

SOCIAL SCIENCE

GRADE 7

STRAND 1

ENVIRONMENT AND RESOURCES

- | | |
|----------------------|---|
| SUB-STRAND 1: | THE PHYSICAL ENVIRONMENT |
| SUB-STRAND 2: | THE HUMAN ENVIRONMENT |
| SUB-STRAND 3: | IMPACTS OF RESOURCE USE |
| SUB-STRAND 4: | SUSTAINABLE PRACTICES |
| SUB-STRAND 5: | HAZARDOUS NATURAL EVENTS
(NATURAL DISASTERS) |

ACKNOWLEDGEMENT

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DIANA TEIT AKIS
PRINCIPAL

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SECRETARY'S MESSAGE

Achieving a better future by individual students and their families, communities or the nation as a whole, depends on the kind of curriculum and the way it is delivered.

This course is part and parcel of the new reformed curriculum. The learning outcomes are student-centred with demonstrations and activities that can be assessed.

It maintains the rationale, goals, aims and principles of the national curriculum and identifies the knowledge, skills, attitudes and values that students should achieve.

This is a provision by Flexible, Open and Distance Education as an alternative pathway of formal education.

The course promotes Papua New Guinea values and beliefs which are found in our Constitution and Government Policies. It is developed in line with the National Education Plans and addresses an increase in the number of school leavers as a result of lack of access to secondary and higher educational institutions.

Flexible, Open and Distance Education curriculum is guided by the Department of Education's Mission which is fivefold:

- To facilitate and promote the integral development of every individual
- To develop and encourage an education system that satisfies the requirements of Papua New Guinea and its people
- To establish, preserve and improve standards of education throughout Papua New Guinea
- To make the benefits of such education available as widely as possible to all of the people
- To make the education accessible to the poor and physically, mentally and socially handicapped as well as to those who are educationally disadvantaged.

The college is enhanced through this course to provide alternative and comparable pathways for students and adults to complete their education through a one system, two pathways and same outcomes.

It is our vision that Papua New Guineans' harness all appropriate and affordable technologies to pursue this program.

I commend all the teachers, curriculum writers and instructional designers who have contributed towards the development of this course.



DR. UKE KOMBRA
Secretary for Education

COURSE INTRODUCTION



Dear Student,

Welcome to the Grade 7 Social Science Course. This course is based on the Education Department's Outcome Based Upper Primary Social Science Syllabus. However, you will be doing this course by correspondence at your own time at your home.

Before we look at what you will study in this course, you must remember what you studied in Grade 6 Social Science. The strands you studied in Grade 6 are the same as in Grades 7 and 8. However, Grade 6 has a local community focus, Grade 7 a national focus and Grade 8 an international focus. The learning outcomes are student-centered and written in terms that enable them to be demonstrated, assessed or measured. The outcomes are written to show progression from one grade to another. In this case, from Grades 6 to 7. Therefore, some ideas, topics and concepts you will see in this course will be familiar.

In the Grade 7 Social Science Course, the learning outcomes and indicators are organised in four strands.

- 1. Environment And Resources**
- 2. Organisation**
- 3. Culture**
- 4. Skills**
- 5. Project 1: A Case Study Of Fiji**
- 6. Project 3: HIV/AIDS In PNG**

Each strand is divided into sub-strands and each consists of Lessons, Summaries, Practice Exercises and Answers. At the end of each lesson, you are expected to do the practice exercises. The answers to each practice exercise are found at the end of each sub-strand. You must correct your own answers. A test is given for each sub-strand in the Assignment Booklet.

There are three Assignments and three Project Assignments giving a total of six. You will find each assignment after each strand you study. You must do these assignments. Before working on them, you must revise all the lessons. Remember to check all your assignments before you send them in for marking. The Assignment marks will be added together with your final external examination marks. This will give you a final mark and grade.

There will be an examination after you have completed this course. You will do the examination only after all your Assignments have been marked and returned to you in preparation for your final examination.

We hope you will find this course interesting and challenging.

All the best in your studies.

Your Teacher

Course Materials

Your course consists of two parts:

Part A:	Strand 1	Assignment 1
	Strand 2	Assignment 2
	Strand 3	Assignment 3
	Strand 4	Assignment 4

You must complete Part A before Part B is sent to you.

Part B materials are as follows:

Part B:	Project 1	Assignment 5
	Project 2	Assignment 6

After the completion of these Strands, Projects and Assignments, an Examination notice will be sent to you. This notice will be communicated to you by your Provincial FODE Coordinator in your Province

STRAND 1 INTRODUCTION



Dear Student,

Welcome to Strand 1 of the Grade 7 Social Science Course. In this Strand, you will study following the **Study Guide**. This is the first Strand in the Grade 7 Upper Primary Syllabus. All topics have been included, but specially modified to suit your study at home.

There are five Sub-strands in this strand.

In Sub-strand 1- **The Physical Environment**, you will learn about the natural environments, their elements, their processes and some mapping skills.

In Sub-strand 2 - **Human Environment**, you will learn about man-made environments such as settlements and settlement patterns, population density; urbanisation and resource industries in Papua New Guinea. You will look at how man influences and changes the natural environment.

In Sub-strand 3 - **Impacts of Resource Use**, you will learn about the impact of resource use on the human (man-made) and physical (natural) environments. You will learn about the good and bad effects of developing natural resources and the importance of using resources wisely. You will also be doing a short case study on Ok Tedi mine.

In Sub-strand 4 - **Sustainable Practices**, you will learn about the good environmental practices and how to conserve our natural resources.

In Sub-strand 5 - **Hazardous Natural Events**, you will learn about natural hazardous events or disasters that affect PNG. You will also identify ways to respond to these hazards.

The lessons in each strand have reading materials and **Practice Exercises** at the end. You must study each lesson and work through the Practice Exercises. When you complete a Sub-strand, do the Sub-strand **test** in the **Assignment Booklet**. Repeat the same process until you finish the Strand. The answers to the practice exercises are at the end of each sub-strand. You will need to correct the Practice Exercises yourself.

The lessons in each strand are written in simple language. If you have any problems understanding the lessons, please talk to your Provincial FODE Coordinator or write to us.

We hope that you will enjoy studying this Strand.

We wish you all the best in your study!

STUDY GUIDE

Follow the steps given below and work through the lessons.

- Step 1** Start with Sub-strand 1, Lesson 1 and work through it in that order.
- Step 2** When you complete Lesson 1, you must do Practice Exercise 1.
- Step 3** After you have completed the Practice Exercises, you must correct your work. The answers are given at the end of each sub-strand.
- Step 4** Then, revise well and correct your mistakes, if any.
- Step 5** When you have completed all these steps, tick the check- box for Lesson 1 on the content page, like this:

☒ Lesson 1: Physical Features

Then, go on to the next lesson. Repeat the process, till you complete all the lessons in a sub-strand.

As you complete each lesson, tick the box for that lesson on the contents page, like this ☒ . This will help you check your progress.

Assignment: Sub-strand Test and Strand Test

When you have completed all the lessons in a Sub-strand, do the Sub-strand test for that Sub-strand in your Assignment Book. The Course Book (Strand 1) tells you when to do this.

Marking

The Sub-strand Tests in each **Assignment** will be marked by your **Distance Teacher**. The marks you score in each assignment will count towards the final result. If you score less than 50%, you will repeat that Assignment.

Remember, if you score less than 50% in three Assignments, your enrolment will be cancelled. So, do your work carefully and make sure that you pass all Assignments.

ALL THE BEST

SUB-STRAND 1

THE PHYSICAL ENVIRONMENT

In This Sub-strand You Will Learn About:

- **The Physical Features**
- **Physical Environmental Processes**
- **Landforms**
- **Map Reference**
- **Weather and Climate**
- **What Makes Climate Different?**
- **Climatic Graphs**
- **Vegetation in Papua New Guinea**

SUB-STRAND 1: INTRODUCTION

In this Sub-strand you will learn about the physical or the natural environment, and its key features. You will also identify the processes that have shaped them and their landforms and characteristics.

The **physical environment**, includes all living and non-living things occurring naturally on earth. There are different elements or features that make up the natural environment. The main features are:

- land masses and oceans, their location, shape and size
- major landforms such as mountains, plateaus and plains
- river systems and lakes
- climatic factors like air pressure, temperature, rainfall, wind patterns and
- global patterns of vegetation

The natural environment can be compared with the **built-up environment**, which is made up of the areas and parts that are strongly influenced by humans. The built environment is sometimes referred to as the human, cultural or the built-up environment. An area is regarded as a natural environment, if the human impact changes little or nothing.

Sometimes these natural features are shown on maps. Maps are pictures of the earth surface. In this sub-strand, you will be learning some skills to help you read and understand maps correctly.



Somburun Waterfall in Liap Village, Manus Province

Lesson 1: The Physical Features of the Environment



Welcome to the first lesson of Grade 7 Social Science Course. In Lesson 1, you will learn about the physical environment and its key features or elements.

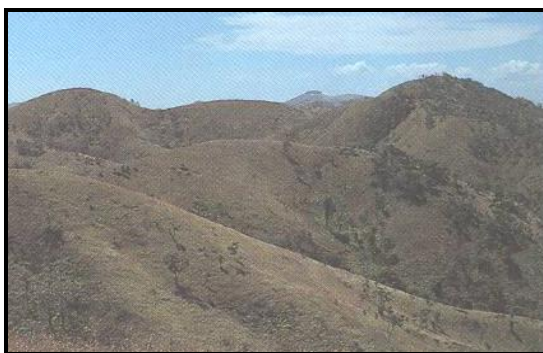


Your Aims

- define the physical environment
 - list the key physical features or elements of the physical environment
 - show the key physical features of Papua New Guinea on an outlined map
 - create your own symbols to be used as keys to understand the distribution of the key physical features
-

What is a Physical Environment?

First of all, we look at the meaning of environment. It is defined as all the things that surround us. Some parts of the environment are *physical* or *natural*, which means people did not make them. For example, the hills around Port Moresby are not made by man. Other parts are influenced by people, even if they appear to be natural. For example, grasslands appear after trees are cut down for gardening. Still other parts of the environment are totally made by man, for example, roads and houses. In the photographs below, you will see some examples of natural environment in Papua New Guinea.



Hills around Port Moresby



Plateaus in Milne By



Swamp areas near the Sepik River

The NATURAL ENVIRONMENT refers to the part of the environment that is not touched or influenced by man.

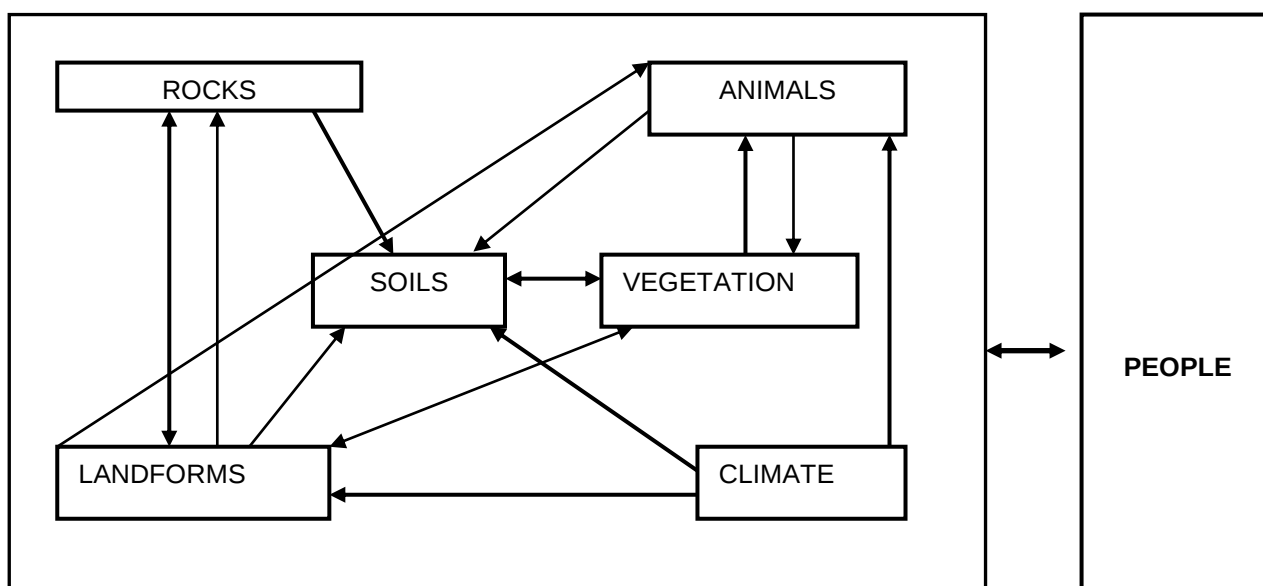
Here are some key factors or parts of the natural environment:

- | | |
|---------------|------------|
| 1. Landforms | 5. Rivers |
| 2. Climate | 6. Oceans |
| 3. Soils | 7. Animals |
| 4. Vegetation | 8. Rocks |

The different parts of the environment are **interdependent**. This means their existence depend on each other. When one part of the environment is affected or changed, it changes or affects the other. In most cases, the effects are negative or bad. For example, cutting down of trees can result in soil erosion. Trees help increase water vapour in the atmosphere to maintain wet seasons. When trees are cut down, the period of dry season becomes longer because water vapour that is usually given off by trees is reduced. Animals are affected because trees (their homes) are destroyed. They may also go hungry and die because they get their food from the trees.

