very difficult to live without money. Discuss in small groups the following questions:
 - a) What does your family use money for?
 - b) If you had no money, how would you live? Describe, or list, what you would be able to do and what you would not be able to do.
- 2) Now work on your own to answer the next questions:
 - a) Choose 10 things you use every day. List them and cost each one in Rupees (an approximate figure is fine).
 - b) Choose 10 things that are really important to you in your own life (e.g. your baby brother, your radio, a special friend, the necklace your grandmother gave you). List them. Now try to give each one a value in Rupees. It might help if you imagine what it would mean to you if you lost it.



Note to teacher: For b) it might help to use categories such as R0-100; R100-1,000; R1,000-10,000; R10,000-100,000; R100,000-1,000,000.

It is difficult to put a money value on some things, isn't it? It is also difficult to give the environment a money value. For example, what is it worth to protect our forests in Seychelles? What is it worth to protect coco-de-mer palms in Vallée de Mai, Fond Ferdinand and Curieuse? How much is a clean environment worth? How much is a healthy freshwater marsh worth?





How Much Is An Unspoiled Environment Worth?

It costs money to look after the environment. If a government decides to safeguard the environment, then the land or sea may not be available for other human activities, e.g. agriculture, housing, fishing. There is usually pressure on a government to push for economic development. Unfortunately, economic gains are often short-term, and the environmental destruction resulting from development is long-term. For example, if you destroy a wetland (such as a freshwater marsh or a mangrove) and develop the area, what will be put there instead? A hotel? Agriculture? A sports field? What are the economic benefits? What are the social benefits? What are the possible environmental consequences?

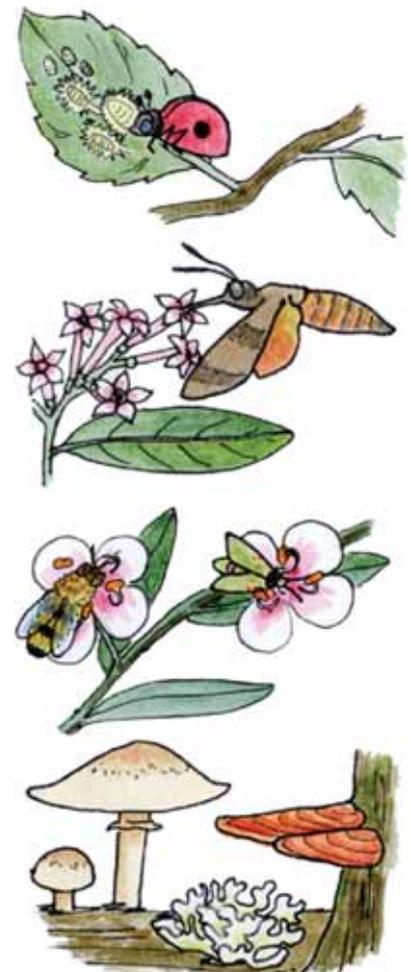
The cost to convert the wetland into dry land, and then build a hotel or farm, can be worked out in money terms. The economic benefits of a hotel or agriculture can be estimated in money terms. It is less easy to work out the economic benefits of a sports field. But is it possible to estimate the worth of the wetland? What is the role of the wetland in the environment? What useful things are lost if the wetland is destroyed? These are the kinds of questions that are being asked now, so that the value of the environment can be given in money terms too.

Ecosystem Services

In order to give the environment an economic value, we have to realise that the environment provides us with many useful services. Usually we take these services for granted and do not even realise how much we rely on them for a healthy environment.

Here are some examples of ecosystem services:

- Ladybirds (*koksinel*) help to protect your garden by eating mealy bugs (*lipou blan*) and other pests.
- A forest collects water from the air (on the trees' leaves and on mosses) and also absorbs carbon dioxide (see *Climate Change theme*). A forest also retains the water and releases it slowly into the soil
- A wetland filters dirty water, collects soil that runs off after heavy rain, and provides a steady source of water for plants in the area.
- Pollination is a service provided by different insects, such as bees, ants, beetles, and also by fruit bats and a few birds. *Which of the following fruits and vegetables would we have to do without if there were no insects:- pumpkins, lettuces, apples, guavas, "sousout", "karanbol", bananas?*



MONEY & ENVIRONMENT



What is good about globalisation	What is wrong about globalisation
People have access to ideas, expertise and goods from all over the world.	Multinational companies control more money than many smaller countries. They also have power to decide where to go, how to make profits, and often ignore the needs of smaller countries, workers, and the environment.
There is a greater choice of things to buy and things to do.	Global advertising makes people want global brands instead of locally produced goods. Local goods often cannot compete. People may have little choice other than to work for a multinational company.
Foreign investment in a country can help to provide money for education, health care, etc.	Globalisation has not shared out money and goods equally. The poorer countries have become poorer and the rich countries continue to get richer.
We come to realise that we are part of a whole world, rather than just a separate small bit of it, i.e. we are global citizens.	The presence of the same goods (and maybe the same values) everywhere threatens the richness and diversity of the world's cultures.



In a nutshell



- It is difficult to give some things a money value.
- It is important to give the environment a money value for us to make decisions - do we destroy a natural resource for human development or not.
- The environment provides us with many useful services, such as providing water and clean air, and breaking down wastes.
- The process of globalisation is becoming increasingly important for all of us, but it has both advantages and disadvantages.



MONEY & ENVIRONMENT

Learning Outcomes

Curriculum Areas - Geography, PSE, Science, English

Knowledge and Skills

Understand how we put a value on things; learn about ecosystem services; discuss issues.

Attitudes and Values

Value in a new way the important things in life, including the environment; question our values.

Activities

1. Imaginary e-Mail Correspondence Between Two Seychellois Kids, Bernard and Joanna

First, read the email correspondence on page 122 (in the Box).

Things to think about:

Several environmental issues are being discussed in these emails:

- Harvesting birds eggs (from sooty terns)
- Meat-eating versus vegetarianism
- Degraded habitats - disregard or restore?
- Payment for work versus volunteering ✿

✿ **Note to teacher:** This issue may not seem to be directly related to the environment, but it actually shows how much our current values are based on money. It raises the need to search for alternatives!