Let us now study the flow diagram below. It shows the relationships between each of these parts of the natural environment.

The different Parts of the Natural Environment



Here is a table of *keys* or *legends* that you can use to interpret the flow diagram.

ARROW SYMBOL	WHAT IT STANDS FOR
$\longrightarrow$	A <u>big</u> and <u>one</u> way influence. One element is influencing another element in a big way
$\longleftrightarrow$	A <u>big</u> and <u>two</u> way influence. Two elements are influencing each other in a big way
$\rightarrow$	A <u>small</u> and <u>one</u> way influence. One element is influencing another element in a small way
$\leftrightarrow$	A <u>small</u> and <u>two</u> way influence. Two elements are influencing each other in a small way

The thickness of the arrow show the amount of influence each element has on the other. The thick arrow shows big influence while the thin arrow shows small influence of one element to another. A two way arrow means both elements influence each other. For example, if the arrow comes out of vegetation and points towards the animals, it means vegetation is influencing animals and not animals influencing vegetation. So you can see that all elements or features in the natural environment depend on each other.

Now have a look at the flow diagram on page 13 again. Study the relationships or links between vegetation, soil and climate. Many more questions can be asked. For example, where does the soil come from? What influences the soil?

Soil is formed when the rock beneath the ground breaks up because of the action of water, heat and chemicals. Now we can say that soils are influenced by climate (which provides water and heat). Animals like earthworms dig through the soil and expose it to air and create chemicals which change the soil. So animals influence soil. Vegetation also influences soil. For example, when grass die and rot, they produce soil. Therefore, the arrows in the diagram show both the *direction* and the *strength* of influence.

On the next page, you will be required to do a map activity of locating the main natural features of PNG. Before you do that, you need to know this information.

Remember these points before you do the activity on page 15

- Maps have special *signs* or *symbols*. They are used to reduce the number of words written on a map. These symbols show the location of key features such as mountains, rivers, towns, roads, railway lines and bridges. These symbols are usually drawn so they look like the things that they stand for.
- Different colours are often used with different symbols. The three commonly used colours are green, blue and brown. For example, mountains are brown; lakes are blue while forests are usually green.
- The meaning of the symbols that have been used on the map should always be explained in the *legend* or the *key*.

Below are examples of map symbols and their meanings.

SYMBOL	MEANING
	Lighthouse
	Airport
	Forest
	Mountain
	Walking track
	Fireplace
	Hospital
	Wreck
	Camping Area
	Railway

Now do this activity. You can correct your work by checking the answers at the end of the Summary.



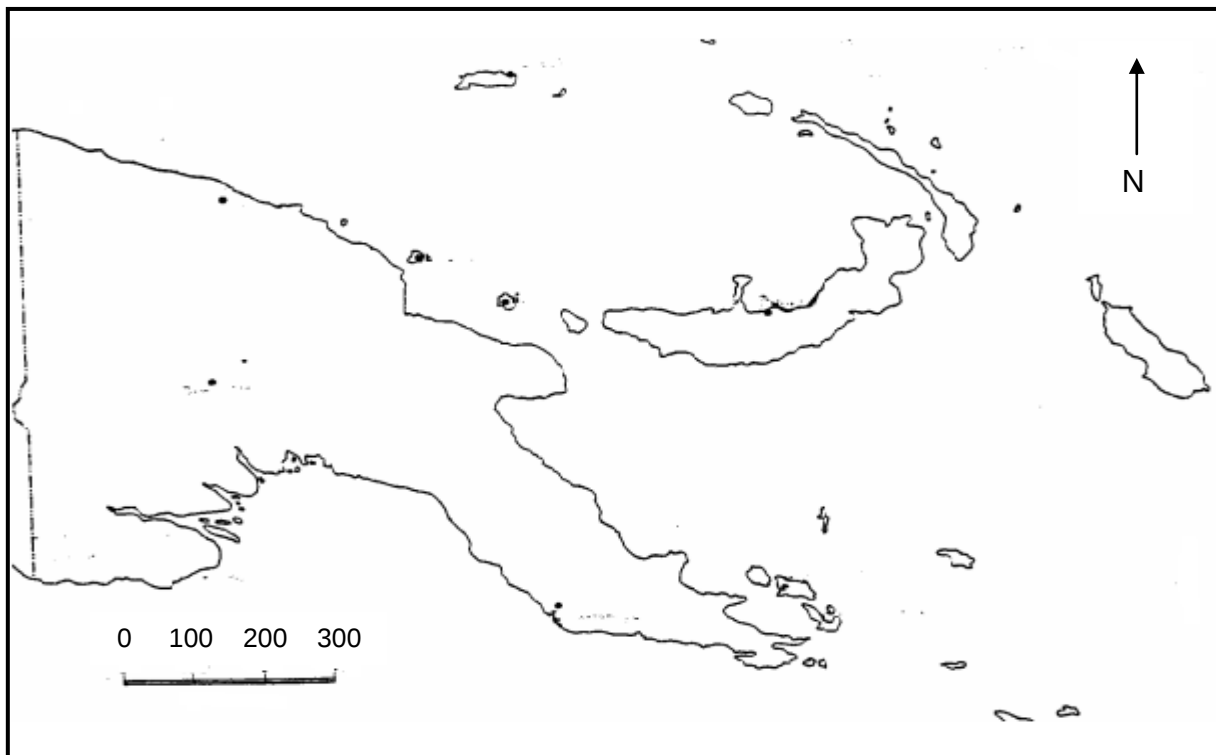
ACTIVITY 1

In the blank outlined map of Papua New Guinea below, you are required to shade and label the distribution of the following natural features: Central Mountain Ranges, the Sepik and Fly Rivers, major swamplands and the main volcanic areas in Papua New Guinea.

Create your own keys using different colours or patterns under the title *key* or *legend* below the map.

A *key* or *legend* is usually found on all maps. It is a list of the symbols and their meaning. The key or legend helps you to figure out what the dots, circles, colours, and lines on a map stand for.

MAP OF PAPUA NEW GUINEA



Key/Legend

☐	Central Mountain Ranges
☐	Sepik & Fly Rivers
☐	Main Swampland
☐	Volcanic Areas

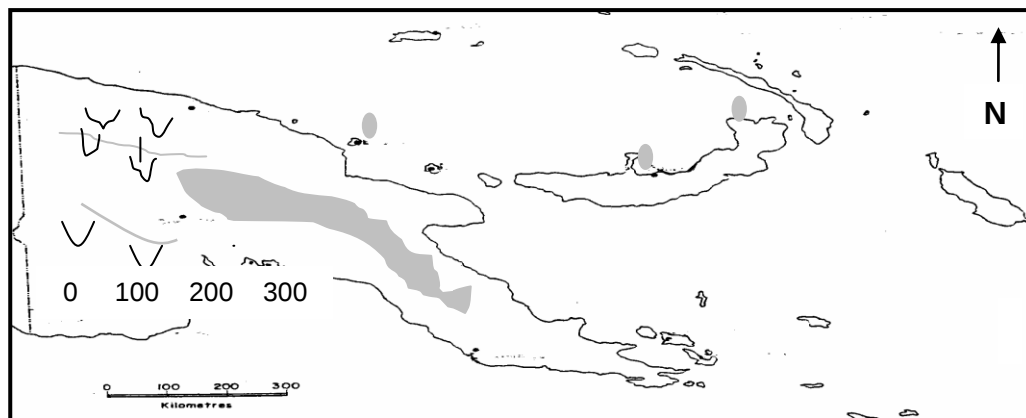


Summary

You have come to the end of lesson 1. In this lesson you have learnt that:

- The environment is everything that surrounds us
- The natural environment is also called the *physical environment*
- Papua New Guinea has many different types of natural features
- Natural features vary in different regions of Papua New Guinea depending on the processes that formed or shaped them
- Symbols are special signs on maps that show location of certain features
- The meaning of the symbols used on the map should always be explained in the legend or the key
- A map key or legend is a list of symbols that shows what they stand for, and it is usually found at the bottom of the map
- All the features or elements in the natural environment depend on each other
- A change in one element will affect the other elements, usually in a *negative* or *bad* way

ANSWERS TO ACTIVITY 1



Key/Legend

	Central Mountain Ranges
	Sepik & Fly Rivers
	Main Swampland
	Volcanic Areas

NOW DO PRACTICE EXERCISE 1 ON THE NEXT PAGE



Practice Exercise 1

1. What is another word for physical environment?

2. Define physical environment.

3. List the eight elements of the natural environment.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____
- (v) _____
- (vi) _____
- (vii) _____
- (viii) _____

4. Explain *one* way by which vegetation and soil influence each other.

5. What is a *key* or *legend* on a map?

6. List two examples of an environment that is influenced by man?

- (i) _____
- (ii) _____

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1
--

Lesson 2: Physical Environmental Processes



Welcome to Lesson 2. In the last lesson, you looked at the key physical features of the natural environment. In this lesson, you will study the processes that have formed these features.



Your Aims

- list the environmental processes that have formed the physical features
 - describe the atmospheric and biotic processes and explain how they affect the physical features of the environment
 - describe the land-forming processes and explain how they influence the physical features of the environment
-

We now take a look at the different physical environmental processes that have formed and shaped the physical features you studied in lesson 1. These environmental processes can be put into three groups:

1. **Atmospheric** – processes happening in the atmosphere (the air around the earth)
2. **Biotic** – the word biotic comes from the word 'bio' which means life. Therefore biotic refers to all living things.
3. **Land forming processes** - are processes that build and shape physical features of the environment. For example; volcanic eruption, tectonic plate movements, weathering and erosion.

Atmospheric Processes

Every time you breathe in, you are inhaling oxygen from the earth's atmosphere. The earth's atmosphere is made up of mainly nitrogen, oxygen and carbon dioxide gasses. It is the air all around you. Other planets also have an atmosphere too. The atmosphere of the earth is a layer of gases surrounding it and is supported by the earth's gravity.

The sun is the source of all energy on earth. Not all parts of the earth receive the same amount of heating by the sun. High pressure and low pressure take place as a result of different heating of the earth. Warm air is lighter and is usually at low pressure. Warm air rises and often brings rain if it cools high up in the atmosphere. Cold air is heavier at high pressure. It brings dry conditions to the areas where it sinks. Air flows from **high pressure** areas to **low pressure** areas. This moving air is called **wind**.

These factors in turn influence the weather and climate of a place. You will learn more about climate and weather later on in your lessons.



Atmospheric processes involve the air around our planet earth!

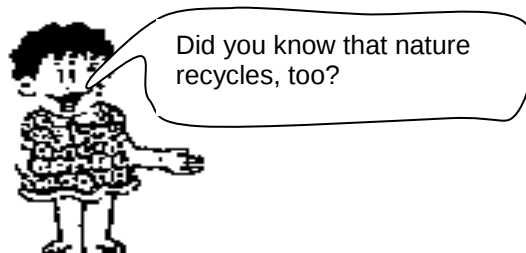
The atmosphere plays an important role in shaping the physical environment and in controlling activities in the human environment. Atmospheric processes help us to understand extreme events such as drought, long periods of rainfall and cyclones. These processes affect the landforms, vegetation, plants and animals, rivers and oceans, the water circulation processes and also man's way of life.

Papua New Guinea is located within the tropical region. This means, Papua New Guinea receives a lot of heat and rainfall throughout the year. The distribution of the major vegetation types is also influenced by the changes in heat and rainfall. For example, elephant grass (kunai) and mosses are common up in the highlands where the climate is generally cool.

The Water Cycle

What is water cycle?

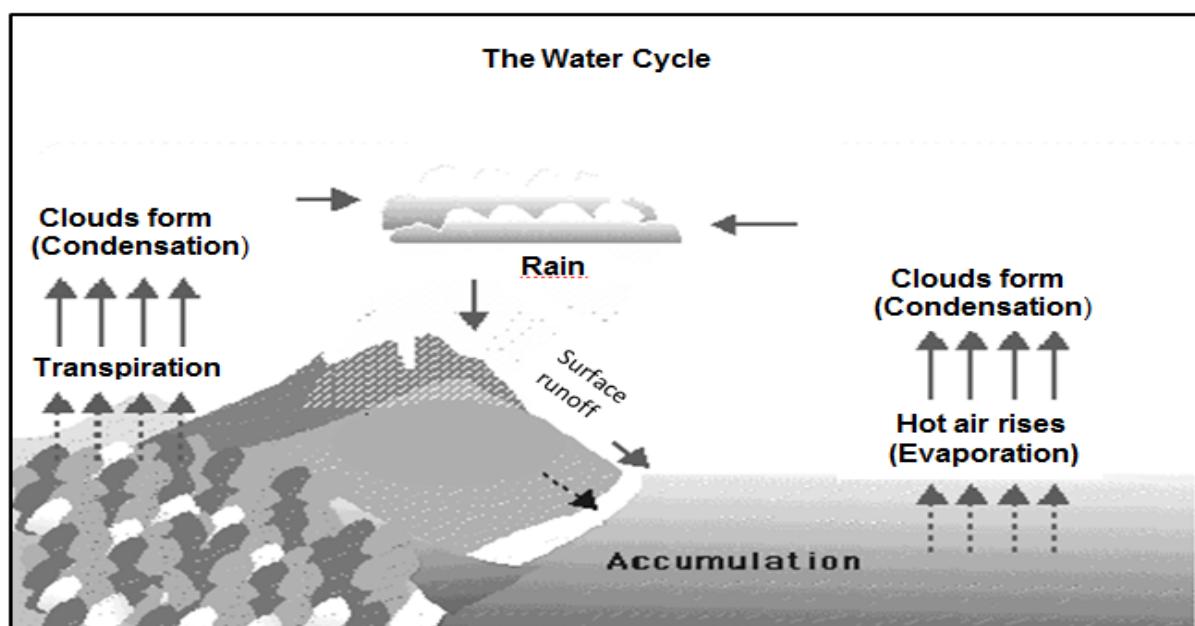
The natural recycling process for water.



In this recycle process; water is circulated to all parts of the earth. The rivers, seas, vegetation and the land all receive water depending on where they are located.

The Sun's heat provides energy to *evaporate* water from the water bodies such as oceans, lakes and rivers. The water vapour eventually *condenses* or cools down, forming tiny droplets of liquid water in clouds which then falls down as rain, and water returns to the land or sea. Some of the precipitation soaks or sink into the ground by *infiltration*. Some of the water is trapped between rock or clay layers; this is called *groundwater*. But most of the water flows downhill as *runoff* (above ground or underground), eventually returning to the seas as slightly salty water. Plants also lose water to the air by transpiration process.

Now have a look at the diagram below. It shows how water is circulated on earth.



Here are the **six** important processes that make up the water cycle.

1. **Condensation** - Condensation happen when water vapour in gas form is changed into water. It is the opposite of evaporation.
2. **Infiltration** - The process where rain water sink into the ground.
3. **Runoff** – The water that runs on the surface of the land, and flows down hill into streams, rivers, ponds and lakes.
4. **Evaporation** - The process where the sun heats-up water causing the water to turn into water vapour.
5. **Precipitation** - The small droplets of water in clouds form larger droplets that result in precipitation. The common type of precipitation is rainfall.
6. **Transpiration** – The process of evaporation from plants. This happens when plants take in water from the soil through their roots and lose water from their leaves.

Biotic Processes

An **ecosystem** is all the *living* and *non-living* things in a certain area. All the plants and animals, including the very small animals that live in the soil, are living parts of an ecosystem.

Air, water, sunlight and rocks are *non-living* parts of an ecosystem. The sun provides the warmth and light that helps all living things to grow.



Remember this; **Biotic** is to do with living things or plants and animals.

Ecosystems are smaller parts of all the living environments on earth. All the living environment on earth is called the **biosphere**. The biosphere is made up of different types of environment. Environment such as grassland, deserts, coniferous forests, deciduous forests and tropical rain forests. River environment, swamp and mountain environment and all the other types of environment have their own ecosystems. Ecosystems can be found on land, in the forests, inside rivers and seas and swamps.

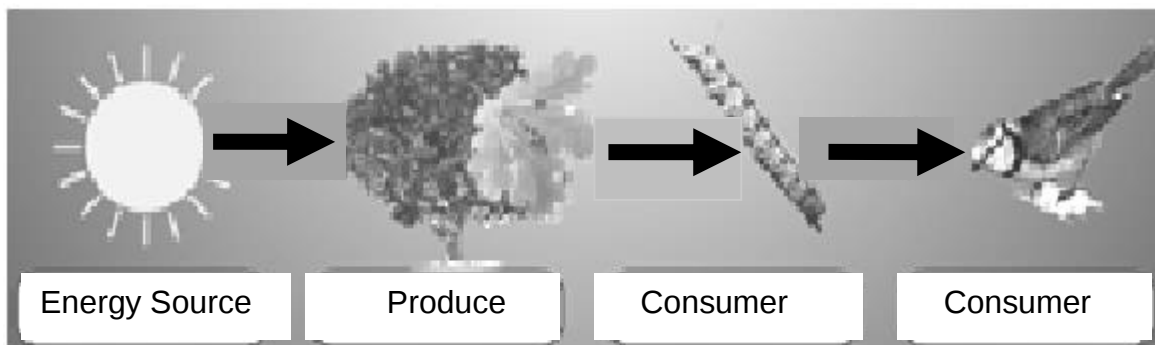
Why Do Ecosystems Need Parts to Operate Smoothly?

Green plants such as trees and grasses make their own food by using sunlight from the sun through the process of *photosynthesis*. They use non-living nutrients in the soil and water, energy from sunlight, and carbon dioxide to make their food. Hence, plants are called **producers**. Animals eat plants while other animals eat the plant-eating animals. They are therefore called **consumers**. When a living thing eventually dies, it is eaten by bacteria. These bacteria are **decomposers** because they get their energy from dead plants and animals.

Therefore, all things in an ecosystem are connected with one another through food and the flow of energy through the food chain system. When living things are eaten by other living things, the energy is passed along from one to another. This flow of energy is called a **food chain**. Food chains show the feeding relationship among living things. When two or more food chains are combined they form a **food web**.

You can see the Food Chain below as shown by a simple flow diagram.

E.g. **Sun → grass → caterpillar → kookaburra → bacteria.**



Animals such as rabbits, cows and sheep eat only plants and are called **herbivores**. Others like bears and hawks eat other animals and are called **carnivores**. The very small organisms such as bacteria help breakdown dead plant and animals. They are called **decomposers**.

Some animals that are high up on the food chain can kill larger animals. The photograph shows a pride of lionesses eating a buffalo they had hunted down at a game park in Kenya.



Lionesses feeding on a buffalo

Let us look at the third group of environmental processes that shape the natural features you studied earlier.

Land-forming Processes

Land-forming processes either build up or reduce the landforms on the earth surface. They are also called *geomorphic*



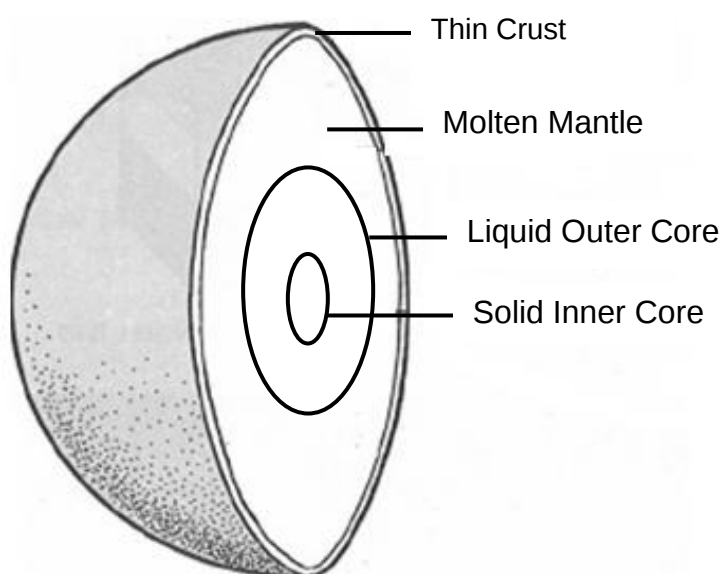
Now try to stand very still. You may think you are not moving, but the ground may be moving ever so slowly under your feet.



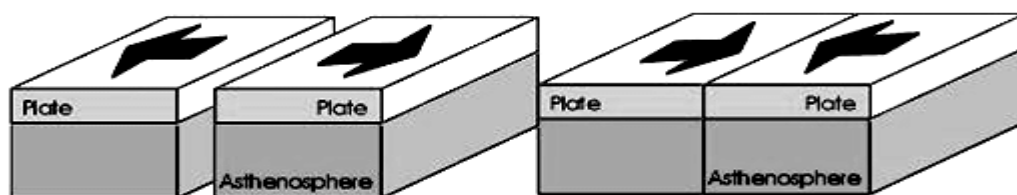
The Earth's Layered Structure

The ground you are standing on is part of the earth's crust. The **crust** is the surface or outer part of the earth.

The layer of rock below the crust is the **mantle**. It is the thickest layer made mainly of hot molten rocks. The **core** is the inner most layer of the earth. It is made up of the liquid outer core and the solid inner core.

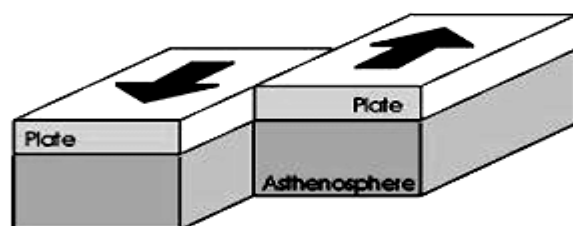


Types of Plate Movements/Boundaries



Move apart

Collide



Slide past

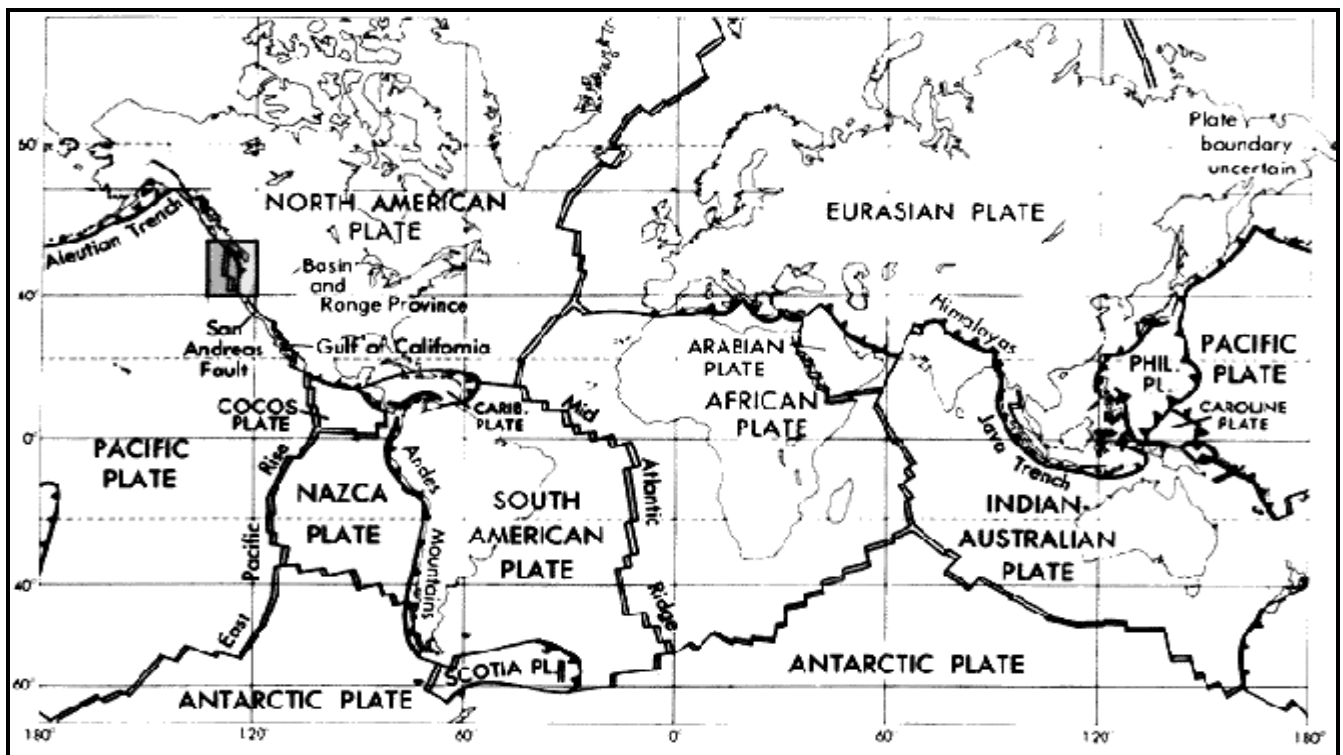
Is the Earth's Crust Moving?