Bernard and Joanna make some comments about these issues, but do not discuss them in great detail. Select just ONE of the issues and look at it in more detail. Environmental issues can be complex so look at the following 6 parts:

1. **Problem:** Most environmental problems involve a threat to some part of nature, caused by human actions. What are the threats to nature in this issue? What human actions are causing the threat?
2. **Issue:** Usually different people disagree about whether the threat is real or not. They also often disagree over the method of solving the problem. What are the conflicts in the issue?



From Bernard in Seychelles:

Hi Joanna,

It's been a long time since I e-mailed you, but life gets busy, with all the football and extra homework this term. It is birds' egg season again yum! I love sooty tern eggs. Don't you miss eating them? Perhaps I should send some to Australia so you can taste an omelette made from them! However, I guess they would break or go rotten on the way. Don't you miss this traditional food - part of our Seychellois culture? But the price has gone up again. Mum says they used to be just 10 cents each when she was a girl, then they went up to 50 cents. Now they are R1.50 each. That's not fair! It is more or less the same price as a chicken's egg, and they cost money to produce. I reckon birds' eggs should be FREE because they are laid by wild birds that don't cost anything to keep.

Anyway, how about you? Are things OK over there? Are you finding exciting things to do? All the best, Bernard

From Joanna in Australia:

Bernard, how COULD you?! Eating sooty tern eggs. I thought you loved nature. Anyway, why should they be free? Even if the sooty terns are not looked after in a special sooty tern farm, the eggs still need to be collected by people, and then taken to Mahé by boat - do you think people will do THAT for free? No, they want to be paid!!

As for me, I have become a vegetarian, so I do not eat meat or fish or eggs any more. Lots of people are vegetarians here and there is some really delicious vegetarian food available in restaurants. You should try some! Mum makes some wonderful dishes too, using lots of different kinds of beans and lentils and soya bean curd (have you ever tried that? Perhaps you cannot get it in Seychelles). At least you can get some organic food, can't you?

I am very busy too now. I have joined a wildlife club and we go on lots of field trips to learn about nature. Our club has recently adopted a small woodland area near our school and we have started to restore it back to how it used to be in the old days (old people told us it used to be full of wildlife but it became overgrown with invasive plants and some people used it as a rubbish dump). It is great fun, and you can see it changing already!

Must go - I have some homework to do. Don't get too much cholesterol from your eggs! Bye. Joanna

From Bernard in Seychelles:

Joanna, you seem to be changing - you used to love fish! I hate lentils anyway. We have been doing something about money at school. My Mum says "Why aren't housework and childcare part of the economy? Mothers don't get paid for their work in the house, garden, and bringing up a family. Interesting, eh?! I never thought of that. Mums are just THERE.

Oops, I am late for football. Talk to you later. Bernard

From Joanna in Australia:

My mum agrees with your mum Bernard! My dad says "What about the work that dads do at home?!" Just off to my wildlife club meeting. I don't get paid for the work I do in the woodland either. Cheers! Joanna

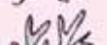


MONEY & ENVIRONMENT

- Parties (sometimes called stakeholders):** Who is involved? Is it individuals or groups, such as farmers, women, wildlife club members, or government officials?
- Interests:** What interests do each party have? For example, does one group want to develop an area, while others want to protect it?
- Beliefs and values:** The different parties often have different beliefs or place different values on the issue. What are the beliefs and values of each party? For example, some people believe that all animals have as much right to exist as humans; other people value a large car that gives them a high status.
- Solutions:** What solutions are possible? Are there ways of addressing the needs of all parties? Listening to all sides and trying to find common ground is more likely to lead to a lasting solution.

2. A List Of Valuables

Work alone or in small groups. Use stars to grade the following items (5 stars for very valuable, 1 star for not at all valuable)

Item	Valuable to you?	Valuable to nature?
 Ants (<i>fourmi</i>)		
 Fruit bat (<i>sousouri</i>)		
 Sooty tern (<i>golet</i>)		
 Corals (<i>koray</i>)		
 Karang		
 Tuna		
 Dragonfly (<i>sigal</i>)		
 Cow		
 Breadfruit tree (<i>pye friyapen</i>)		
 <i>Bwa mediz</i>		
 Fungi		
 Mother (or other person who cares for you)		
 Your best friend		
 Yourself		

Discuss your gradings. Which items are most valuable and why? Is everything equally valuable to nature? Should we value some items more than we do at the moment?



3. Which Country Does This Come From?

This activity will show you where in the world our clothes, food and other things come from.

1) Work in small groups. Decide in the class which items each group will investigate. Examples of items you could investigate are:

- Clothes and shoes
- Toys
- Kitchen equipment
- Electrical equipment
- Packaged food (e.g. packets and cans)
- Stationary and school items (pens, etc.)



2) At home, look at the labels on items that your group has chosen to investigate. See where each item has been made. Find between 10 and 20 items if possible. Make a list of the items and which country each has come from. You could also visit a supermarket to look for a greater variety of items.

3) When you meet with your group again, share your information. Use a large world map. Stick pictures of the various items (or use the actual labels or packaging) around the edge of the map. Use string or thread to link each item or group of items with a particular country, to show the origin of the things we buy.

4) With the whole class, discuss which countries different kinds of goods come from. How much of what we buy comes from the global market place?



INDUSTRY & COMMERCE

● What industry and commerce is there in Seychelles?

● Can a business be sustainable?

● How do you set up a business?

As we have seen in the last theme (Money and the Environment), money does not grow on trees! Where does Seychelles get its money from?

The two main areas (sectors) which provide money for the government are Tourism and Fisheries (see *Tourism and Fisheries themes*). In addition there is Industry (manufacturing of various products that can be sold) and Commerce (trade + services).

Industry

In Seychelles there is little industrial production compared with Mauritius and many other larger countries. Nowadays, the largest company is Indian Ocean Tuna, which produces canned tuna for export to other countries (see *Fisheries theme*). Most other companies are small and manufacture (produce) items for the Seychelles market and for tourists. For example, there are companies that manufacture items such as concrete blocks, roofing material, paint, furniture, clothing, soap, drinks, biscuits, jewellery, crafts and many more.