Yes, scientists think that the earth's surface is divided into different parts or pieces that are always moving. The many different pieces of rock are called **tectonic plates**. The idea that pieces of the earth's crust move is called the '**Theory of Plate Tectonics**'. The plates move very slowly and when they come in contact major landforms are created.

Some plates make up big pieces of land called *continents or continental crust* while other plates make up the bottom of the oceans and are called *oceanic crust*. Two plates can *move apart, collide* or just *slide past* each other. The sliding plates are also called *Transform Fault* as shown in this diagram.

Here is a map of the major tectonic plates in the world.

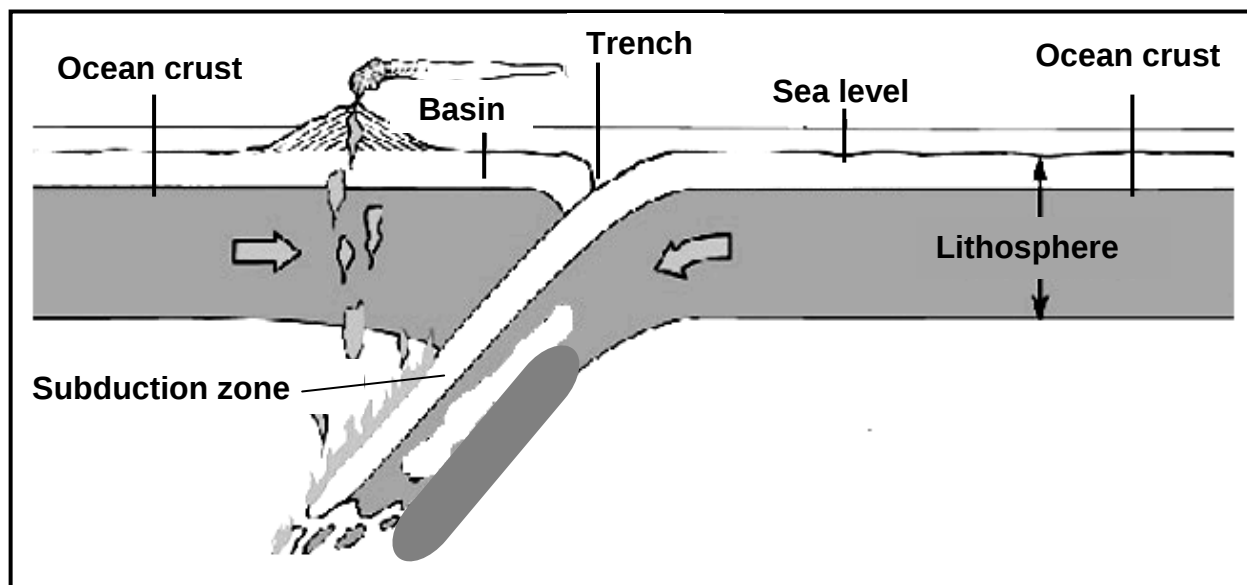
MAJOR TECTONIC PLATES



The next diagram on the next page shows what happens when two plates collide or bump into each other.

In the diagram you will see two oceanic or sea plates meeting. The weaker plates get subducted under the stronger plates, creating an area or *zone of subduction*.

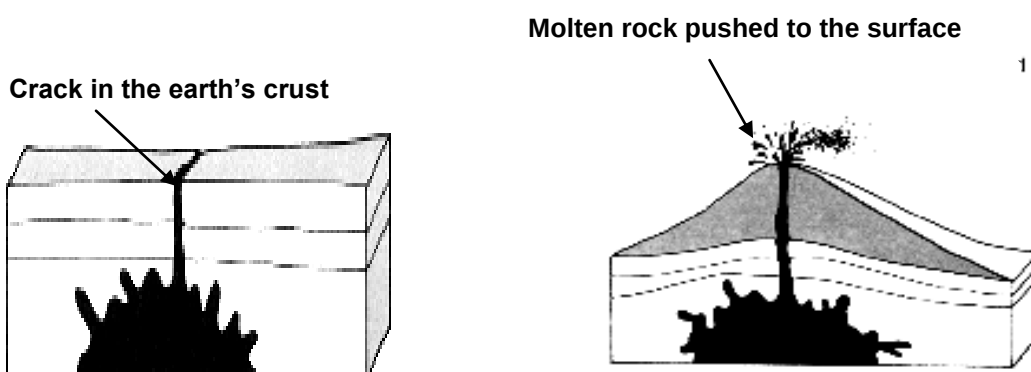
Subduction comes from the word subduct. Subduct means to sink or go underneath. Tectonic plate subduction happens when two plates bump into each other and the heavier plate sink under the lighter plate. The built up pressure in the earth's crust around subduction areas can cause earthquakes and volcanic eruptions.



Sometimes the edge of one plate slides under the edge of another plate. The edge of the plate that slides down melts in the hot magma of earth's mantle. This hot molten rock inside the earth surface is called **magma**.

During plate movements, magma can make its way to the earth surface through cracks in the earth's crust. Upon reaching the surface, it often erupts (bursts out) as volcanoes. This molten rock which flows out of a volcano is called **lava**.

Now take a look at the diagrams below. You will see that a *volcanic mountain* is formed as *lava* cools to form solid rock on the earth surface.



Faults are formed as a result of the different movements of plates such as plates colliding against each other or, plates sliding passed each other, or plates moving away from each other. These different movements of plates can cause the formation of mountains, valleys, ridges and trenches.

The edges of sliding plates can get stuck together. The plates keep trying to move, and pressure builds up. Suddenly, the plates break free. Plates that move suddenly can cause an *earthquake*. The ground shakes during an earthquake and this can damage houses and other buildings.

An earthquake is a violent shaking of the earth's crust.

We now take a look at processes that operate on the earth surface to shape and control the elements of the natural environment that you have studied earlier. They are described as *surface processes*.

Surface Processes

The 3 main processes that shape the surface of land are;

1. Weathering
2. Erosion
3. Deposition

Weathering is the slow break down of rocks by forces of weather such as heat and water. This happens when heat from the sun causes rocks to expand and crack. When water gets into these cracks in the rock, it freezes and expands, causing the rocks to break up.

Plant roots can grow into rocks and break up the rocks. Rainwater can dissolve minerals in rocks, turning them into liquid. Rainwater can turn other rocks into sand or clay. Once rocks break into pieces, erosion takes over.

Erosion is the wearing away and removal of weathered materials. This is caused by wind (moving air) glaciers (moving ice) and waves (moving sea water). Wind, glaciers, and waves are known as **agents** of erosion.



A brown river is an example of erosion taking place. Flowing water carries away, or erodes, tiny bits of dirt and rock from the ground it passes over. Rivers erode and move rock and dirt, which eventually settles at low lying places like valleys or coasts. This settling down of weathered or eroded materials is called *deposition*.

Deposition is also a surface process but it builds up landform. The earth's surface can greatly be changed by erosion. Over long periods of time, erosion can carry whole mountains into the sea. The dirt and pieces of rock that erosion carries away come from weathering.



Summary

You have come to the end of lesson 2. In this lesson you have learnt that:

- Atmospheric refers to with processes involving the air around our planet
- The sun is the source of all energy on earth
- Biotic refers to living things or plants and animals
- There are three layers of the earth, the *crust*, *mantle* and the *core*
- Tectonic plates are large pieces of land masses
- The tectonic plates can *move apart*, *collide* or *slide past* each other
- Ecosystems are smaller parts of all the living environments on earth
- Earth's entire living environment is called the *Biosphere*.
- An *ecosystem* is all the living and non-living things in an area
- All things in an ecosystem are connected with one another

NOW DO PRACTICE EXERCISE 2 ON THE NEXT PAGE



Practice Exercise 2

1. The main source of energy on earth is the _____.
 2. Explain water cycle?

 3. The two main parts of the ecosystems are the _____ and _____ things.
 4. What is a Biosphere?

 5. Name two features that are formed as a result of plates movements.
 - (i) _____
 - (ii) _____
 6. What is the main difference between erosion and weathering?

-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1
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Lesson 3: Landform



Welcome to Lesson 3. In the previous lesson, you studied some key physical features that make up the environment. In this lesson, you will study some of the main landform features.

Your Aims

- define landform
 - identify the four main characteristics of landforms
 - classify landforms into four main types
 - identify and describe the distribution of major landforms in Papua New Guinea
 - describe the processes that formed these landforms
-

First of all, let us take a look at the main landform features of Papua New Guinea and where they occur.

Landforms in Papua New Guinea

Papua New Guinea is a *mountainous* country. It is north of Australia and lies in the Pacific Ocean. It is the eastern half of the island of New Guinea. The mountains form a chain along the centre of the main island. This chain of mountains is called the *Central Cordillera*. These mountains extend from Irian Jaya in Indonesia to Papua New Guinea's mainland. Part of this mountain chain forms the Owen Stanley Range, and the nation's highest peak, Mt. Wilhelm with a height of 4,509 metres above sea level. The coastal areas are much flatter and are called *lowlands*.



I know of mountains and valleys, but what really is *landform*?

Geographers use the word *landforms* to mean the shape and form of land.



The mountains are steep and rugged with many big rivers flowing away from them and across the lowlands to the sea. The two biggest rivers are the Sepik River and the Fly River.

Landforms do not include man-made features, such as canals, ports and harbours

Many *active* as well as *in-active* volcanoes are found in many areas of Papua New Guinea. There are also many smaller islands that form parts of Papua New Guinea.



Owen Stanley Ranges

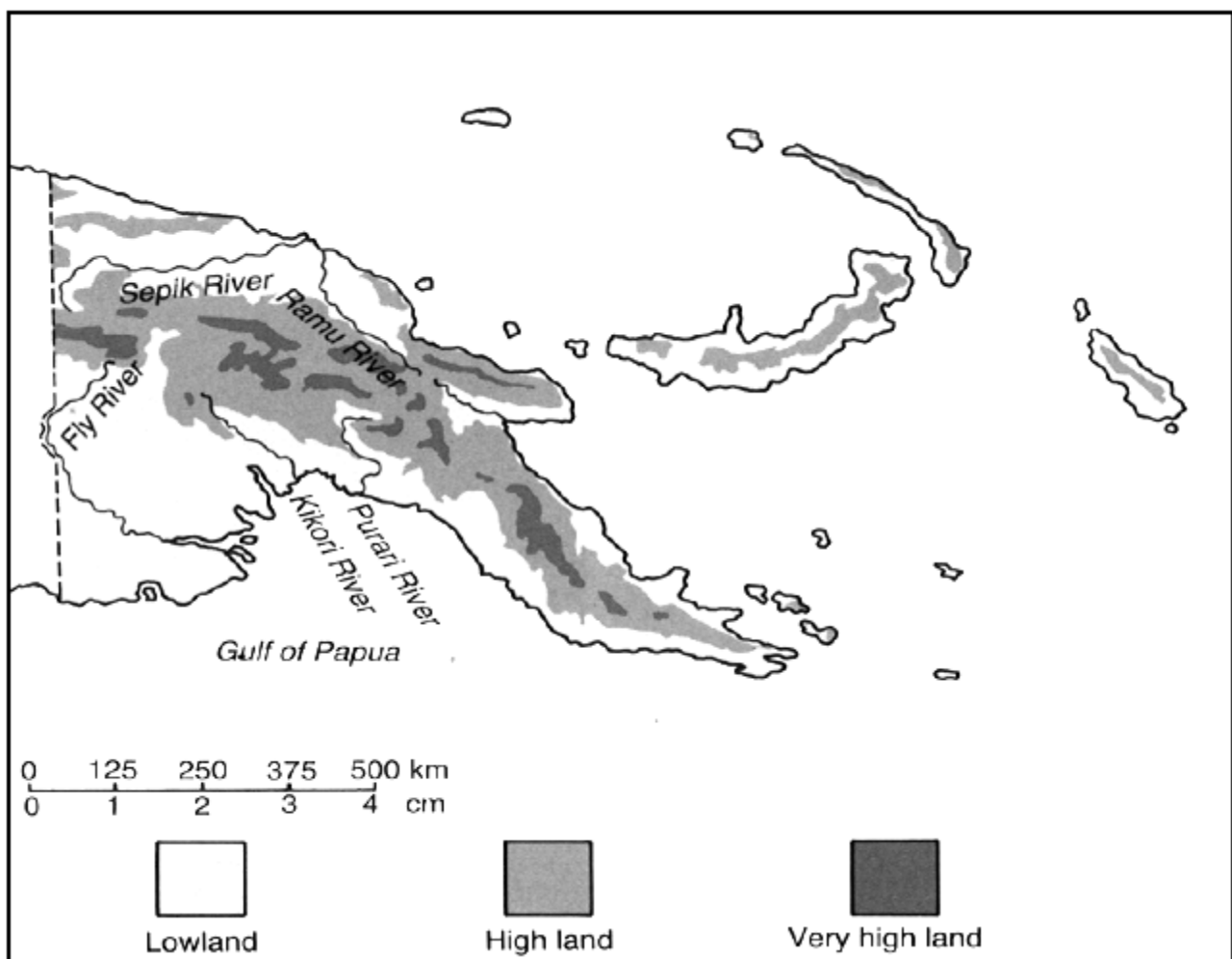


Views of Mt Wilhelm



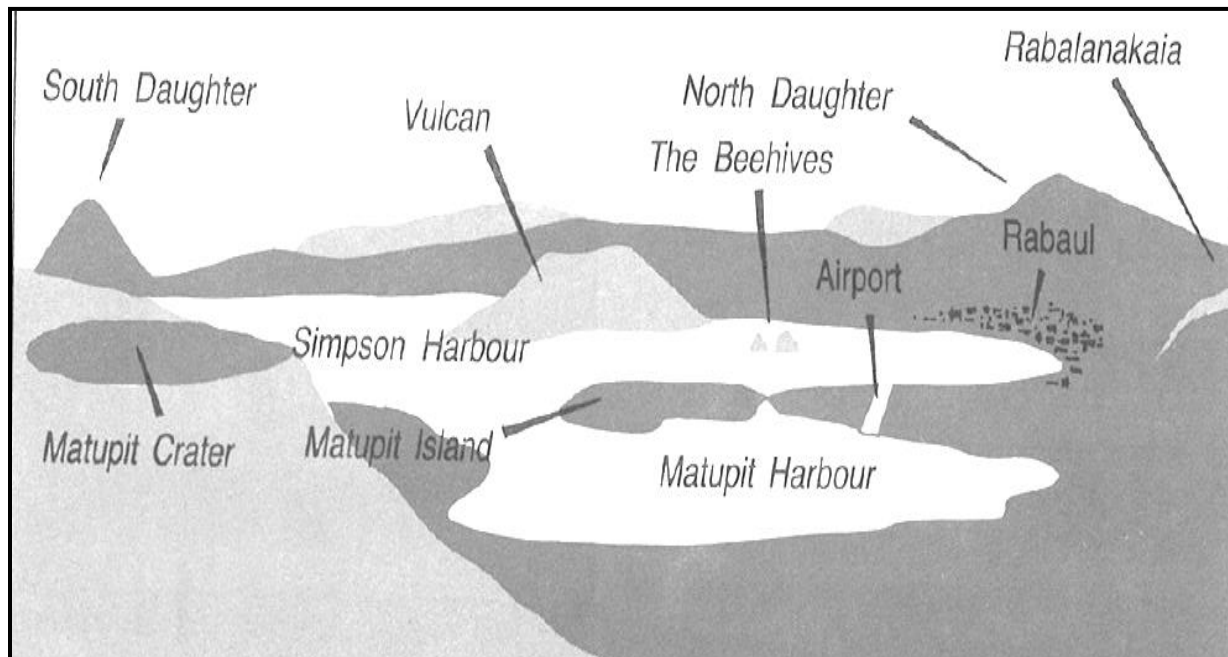
Now, take a look at the map below. It shows the highlands and lowland areas of Papua New Guinea.

Landforms of Papua New Guinea



There are also many mountainous features in the islands of New Britain, Bougainville and some of the smaller islands have been formed by volcanic processes.

The diagram below shows Rabaul and its volcanoes in 1986.



Rabaul and its Volcanoes, 1986

From the diagram given above you can see that the landforms of Papua New Guinea are different from place to place.



Now, what makes you think it is a landform?



If you look around, you will notice that the land has many different shapes and form. Some are very big while others are very small. Some are high, others are low, some are steep and others are flat and so on.

Characteristics of Landforms

We can say that there are four important characteristics of landforms. They are:

1. **Height**- How high the land is above the sea level
2. **Shape**- What it looks like
3. **Slope**- How steep or gentle it is
4. **Relief**- The differences in height

Using the characteristics of landforms we can now group all the different landforms into four main types.

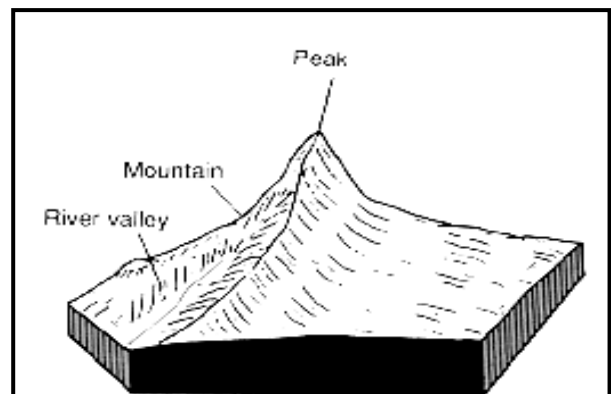
They are:

1. **Mountains**
2. **Hills**
3. **Plateaus**
4. **Plains**
5. **Valleys**

Mountains are usually large, steep- sided piece of upland which sometimes has a sharp pointed top called a *summit* or a *peak*.



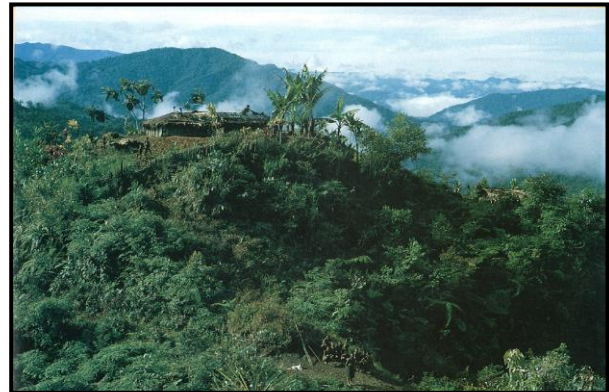
The Rocky Mountains in North America



Profile of a Mountain



A River Valley in the Highlands of PNG



The Steep and Rugged Slopes of
Western Highlands Province-PNG

Mountains are usually bigger with steep slopes with heights greater than 1000 metres above sea level. **Hills** are smaller landforms with heights ranging from 200 to 1000 metres above sea level. Usually hills are not as steep as mountains.

A **plateau** is a raised area with a flat or level top. In other words, it is an area of high ground with a fairly level surface. They can be found at 500 metres above sea level. The shapes depend on where they are found.

A PLAIN is usually found below 500 metres above sea level, above these they will be called *plateaus*. Plateaus are simply area of flat land that is higher than the land surrounding it.



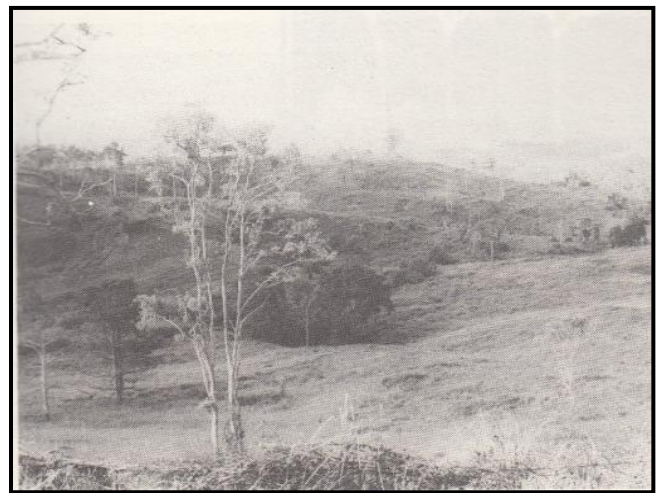
A Plateau



Mountains in Milne Bay Province



Hills Around Port Moresby



Sogeri Plateau in Central Province

In Papua New Guinea, we find landforms which look like plains but are quite higher up. For example, the Waghi, Asaro and valleys are situated in the highlands region. It is common in most parts of the world where there are mountain ranges. Sometimes these different landforms may also be found together. You may find hills and plains together and plateaus and mountains together.

How was Papua New Guinea Formed?

Nearly all of Papua New Guinea was formed when the Australian plate moved northwards and collided against the Pacific plate. These two plates are *still colliding* today along the north coast of the main island and through New Britain. This is why earthquakes are so common in this area.

Millions of years ago, the collision was happening where the Highlands are now, but the Australian plate has slowly pushed to the north. There are *extinct volcanoes* all over the Highlands, showing that the two plates once collide under the highlands region. The active volcanoes show us where the two plates are colliding today.

Extinct Volcanoes do not send out lava, dust and smoke while an **Active Volcano** sends out lava, dust and smoke continuously. Extinct volcanoes are dead.

As you can see in the map below that most of Western Province and parts of Gulf Province are really part of the Australia Plate. Almost everywhere else in Papua New Guinea has been formed by the collision of the Pacific and Australian plates.

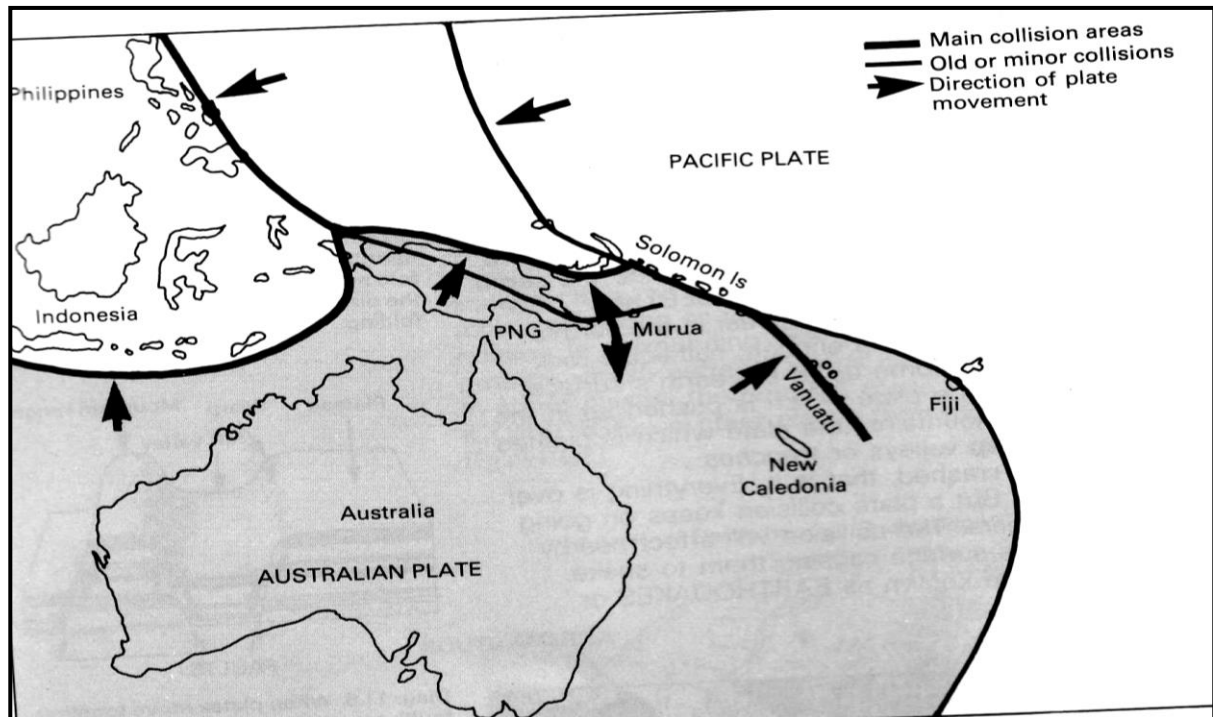


Plate tectonics in Papua New Guinea

The land north of the Markham is slowly being pushed up as it collides with the Pacific plate. That is why the Finisterre and other mountains are so high. Perhaps in thousands of years' time as this collision continues the highest mountain in PNG will be some other mountains and not Mt Wilhelm.