There is also the construction industry which is responsible for building houses, office buildings, hotels, and boats.



Commerce

Commerce in Seychelles consists of businesses of many kinds:

1. Trading, which includes:
 - importers of a large variety of goods from overseas.
 - shops that sell these goods, either manufactured locally or imported from other countries.
2. Maintenance and repair services, which include:
 - businesses that repair and maintain equipment such as refrigerators, televisions, computers, cars.
3. Other services, which include:
 - businesses that provide services such as transport, storage, communications, food outlets (e.g. restaurants).
 - Professional services such as legal advice, banking, insurance, design and printing facilities, health care, hairdressing.



Sustainable Business

What does it mean for a business to be sustainable? It needs to make enough money so that all costs are covered, loans are repaid, people/workers are paid a “living wage” and the owner(s) also earn enough money to live a reasonable life. It also means that the owners and workers should enjoy their work or feel some satisfaction that their work is producing something of value to the community.

It does NOT mean that the business has to keep on growing and growing! But the business must make enough money to survive or to sustain itself. *Why do you think many small businesses want to expand or grow (get bigger)?*

A sustainable business must also have a low impact on the environment, so:

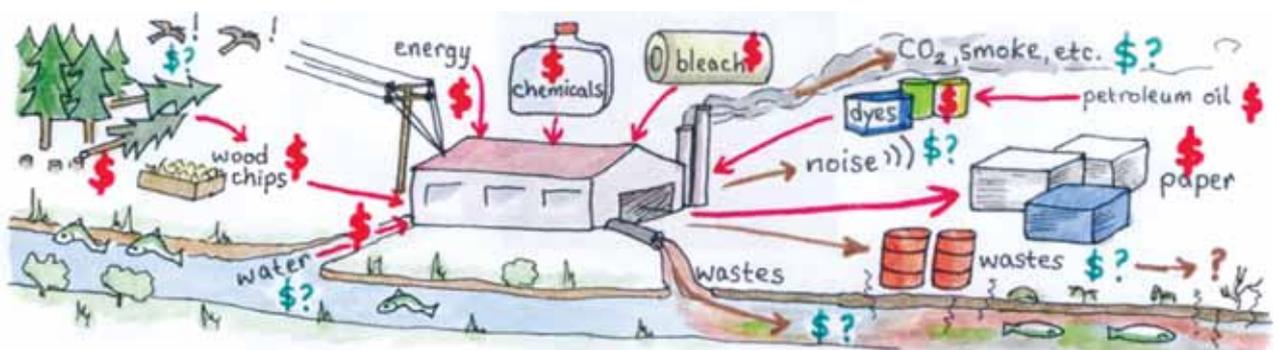
- it should not take more resources from the Earth than can be replaced,
- it should not put into the environment anything dangerous or poisonous that will spoil the Earth, or that cannot be broken down by normal environmental processes.



Environmental Problems

It is easy for a business to just throw waste out into the environment and turn a blind eye - for example, allow dirty water to flow into the local river or the sea, where it becomes a problem for someone else to deal with.

Treatment of wastes costs money. The problem in the past was that industries and businesses all over the world did not care what happened to their wastes (chemicals, dirty water, pieces of waste metal, wood, rubber, etc.). The accounting systems of these businesses failed to look at the bigger picture. For example, when the price of making paper was calculated, the environmental costs were ignored. The business paid for the timber but not for replanting the trees and not for the loss of forest wildlife. It paid for the use





INDUSTRY & COMMERCE

Glossary

Solvents - liquids used for dissolving something. **Effluents** - liquid substances that result from a process, and flow away.

of large quantities of water and for chlorine to bleach the paper, but not for cleaning the polluted water so that wildlife and people downstream from the factory could use the water. As a result the environment was spoilt and habitats disappeared. It was usually the local people who suffered the consequences and the society as a whole that had to pay to clear up the mess and repair the damage. *Is the situation still the same? Or has it changed? If a polluting industry has to pay for the damage it causes, is it more careful with the wastes it produces?*

Examples Of Environmental Problems Related To Industry In Seychelles

Air pollution:

- Charcoal production - smoke
- Paint, fibreglass manufacture - **solvent** vapours
- Quarry - dust
- Transport and construction - exhaust fumes, dust

Water pollution:

- **Effluents** of various types - oil, **solvents**, dirty water

Noise pollution:

- Electric power generators - continuous noise
- Construction - breaking rocks, banging, power tools
- Transport - heavy vehicles on roads

Land pollution and degradation:

- Solid wastes of various types
- Construction - loss of vegetation, soil erosion, baked soil

All these problems have environmental, social and health consequences. They need to be taken into account by a business.

What Can Be Done To Reduce These Environmental Problems?

Increasingly businesses are realising (or are being made to realise) that the cost of negative effects they have on the environment must be built into their business. In other words, **THEY** must pay for treatment of wastes before they are released into the environment; **THEY** must use equipment that is more efficient in the use of resources; **THEY** must use chemicals that are less damaging to the environment, and so on. However, it is necessary to have good knowledge of the environmental impacts and how they can be reduced, in order to make good decisions.



I've found the perfect product!





So, in Seychelles, the government has found it necessary to introduce laws and regulations (such as the Environment Protection Act of 1996) which control the amount and types of wastes that can be released into the environment. Also, International Standards such as the ISO 14001 have been introduced, so that products are of a suitable standard to ensure safety for people and safety for the environment. The aim of such standards is to support environmental protection and still balance this with social and economic development.

One example of a business that has taken such actions is the Indian Ocean Tuna factory. People in Victoria complained about the terrible smells from the factory caused by oily waste water which was not fully treated, and also by the fishmeal factory when it prepared the fishmeal product. The factory installed condensers to remove as much of the odour as possible. Waste water is now treated and reused for factory cleaning, so that the use of water (a valuable resource for the rest of us!) is reduced. They installed a desalination plant (to turn sea water into fresh water) for the same reason.



Another example is Seychelles Breweries, which recycles the majority of the glass bottles used for soft drinks and beer. PET (a type of plastic) bottles used for soft drinks are also collected and then ground down into chips that can be exported and re-used to make more plastic. The waste material from beer-making is used for manufacturing animal food.

Slowly but increasingly, overseas markets are demanding higher environmental and social standards in a business before they will buy products. For example, there is more demand for tuna that can be guaranteed to have been caught in such a way that dolphins, turtles, sharks and smaller fish are allowed to escape from the huge nets. Non-governmental organisations (NGOs) have played an important role in increasing awareness about such issues.





INDUSTRY & COMMERCE



- *Industry and commerce are important in Seychelles for earning money for the economy.*
- *A business should be sustainable both financially and environmentally.*
- *Past practices in industry have tended to ignore the environmental consequences of the wastes that they produce.*
- *Businesses now have to face up to the challenges of being responsible for the wastes that they produce.*
- *There are many requirements for setting up a business, especially if it is to be environmentally friendly.*
- *The Tourism Industry is one important example in Seychelles of a sector which includes not only businesses directly related to dealing with tourists, but also businesses that provide services and goods for everyone.*
- *All businesses associated with Tourism in Seychelles are affected by factors which impact on the Tourism Industry.*

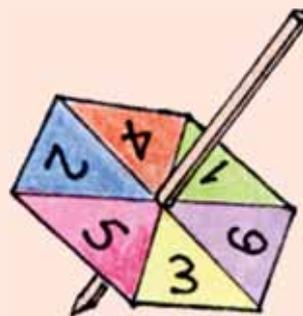
No die for a board game? Make a spinner!

Making the spinner:

- Trace the hexagon shape onto thick card.
- Colour the triangles in different colours.
- Cut round the edges of the hexagon.
- Make a hole exactly in the centre of the hexagon.
- Carefully sharpen the end of a matchstick.
- Push the matchstick through the hole (it must fit tightly).
- Voila! The spinner is ready for use.

Using your spinner:

- Spin the hexagon spinner.
- The side it lands on gives you the number of places to move forward in the game.
- Adjust the position of the match if necessary.





Learning Outcomes

Curriculum Areas - Geography, History, PSE, English

Knowledge and Skills

Learn about industry and commerce in Seychelles; understand about environmental impacts and how to reduce them.

Attitudes and Values

Creative use of knowledge to foster values; learn through playing games.

Activities

1. Business In A Changing World

You will need one copy of this game for 15 people, one die (or a spinning number disc - see page 129 for instructions), one counter, and small pieces of paper for each person.

The counter is placed on square 1 to start. One person acts as the controller and reads out the information on the square. He or she then rolls the die (or spins the number disc), moves the counter forward and again reads out the information on the square.

The fourteen other people take the role of one of the businesses that are related to tourism. As the game proceeds, listen to the information and make a note of your score on the piece of paper. There are certain squares (marked with ⊗) that may need discussion before you decide which businesses will score! Here are the fourteen businesses:

- Airline
- Taxi drivers
- Craft makers
- Local tour operators
- Dive operators
- Hotels
- Car hire
- Nature trail guides
- Game fishing operators
- Soft drink / bottled water industry
- Restaurants
- Farmers
- Fishermen
- Boat operators