You have learnt that faults are **CRACKS** or **BREAKS** in the earth's crust. It happens when plates come in contact.



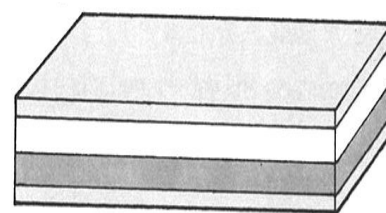
Some processes that built landforms happen way beneath the earth's surface. Let us now look at **faulting** and **folding**



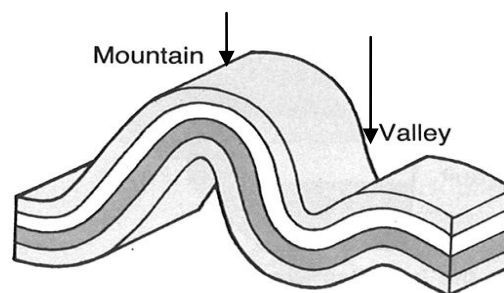
Faulting occurs when rocks *crack* or break. This is normally caused by a big pressure from tectonic plates that move in different directions. Some rocks are not as strong as others. For this reason, the very strong rocks sometimes do not break when force and pressure is applied on them. Instead, these rocks *bend* and change shape. This bending of rocks is called **FOLDING**. When tectonic plates meet they bend to form *Fold Mountains*.

Plates that move suddenly may cause an *earthquake* and *volcanoes*. When the ground shakes and volcanoes erupt, houses and buildings can be destroyed and people can die. Earthquakes take place at plate boundaries.

A **volcano** is formed when molten rock called *magma* finds its way to the surface through cracks or opening at the boundaries of colliding plates.

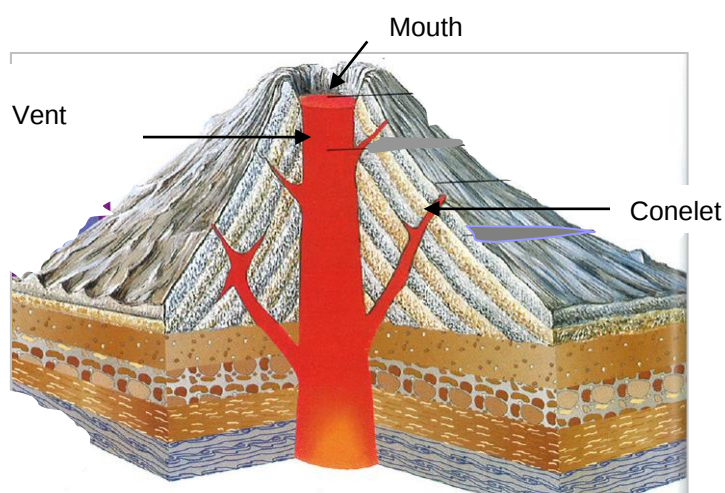


- Before Folding the Land is Flat



- After Folding the Land is Pushed Up to Form Mountains and Valleys

Take a look at the pictures below. The profile shows the **cone shape** of a volcano and its main parts.



A Profile of a Volcano



Mt Tavurvur in Rabaul, March, 2008



Summary

You have come to the end of lesson 3. In this lesson you have learnt that:

- The four main characteristics of landforms are: *height, slope, shape and relief*
- The four main types of landforms in Papua New Guinea are *mountains, hills, plateaus, plains and valleys*
- Basins are landforms which looks like valleys but are found in highlands
- The major landforms in Papua New Guinea were formed when the Australian plate moved northwards against the Pacific plates.
- Faulting refers to cracks or breaks in the earth's crust
- Folding is the bending of rocks when tectonic plates collide
- Volcanoes are formed at the boundaries of tectonic plates
- Deposition is the laying down of weathered and eroded materials
- Processes such as folding, and faulting build up land forms
- Processes such as weathering, erosion and deposition shapes the land surface

NOW ANSWER PRACTICE EXERCISE 3 ON THE NEXT PAGE



Practice Exercise 3

1. List and explain the four important characteristics of landforms.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____

2. What is a common shape of a volcano? _____

3. Name the five main types of landforms in Papua New Guinea?

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____
- (v) _____

4. The _____ and the _____ plates collided to form the major mountain systems in Papua New Guinea.

5. Which tectonic plate do the Western and Gulf provinces belong to?

6. Give three destructive effects of volcanoes.

- (i) _____
- (ii) _____
- (iii) _____

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1
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Lesson 4: Four Figure Grid Reference



In the last three lessons, you learnt about the physical features of Papua New Guinea and the processes that helped form and shape some of these features. In this lesson, you will learn a mapping skill that will help you locate some of these features on a map.



Your Aims

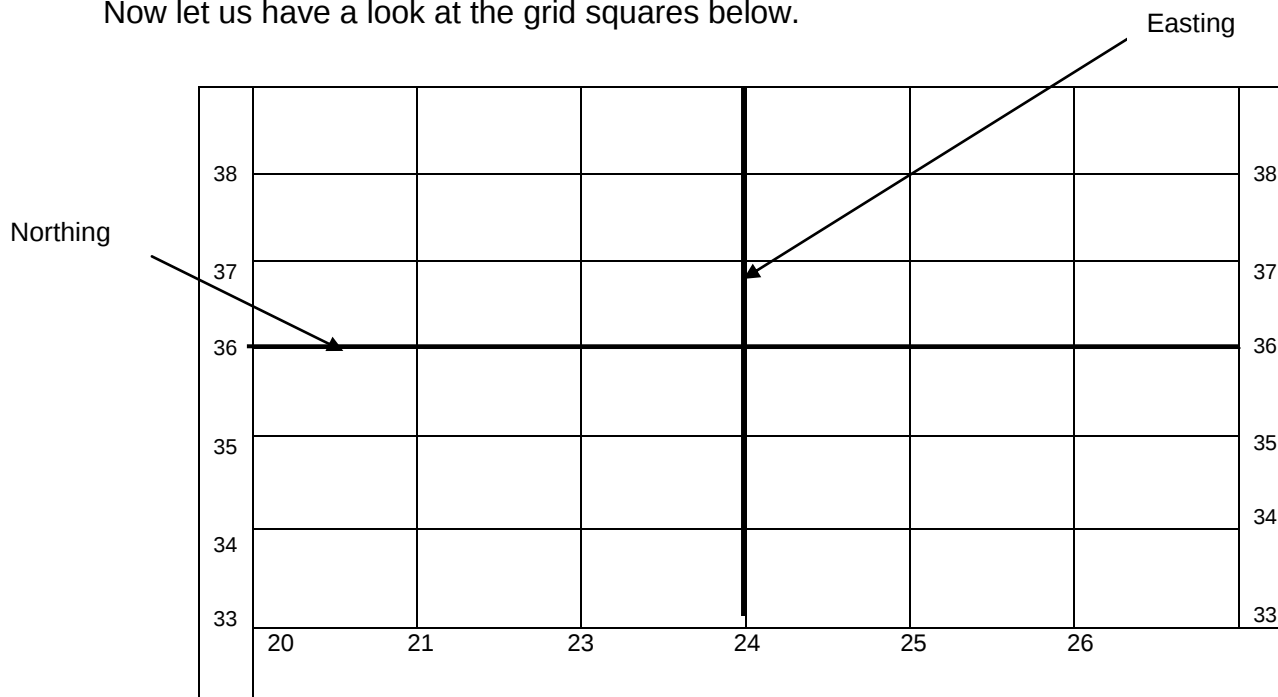
- define grid reference and four figure grid reference
- locate or find features on maps using four figure grid reference
- read and give the four-figure grid references of certain features

In Social Science, a number of tools such as maps, tables and graphs are usually used. Grid referencing is one such skill that you need, to help you read and understand maps.

What is a Grid Reference?

A **Grid Reference** is a set of either *four* or *six* numbers which can be used to find places on a topographic map. A topographic map simply shows the different heights of the land. A topographic map will show mountains, hills, rivers, vegetation, buildings, roads, and any other things that can be found on a given map.

Now let us have a look at the grid squares below.



The lines shown on the grid are known as **Grid Lines**. When put together they form a *pattern* of squares called **Grid Reference**.

The *vertical lines* that *run up and down* on a map are called **Eastings**. These lines *give the reading or show things* that are found *to the east of the line*. They are *numbered from left to right* at the *top or bottom* of the grid lines.

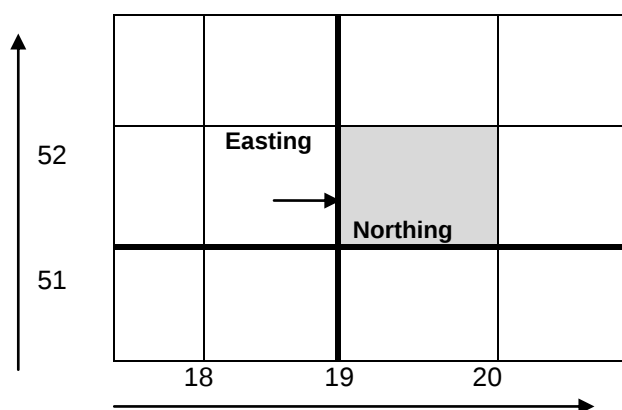
The *horizontal lines* that *run across* the map are called **Northings**. These lines *give the reading or show things* that are found *north of the line*. They are *numbered from the bottom to the top* at the *left or right side* of the grid lines.

Finding Places Using a Four-Figure Grid Reference

A **four figure grid reference** is used when we want to describe the *general location* of a place or thing on the map. Four figure grid references are also called **area reference**

A four figure grid reference has four numbers. The first two numbers are an easting. You will find out which one it is by looking across the *bottom* of the map. The second two numbers are a northing. This will be found by looking up the *side* of the map. This eastings and northings form the bottom left-hand corner of the square we are trying to find.

Now look at this illustration. It shows how you can correctly use the eastings and the northings on a map.



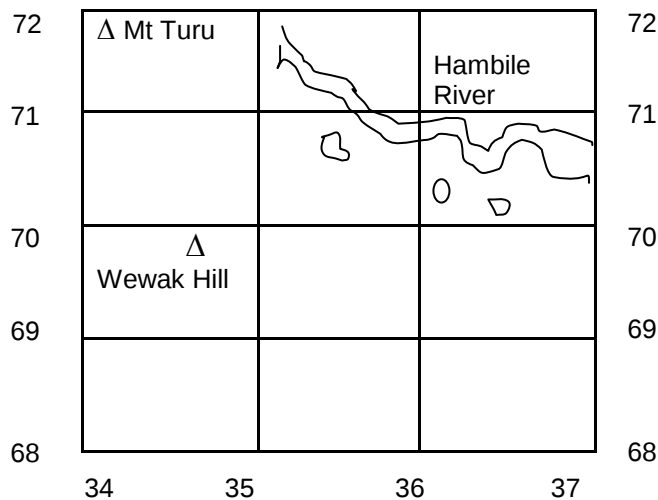
This shaded square has a four figure grid reference of **1951** because easting **19** and northing **51** form the bottom left hand corner of it.