INDUSTRY & COMMERCE

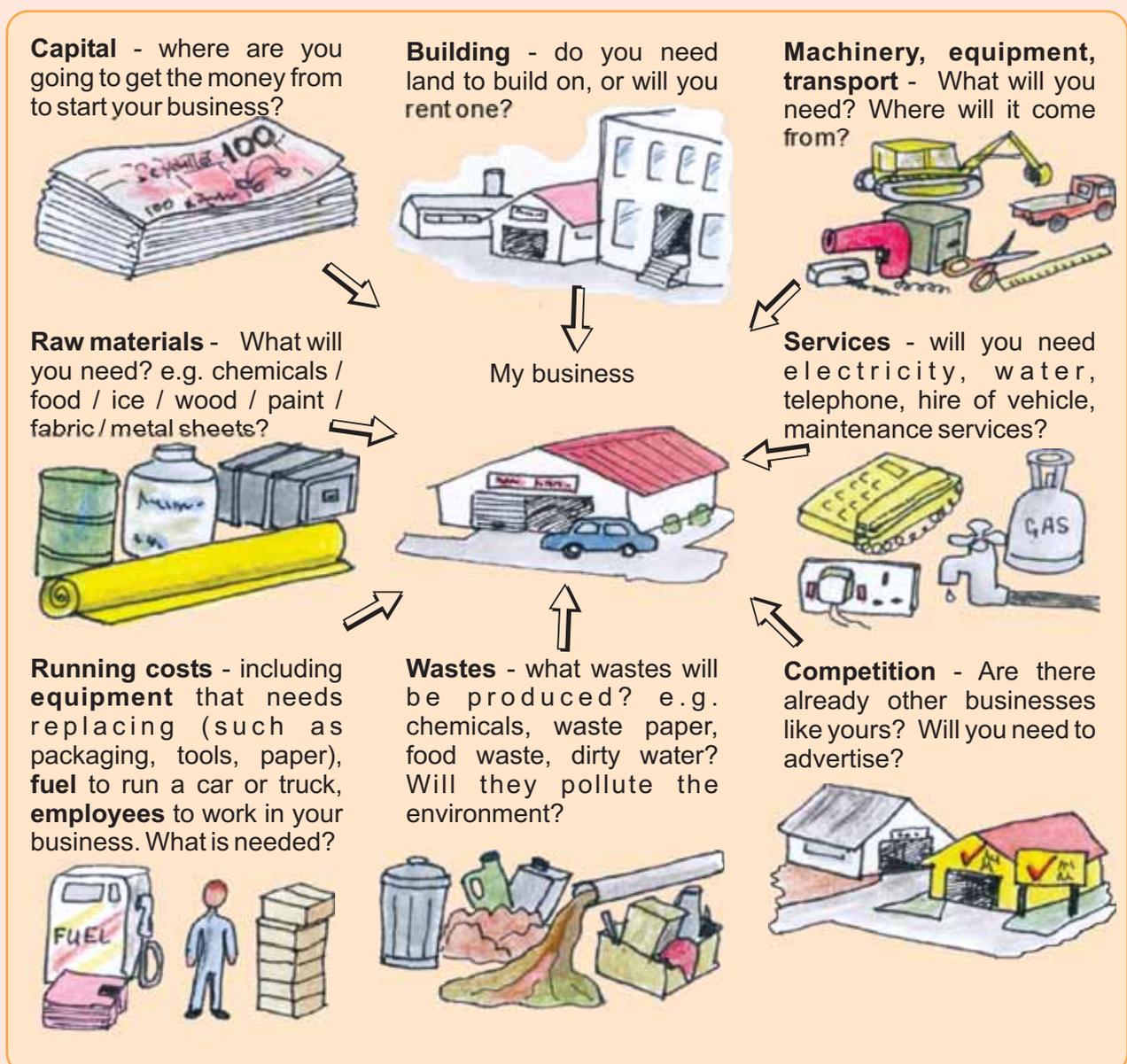
<p>1 START A large group of tourists arrive in Seychelles. All businesses + 3</p>	<p>2 Airline flies to a new country, bringing more tourists. Airline +2, All other businesses +1</p>	<p>3 Too many hotels built for the number of tourists arriving. Hotels -1</p>	<p>4 Outbreak of fish poisoning. Tourists eat more meat. Farmers + 1, Fishermen -1</p>	<p>5 Good weather. Happy tourists tell their friends to visit Seychelles. All businesses +1</p>
<p>10 ⊗ War in the Middle East, creating petrol shortages. All vehicle users (boats, buses, cars, planes) -1</p>	<p>9 Specialist group arrives with great interest in game fishing. Game fishing operators +2</p>	<p>8 ⊗ Cruise ship arrives with lots of tourists. Local tour operators, Craft makers, Car hire +1</p>	<p>7 Hotels become eco-friendly. This requires money investment. Hotels -1</p>	<p>6 Air crash in small plane. Tourists scared. Airline -1, Boat operators +2</p>
<p>11 New marketing programme for craft makers. Craft makers +1</p>	<p>12 Disease hits agricultural crops. Farmers -2 Restaurants and Hotels -1</p>	<p>13 Coral bleaching reduces reef biodiversity. Divers disappointed. Dive operators -1</p>	<p>14 ⊗ Drought leads to water shortages. All water users -1</p>	<p>15 Tourists really like upgraded eco-friendly hotels. Hotels +2</p>
<p>20 Mauritius is very competitive. Less tourists in Seychelles. All businesses -1</p>	<p>19 Very hot weather. Tourists thirsty! Soft drink/water industry +2 Restaurants and Hotels +1</p>	<p>18 ⊗ Group of eco-tourists arrive and want eco-tourism products. All eco-friendly businesses +2</p>	<p>17 Serious disease reaches Seychelles. Few tourists come. All businesses -2</p>	<p>16 ⊗ Creole Festival a great success with tourists. Hotels, Taxis, Restaurants and Craft makers +1</p>
<p>21 Some of business profits used to improve business. All businesses -1</p>	<p>22 ⊗ Oil spill in Seychelles waters. Fishermen and all boat users -1</p>	<p>23 Good year for farmers growing fruits and vegetables. Farmers +2</p>	<p>24 Seychelles becomes a more popular tourist destination. All businesses +1</p>	<p>25 Large group of scuba divers arrives. Dive operators +2</p>
<p>30 FINISH! Money invested in improving business brings success. All businesses +1</p>	<p>29 Fish Festival held. Fishermen +2 Restaurants +1</p>	<p>28 New cars imported to replace old ones. Taxi drivers, Car hire +2</p>	<p>27 Terrible storm hits Seychelles, resulting in much damage. All businesses -2</p>	<p>26 Better monitoring of boats allows fishermen to fish further afield. Fishermen +1</p>



2. Invent Your Own Business!

Work in pairs or in small groups.

- 1) First decide what kind of business you would like to set up, for example a bakery, a café, a car repair garage, a paint factory. Within the class as a whole, try to choose a variety of different kinds of businesses.
- 2) Write down things that you will need for your business (be inventive and creative!):
- 3) When you have prepared the details about your business, share the information with the rest of the class.
- 4) Re-read the section on environmental problems on page 126. Look at the business you invented. How environmentally friendly is your business? Is there anything you could do to make it more environmentally friendly?





CLIMATE CHANGE

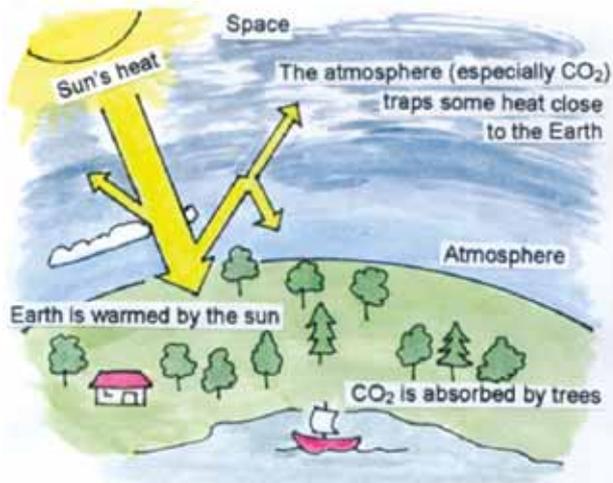
● What is the greenhouse effect?

● Will the weather change in Seychelles?

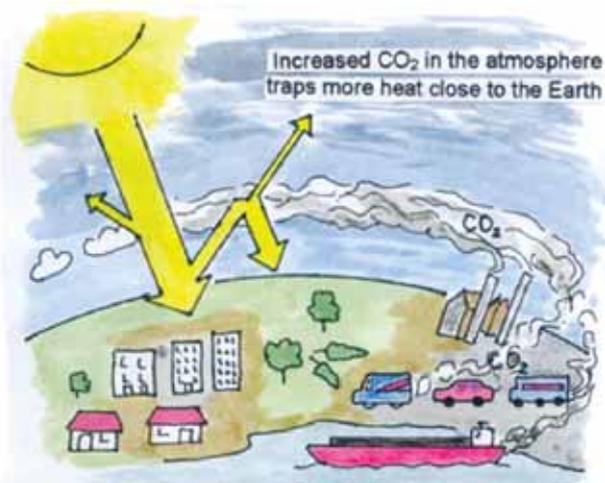
● Can we do anything to change the situation?

What Is Climate Change?

The Earth has warmed and cooled many times during its long history. Regulation of the Earth's temperature is very important for the maintenance of life. This regulation occurs mainly through the atmosphere (the "blanket" of gases such as oxygen and nitrogen that surrounds the Earth). The most important gas in the atmosphere for regulating temperature is carbon dioxide. Much of the sun's heat passes through the Earth's atmosphere and warms the planet. Some of the heat energy is trapped by carbon dioxide in the atmosphere. This trapped heat also warms the planet. This is known as the **greenhouse effect**:



The natural Greenhouse Effect makes life possible on Earth



Human activities increase the Greenhouse Effect, producing Global Warming

Human activities, particularly **industrialisation**, are responsible for increasing the amount of carbon dioxide and other greenhouse gases (see Box) in the atmosphere. These gases are increasing the greenhouse effect and making the Earth warmer. Even in 1898, Arrhenius, a Swedish scientist predicted that global temperatures would rise by 4-6 C. Scientists argued about the links between climate, greenhouse gases and industrialisation for years. It is now accepted that global warming and climate change are happening even more rapidly than scientists first thought. Even if we do something now, the amount of carbon

Greenhouse gases

These gases include:

Carbon dioxide - mainly produced by burning **fossil fuels**; it can be absorbed by plants, so forest removal means that less is absorbed from the atmosphere.

Methane - produced by some farming practices (e.g. rice cultivation and cattle rearing), coal mining, rotting waste.

Nitrous oxide - released during fuel and wood burning, and when using fertilisers.

CFCs - used in refrigerators, aerosols, air-conditioners, foam packaging; many countries have reduced the use of CFCs because they also damage the ozone level in the upper atmosphere.

Low-level ozone - this is formed when strong sunlight reacts with air pollution.



Industrialisation - the development of large-scale industries from the 18th century onwards.

Fossil fuels - coal, oil, natural gas.

CLIMATE CHANGE



dioxide will continue rising for some years because 95% of human energy use is obtained by burning fossil fuels. Global warming will cause climate change throughout the world. All countries will be affected.

Carbon dioxide given out (in grams per tonne-kilometre) by different forms of transport

Boat 30

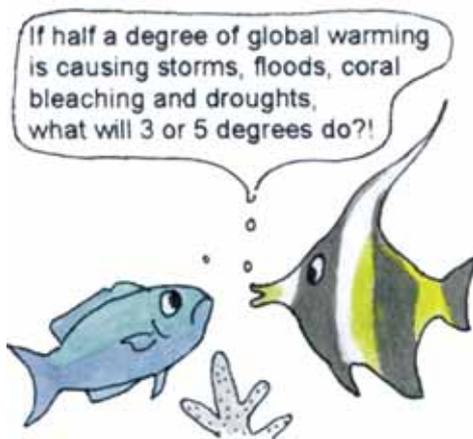
Rail 41

Road 207

Air 1,206

Look at the figures given above. Which form of transport pollutes the most? Should we go back to travelling by boat? What would be the advantages and disadvantages of doing this? What could this mean for our tourism industry?

What Effects Will Climate Change Have?



Climate change has an impact on all the other themes discussed in this book. In fact it may be the most important environmental problem facing us in the 21st century.

The effects of global climate change are already being experienced around the world. Storms are becoming more frequent, with strong winds and heavy rain. Rainy seasons have become less predictable. Extreme temperatures have become more common. The results can be disastrous - houses and farmland flooded, bridges washed away, mudslides covering roads and villages; longer droughts, water shortages, failed harvests; people dying from cold or heat stress.

What happens to the weather in one part of the world affects the weather in other parts because the atmosphere is shared by all.

a. Changes in the weather

Air temperatures are increasing and so are sea temperatures, even though they vary from place to place and year to year. Our weather depends on the interactions between the atmosphere, the land masses and the oceans. The processes which give rise to weather are very complex, so it is difficult for scientists to predict exactly what will happen and how fast it will happen. In Seychelles there is always some natural variation in our weather from one year to the next. We have two distinct seasons. From November to March there is the North West monsoon wind, which is warm and moist. It normally brings heavy rain. From May to September the South East trade wind blows. There is less moisture in the air and usually there is relatively lighter rainfall.

Is this fair?

Only countries with many large industries, such as USA and Japan, produce large quantities of the main green-house gases (the average American produces 19.53 tonnes per year, compared with 0.81 tonnes per year for an Indian).



But all countries will be affected by climate change. The effects will be especially serious for low-lying small island states such as Tuvalu and the Maldives, and for low-lying areas of developing countries such as Bangladesh. Smaller countries and poorer countries will find it difficult to deal with the consequences. Seychelles is luckier than several island states because it has at least some higher land, even if the total land area is small.



CLIMATE CHANGE

In Seychelles we experienced an extreme weather event in August 1997, when there were four days of torrential rain (almost 700mm fell in that month, compared with an average of 107mm for August). It caused landslides, flooding, loss of crops, damage to buildings and erosion of beaches. Why did it happen? It was related to a cycle of weather patterns called El Niño Southern Oscillation (ENSO), with El Niño representing one extreme and La Niña the other extreme. The cycle used to occur every 60 to 70 years; now it occurs every 3 or 4 years. This could also result in increasing drought for Seychelles. Another extreme weather event was the violent storm that affected Praslin and Cousin island in 2002.