Some Important Rules for Finding Area Reference:

- Always start observing from the bottom left-hand corner of the grid square on the map.
- Read the easting grid reference first, and record the easting number.
- Read the northing grid reference, and record it next to the easting number
- Write the letters A.R (Area Reference) in front of the figures

Now have a look at this example, you will learn two things:

- how to locate features on the map using a given Area Reference and
- how to read and record the Area Reference for given features on a map



A: Finding Area Reference for a given feature (e.g. Wewak Hill):

- Step 1 Observe the bottom left-hand corner of the grid square where Wewak Hill is located
- Step 2 State the easting on the left hand boundary of the grid square where Wewak Hill is (i.e. 34)
- Step 3 State the northing on the bottom of the grid square where Wewak Hill is located (i.e. 69)
- Step 4 The Area Reference for Wewak Hill is now written as A.R.3469

Sometimes you see only symbols of a feature on the map. In that case, you need to use the *map key* to name the features.



Summary

You have come to the end of lesson 4. In this lesson you have learnt that:

- A grid reference is a set of four or six figures which can be used to find places on a topographic map
- The four-figure grid reference is also called an Area Reference (AR)
- An Area Reference shows the general location of a feature on the map
- Eastings are vertical lines and are numbered from west to east
- Northings are horizontal lines and are numbered from south to north
- Always start reading Area Reference from the bottom left hand-corner of the map
- The easting always come before the northing when reading and writing Area Reference
- Use the key or legend of the map to name a feature

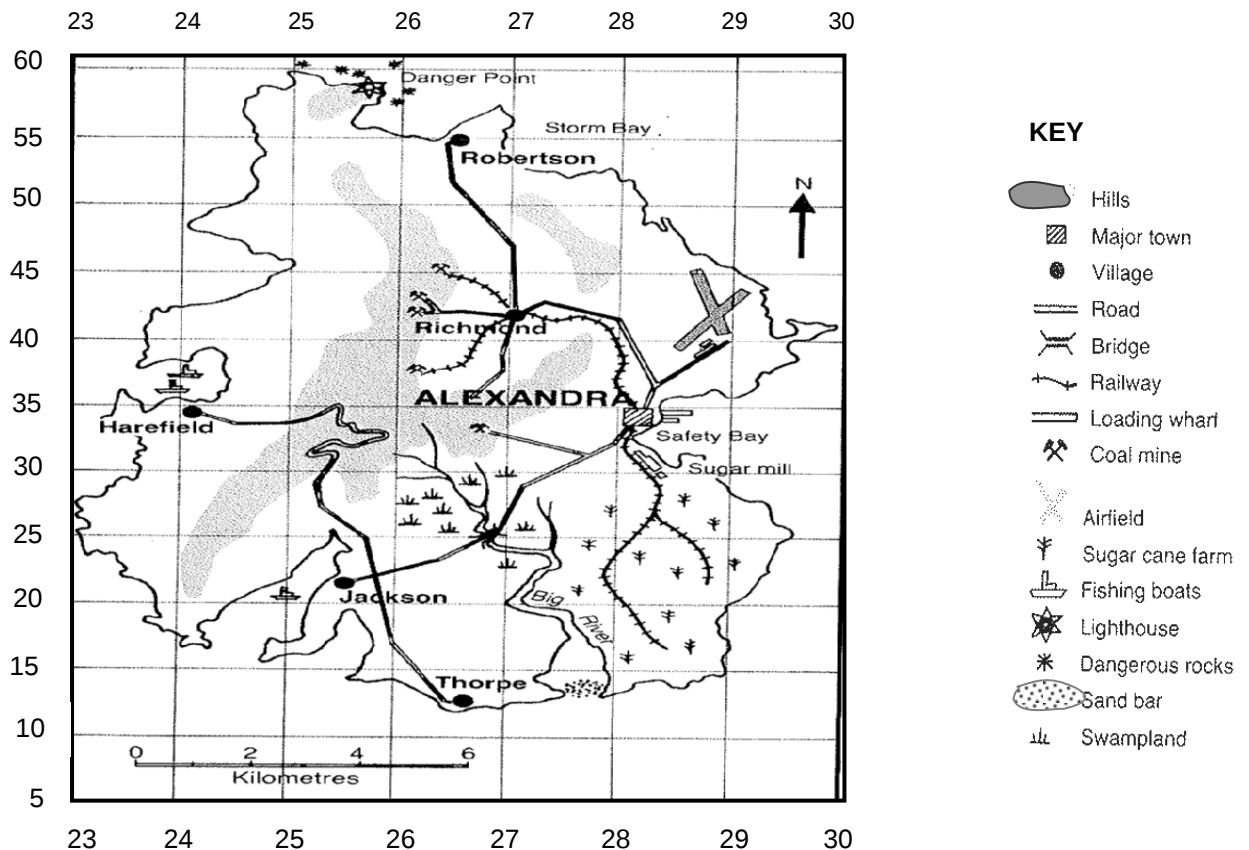
NOW DO PRACTICE EXERCISE 4 ON THE NEXT PAGE



Practice Exercise 4

Refer to the map below to answer the questions.

MAP OF STING ISLAND



1. What is the name of the vertical lines that run up and down on the map?

2. What is the name of the horizontal lines that run across the map?

3. Give the Area Reference for Harefield? _____
4. What features are found in grid square 2555? _____
5. What is the name of the natural feature found in grid square 2715? _____

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1

Lesson 5: Weather and Climate



Welcome. You will continue the study of physical features. This time you will learn more about weather and climate.

Your Aims

- differentiate between weather and climate
 - identify and explain the factors that influence weather and climate
 - discuss the major influences of climate in Papua New Guinea
-

Weather

'I wish it rains, it has been very dry in the last few days in Port Moresby!' "It's very cloudy this morning and the children need to carry umbrella in case it rains". These are all statements about the *weather*.

People who listen or watch the weather forecast on the radio or television want to know how the day will be like, whether it will be cold enough to wear a jacket or warm enough to wear shorts.

Weather is important for many things that you do. Hot and cold temperatures, wind, rain, and snow are all part of the weather.

Crack! With a flash and a bang, a bolt of lightning splits a tree in half. Hurricanes bring the ocean onto the land and carry houses away. Tornadoes pick up cars and throw them through brick walls. Floods turn roads into rivers. The events above are all examples of weather.

Weather refers to the day to day conditions of the atmosphere.



A rainbow appears from beneath large thunderclouds during a break in a storm.



A Hurricane is a huge storm with heavy rains and strong, swirling winds.

What Makes Weather?

Weather is caused by the change in the earth's atmosphere and the sun's heat. The atmosphere is made of air. Wind is moving air. Heat from the Sun makes the air particles to move around. Hot air rises, leaving a space behind. Cooler air flows into that space. Air is always moving around the earth. The moving air carries clouds along with it.

Clouds are formed through the **water cycle**. Clouds are formed when water vapour in the air is changing from its gas form into liquid water particles. Water vapour is a gas that is *invisible* (you cannot see), it become only *visible* (you can see) as it changes into liquid water particles. As the liquid water particles become larger, the clouds turned from white to gray, and from gray to black and eventually rain falls.

In some areas where it is cold, the water vapour leads to snowfall instead of rainfall.

Here are some factors that affect weather: *temperature, precipitation, humidity, air pressure, sunshine, wind speed, wind direction and cloud cover.*

Now, where do clouds come from?



Watch out for dark clouds! They could mean a storm is coming.



Weather balloon and a tourist at NWS Weather Forecast Office, Riverton, Wyoming, USA.

It is not easy to predict or *forecast* the weather. **Meteorologists** are scientists who study weather.

What do meteorologists do?

- They use many kinds of instruments to study the kinds of clouds that form in the sky and measure how fast winds are blowing.
- They even send up **weather balloons** to measure temperature and humidity high up in the atmosphere.
- They use satellites to take pictures of clouds and storm moving around the earth.

Today, all this information is fed into computers which help to predict the weather.

Most airports will have weather stations that record information such as wind speed and direction, cloud cover and humidity. Pilots use these information for their flights. You can even read weather information in the newspapers. Check the classifieds at the end of the Post Courier to see the weather forecasts for your area.

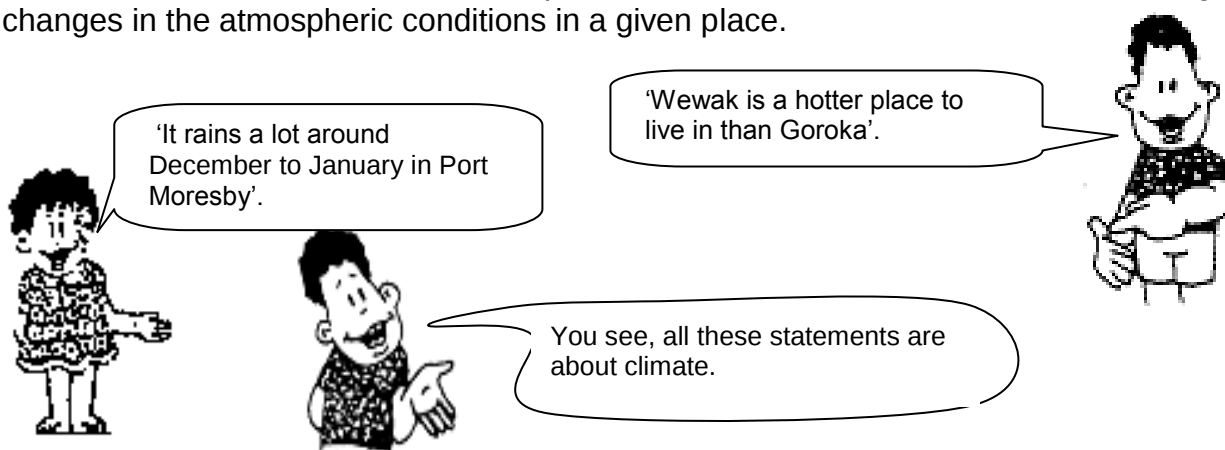
Can you think of other people who might need weather information?



A weather or sounding balloon is a high altitude balloon which carries instruments for measuring weather information (such as atmospheric pressure, temperature, humidity and wind speed) to send back to earth.

Long ago, Papua New Guineans used traditional methods of observation to tell weather. For example, a flock of bird flying away from a certain location, the changing behaviour patterns of animals, appearance of black clouds and feeling hot and sticky. These observations meant rain was expected. These people were meteorologists that used simple instruments. Sometimes the weather forecast is right and sometimes it is wrong. Meteorologists are always looking for better ways to predict weather.

Now let us look at climate and compare climate to weather. **Climate** is the long-term changes in the atmospheric conditions in a given place.



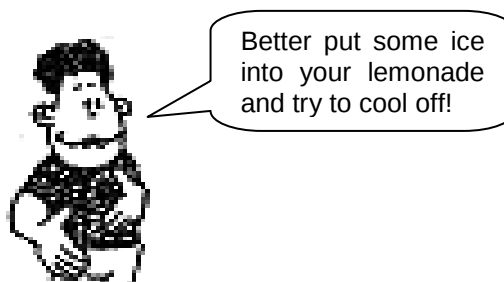
The Three elements of climate are *Temperature, Precipitation* and *Atmospheric Pressure*.

In this discussion, you will learn about temperature and precipitation and their influence on the climate of a place.

What is Temperature?

Temperature and heat are not the same thing. *Temperature* is a measurement of heat; a measure of the amount of heat energy possessed by an object. It tells whether something is hot or cold. You measure temperature with a *thermometer*. A Thermometer has a *scale*, measured in units called *Degree Celsius*. A thermometer hanging outdoors measures the temperature of the air. Air that is 0°Celsius does not have much heat energy. At that temperature, water can freeze into ice. Air that is 38°Celsius can make you feel very hot.

Places near the equator receive more heating because the sun is overhead for most time of the year. This warm air rises and cool in the atmosphere and sinks somewhere near 30° north and south of the equator. This cooler air replaces the heated air. The circulation of warm and cool air is called *Convection Currents*.



Latitude (distance from the equator to the north and south pole), altitude (height above sea level), ocean currents, distance from the sea, winds and cloud cover are factors that cause temperature to change from place to place.