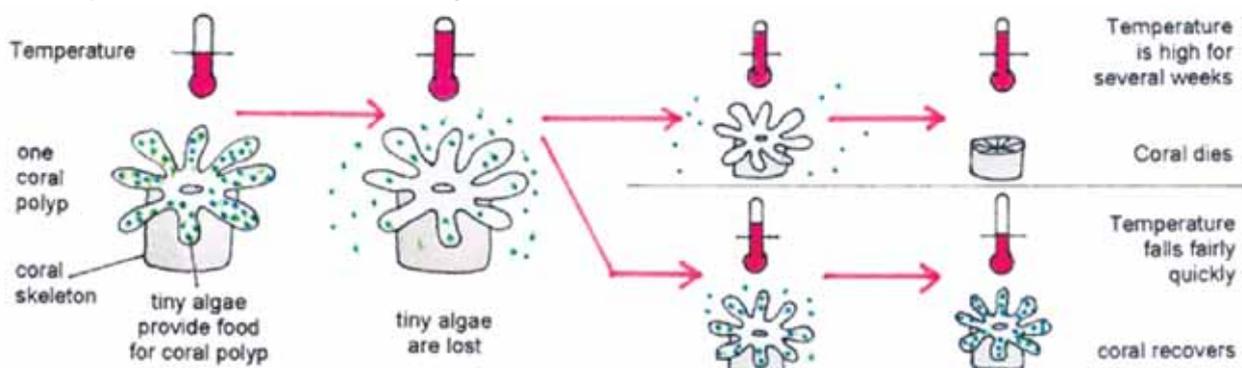


Damage on Cousin Island 2002

b. Sea-level rise

Higher global temperatures cause ocean water to warm, so it expands. The polar icecaps and glaciers are also melting faster. As a result the sea level is rising. In November 1997 there were abnormally high tides in Seychelles, which resulted in sand being left on coastal roads and sea water flooding low-lying land and freshwater marshes. Sea level has already risen by 10 to 25cm in the last hundred years. It could rise another 50cm or more by 2100. The increase will vary from one part of the world to another.

In 1997 and 1998, the ENSO weather cycle (see above) resulted in higher sea temperatures than normal in many tropical regions of the world. In Seychelles the sea temperature rose to 32 C or more. Corals are very sensitive to high temperatures, and almost 100% of the corals suffered from “coral bleaching” (see below). Between 50% and 85% of corals actually died. When corals die they often get covered by algae (seaweed). The result is a change in the biodiversity (variety of plants and animals) on the coral reef. Although there was some recovery, another high-temperature event in 2003 set back this process. So, long-term recovery is very uncertain. Will we lose our reefs? What will be the impact on the tourism industry and fisheries?



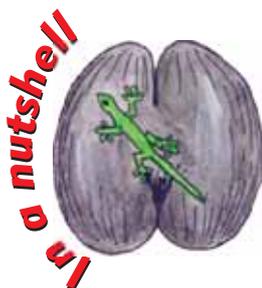


c. Changes in biodiversity

Climate change is happening faster than people first thought. Endemic plants and animals may not be able to adapt to climate change fast enough and perhaps some will not survive. More aggressive introduced species may be able to adapt better. It is difficult to predict exactly what will happen but all natural habitats are at risk. Corals have already been affected by high sea temperatures. Will corals (and mangroves and seagrasses) be able to cope with rising sea levels as well?

What Can Be Done?

Climate change is a global problem and only global action can solve the problem. International agreements on carbon dioxide levels and other emissions are vital. The countries that are producing the most emissions must put limits on them. But ordinary people are also realising that energy-wasting lifestyles are unsustainable and will harm the whole world. Every small action can help, so play your part!



- Climate change results from increased quantities of carbon dioxide and certain other gases in the atmosphere.
- Human activities are responsible for these increases.
- Climate change is producing extreme weather events, rising sea levels and will cause alterations to biodiversity.
- Climate change appears to be the major environmental problem currently facing the world. It affects all of us.



CLIMATE CHANGE

Learning Outcomes

Curriculum Areas - Science, Geography, PSE, English, Art

Knowledge and Skills

Understand about climate change and its impacts; share ideas and plan actions; consider the outcomes of climate change and describe/picture them.

Attitudes and Values

Be aware of our responsibility to reduce the causes of climate change; enjoy and learn from educational games.

Activities

The Greenhouse Game

This game demonstrates the greenhouse effect by showing how carbon dioxide in the atmosphere traps some of the sun's heat, insulates the Earth and allows life to survive. It also shows what happens when human actions affect the concentration of greenhouse gases in the atmosphere.

Note for Teacher: Allow about 20 minutes for the game and explanations. Materials you need are: An open area, two pieces of string (30cm and 230cm), chalk, a small bag with "What are Humans doing?" written on it, Human Action cards (see samples on page 139).

Preparation: Draw a 60cm circle on the ground by holding one end of the 30cm string in one place and using chalk attached to the other end to make the circle. This circle represents the Earth. Draw a larger circle (about 460cm diameter) around it using the longer string. This circle represents the Earth's atmosphere.

The Game is played in several rounds.

Round 1: Two students are CO₂ molecules and stand anywhere in the "atmosphere" (see illustration on page 139). They must not move their feet during the game. **The other students are the sun's rays.** They must try to reach the "Earth" (to touch it with a hand or foot) and then escape through the atmosphere without being touched by a CO₂ molecule. Rays that are touched by a CO₂ molecule must stay standing still in the "atmosphere". Rays must only try to reach Earth once. Each round takes about 30 seconds.

Rays that have escaped into space then make a circle around the atmosphere.

Interpretation:

How many rays have been trapped in the atmosphere by CO₂ molecules? This represents the amount of heat energy from the sun that has been trapped in the atmosphere, which is called the greenhouse effect. Discuss how this affects the temperature of Earth. Remember that a certain amount of CO₂ is required to keep the planet warm enough to support life.

Round 2: What happens if the amount of CO₂ in the atmosphere is increased? First of all remove any sun's rays that were trapped in Round 1. Take a Human Action card out of the bag (which contains only actions which **add** CO₂). Read the card. Add the appropriate number of CO₂ molecules to the two that are already in the atmosphere. Play the game again. Discuss what happens.



Round 3 and following Rounds: Repeat the game, picking a Human Action card out of the bag, which now contains all of the cards, so the number of CO₂ molecules can go up even more, or go down.

Interpretation:

The game should illustrate that when the amount of CO₂ increases, more of the sun's heat energy gets trapped, and the temperature of the Earth goes up. Burning fossil fuels is one of the main ways humans increase the amount of CO₂ in the atmosphere. When human actions reduce the amount of CO₂ in the atmosphere, the greenhouse effect is less strong. Reference can be made to the Energy and Land Transport themes in this book.



Further activities and actions

■ **Draw a world map:**

- Show the main areas where there are developed (or industrial) countries.
- Show the main areas where there are developing countries.
- Research climate-related disasters (e.g. flood, drought, unusual storm, coral bleaching, extreme temperature), by asking people what they remember from the news, using newspaper cuttings, and/or using the internet.
- Mark some of the countries which have suffered from climate-related disasters.
- Write a paragraph about the effects of one of these disasters, describing what happened to the people in that country and how the environment was affected.

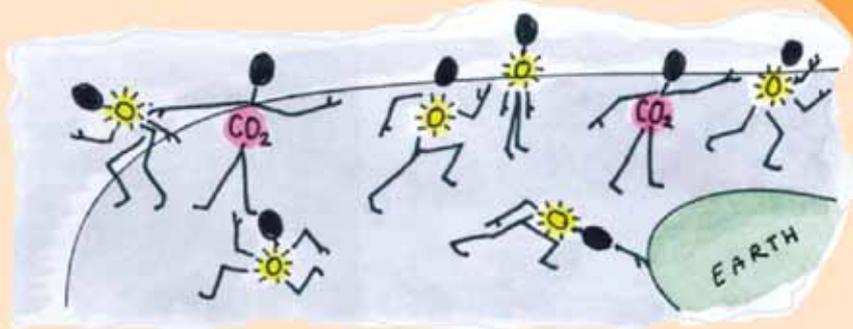
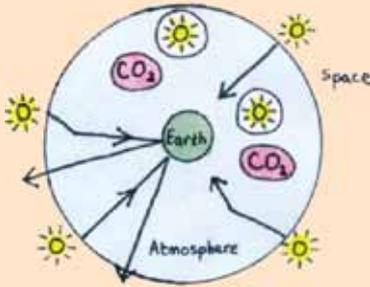
- **Be creative!** Climate change is a bit scary because we do not know exactly how it will affect us. Think about the possible consequences in your own community. Then write a story, a poem or a short play; draw a cartoon or paint a picture; or make a model, about the possible effects of climate change on your community.

- **Write a letter!** Find the address of a large industrial company, or an important politician or Minister in an industrial country. Write a letter describing the likely effects of climate change in Seychelles (you could include a story or poem or picture from the activity above). Ask them what they are doing to prevent global warming. Ask them if they are doing anything to help small countries to cope with the consequences of climate change. Make sure you ask for a reply! Note that there are also special forms available on some internet sites, which allow you to send your comments directly via the internet.





CLIMATE CHANGE



Humans drive cars

Every litre of fuel puts 2.35kg of CO₂ into the atmosphere. There are at least 500 million cars in the world.

(Add two CO₂ molecules)



Humans travel in aeroplanes

Aeroplanes produce more CO₂ than cars. More and more people travel by aeroplane.

(Add two CO₂ molecules)



Humans cut down trees

Trees remove CO₂ from the atmosphere during photosynthesis. Fewer trees means more CO₂.

(Add four CO₂ molecules)



Humans burn rubbish

Burning waste puts CO₂ into the atmosphere, along with other pollutants.

(Add two CO₂ molecules)



Humans recycle glass, metal, paper, etc.

Recycling saves energy, reducing our use of fossil fuels. This means less CO₂ in the atmosphere.

(Remove two CO₂ molecules)



Humans plant trees

Trees remove CO₂ from the atmosphere during photosynthesis. More trees means less CO₂.

(Remove four CO₂ molecules)



Humans create energy-efficient technology

If energy is used more efficiently, less CO₂ is released into the atmosphere.

(Remove four CO₂ molecules)



Humans travel by bus not car

A full bus is more efficient than a car with one or two people in it. This means less CO₂ in the atmosphere.

(Remove two CO₂ molecules)



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AN INSIGHT INTO THE MARINE LIFE OF SEYCHELLES Nirmal Shah, Michele Martin, Colleen Morel, Nature Seychelles.

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ABOUT NATURE SEYCHELLES

Nature Seychelles, formerly known as BirdLife Seychelles, is a local not-for-profit association founded in 1998 whose aim is to keep working for an environment rich in biodiversity by improving the conservation of local species. We manage Cousin Island Special Reserve and work with several island partners. Our activities include species and habit conservation, monitoring, research, eco-tourism, education and awareness and advocacy.

We publish many different types of publications including the biannual magazine, Zwazo. We maintain a permanent staff of biologists, economist, environmental educators and project specialists.

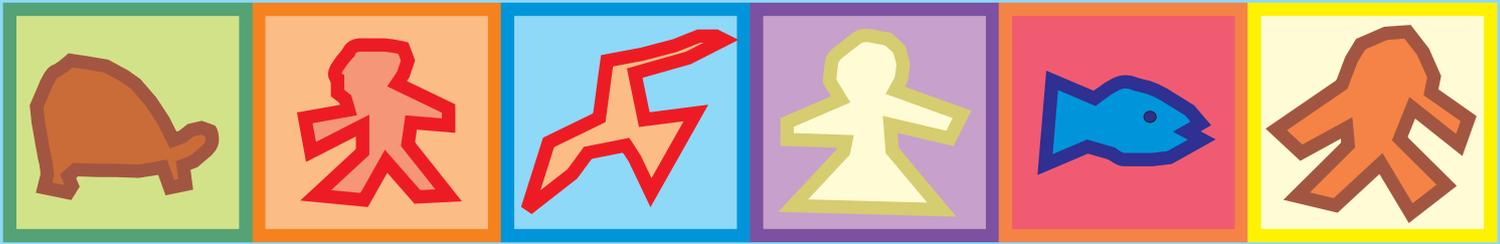
We belong to the growing BirdLife International network, with many overseas and local partners such as RSPB, WWF, Mauritius Wildlife Foundation and Wildlife Clubs of Seychelles.

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Learning for Sustainable Living in Seychelles

This publication has been developed to provide support materials and activities that assist in understanding the concept of Sustainable Living. It has been developed after a series of workshops with teachers, and in consultation with other professionals. It has been designed for lower secondary students and can be adapted for younger and older age groups.

Both the language and style used are simple and easily accessible to parents and teachers wishing to help youngsters in using the resource. The information and activities included here are not prescriptive and can be adapted to meet different needs.

The aim of this book is to make each one of us review our lifestyle and behaviour so that we can then evaluate our impact on the environment and initiate appropriate environmental action.