Remember, hot air brings rainfall while cold air brings dry conditions

Precipitation

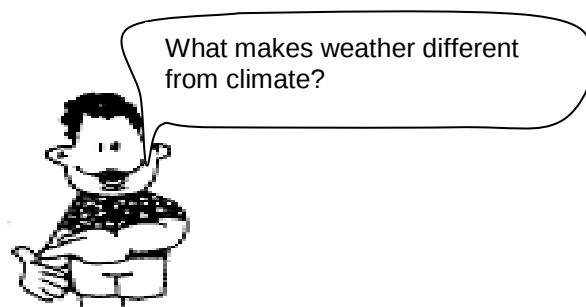
Precipitation is water that falls on the earth's surface from the air above. It can be in solid or liquid form. *Rainfall* is the common type of precipitation. Rain can fall from clouds when the air temperature is above freezing point. Sometimes water vapour in clouds cool and become raindrops. The drops get bigger and heavier until they fall from the clouds. Rain is important for life on earth because it brings water to plants so they can grow.

If the temperature is below freezing point, tiny bits of ice called crystals form in a cloud. The ice crystals stick together and fall to the earth as snowflakes.

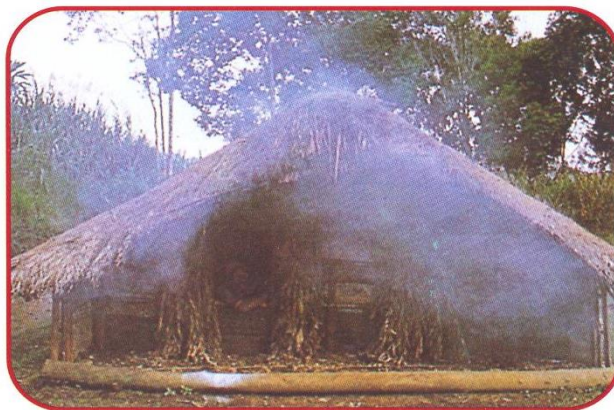
***Water Vapour* is gas that takes the form of tiny droplets of liquid. These often appear as clouds, mist, fog, hail, dew or rain.**

What is the Climate like in Papua New Guinea?

Weather can change from place to place quite quickly. For example, in Port Moresby it can be raining in Gerehu, while it is very dry in Taurama Barracks. Papua New Guinea is located a little to the south of the equator. The air remains hot for most parts of the year but hotter still on the coasts than in the Highlands.



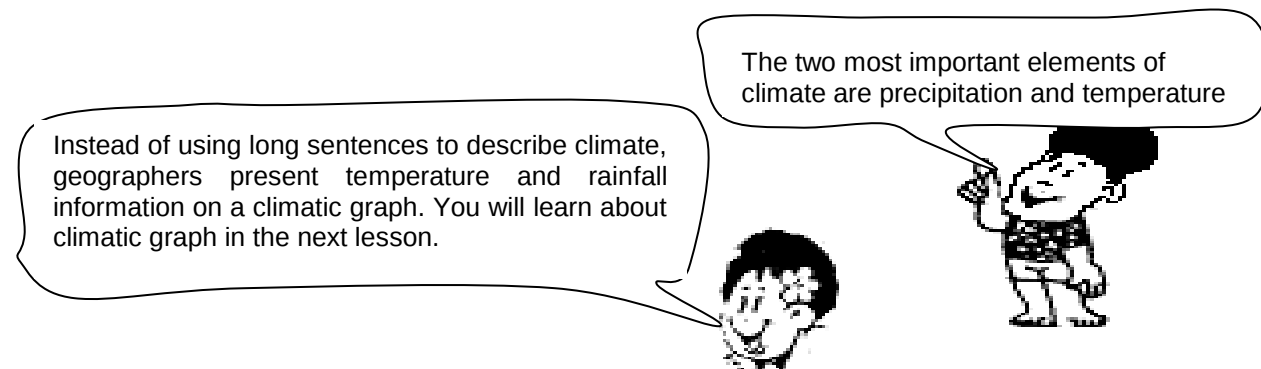
Why is it cooler in the Highlands than on the coasts? The answer is to do with *Altitude* or *Height Above Sea Level*. Because the earth is round, the air above the earth gets more spread out the higher you go. When air is thin it cannot keep the heat in. The air temperature falls to an average 7° Celsius and an average high of 16° Celsius daily in the Highlands.



In the Highlands of PNG, houses are built low on the ground to keep the warmth inside

Rainfall and Wind

Rainfall changes from place to place. Most parts of Papua New Guinea experience hot and wet season. The rain comes at certain times of the year and is influenced by the direction of the major wind systems. You will study climate type and its influences in detail in Lesson 7.



Summary

You have come to the end of lesson 5. In this lesson you have learnt that:

- Weather is the day to day conditions of the atmosphere while climate refers to the average atmospheric conditions over a period of time in a given place
- The Highlands is cooler than the coastal areas of Papua New Guinea because of the effect of altitude, or Height Above Sea Level
- Precipitation refers to water that is deposited on the earth surface
- Examples of solid precipitation includes snowflakes, frost and snow while liquid forms include rainfall and dew
- Weather influences the food people eat, the type of house they built and the type of clothes people wear
- Temperature is a measurement of heat while heat describes how hot or cold something is
- A meteorologist is a scientist who studies weather.

NOW ANSWER PRACTICE EXERCISE 5 ON THE NEXT PAGE



Practice Exercise 5

1. What is the difference between weather and climate.?

2. What is the difference between temperature and heat?

3. Why is it cooler in the Highlands of Papua New Guinea than in the coastal regions?

4. What is precipitation?

5. List at least five factors of weather.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____

6. The following are examples of precipitation. State whether they are in solid, liquid or gas form.

Examples of Precipitation	State of Matter
Fog	
Morning Dew	
Snow	
Rainfall	

NOW CHECK THE ANSWERS TO PRACTICE EXERCISE 5 AT THE END OF SUB-STRAND 1

Lesson 6: Climatic Graph



Welcome to Lesson 6. In this lesson, you will learn about climatic graphs and what they measure.



Your Aims

- define climatic graph and climatic tables
- read and interpret a climatic graph
- identify components or parts of a climatic graph
- distinguish between a line graph and a bar graph
- construct or draw a climatic graph using a given set of steps

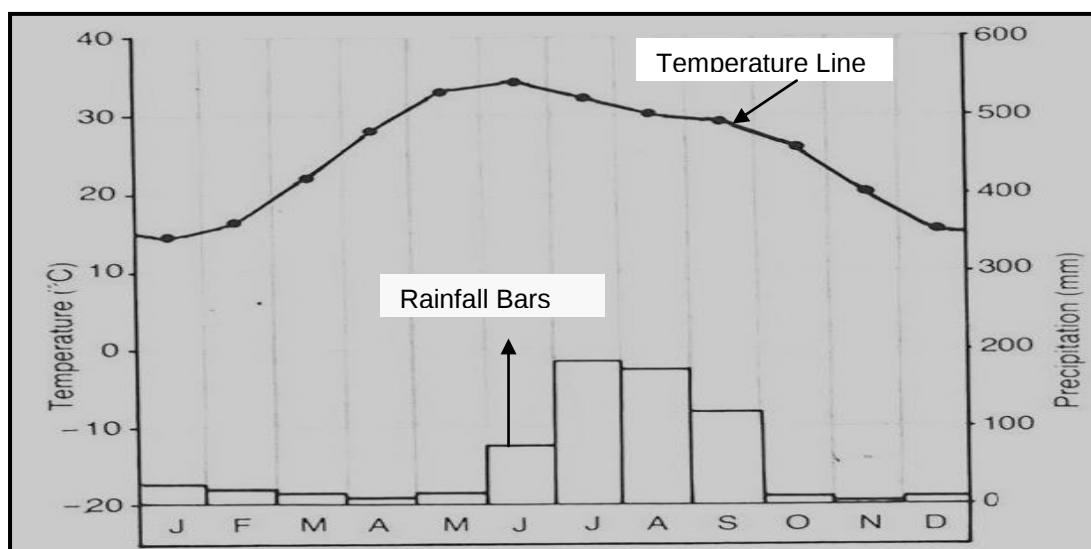
Climatic Graph

A **Climatic Graph** shows temperature and rainfall patterns and distribution of a given place over a year. Usually, temperature has an effect on rainfall, and rainfall has an effect on temperature. This is why, climatic graphs shows temperature and rainfall only.

A **climatic table** shows the average temperature and rainfall readings for each month of the year. Geographers then use the data in the climatic table to construct a climatic graph. If you look closely at the climatic graph, you will see that it is really a combination of a *line graph* showing the monthly temperatures and a *column graph* showing monthly rainfall.

Can you identify the line and the bar graphs that make up the climatic graph below?

A CLIMATIC GRAPH



REMEMBER: A COLUMN GRAPH is different from a bar graph. It has bars that run up and down it while BAR GRAPH has one or more bars running across it.

Before you start reading or drawing a climatic graph, you need to know about a line and a column graph. But first, study the different parts of a climatic graph below.

CLIMATIC TABLE and GRAPH for BRISBANE

The heading tells us what place it is

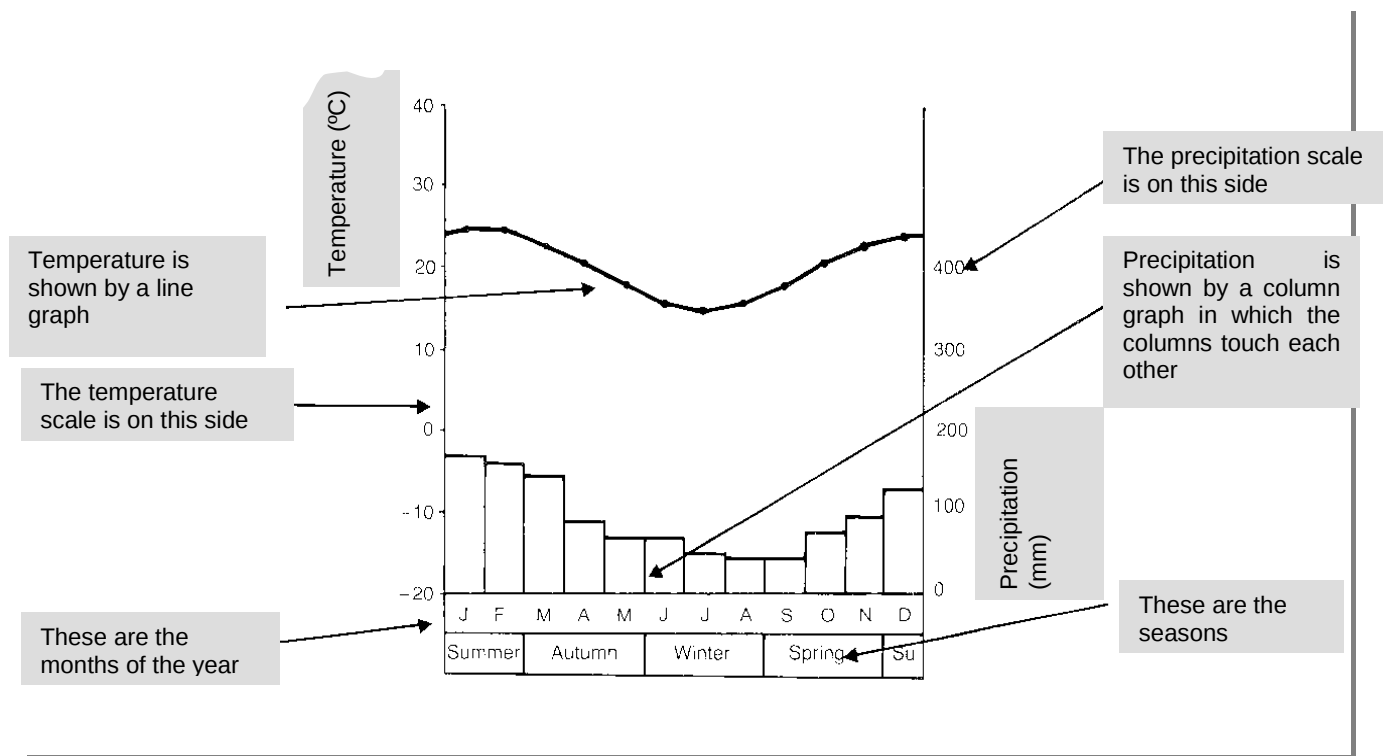
This information can be used to pinpoint location of place on a world map

Latitude 27°S, Longitude 153°E

These are the months of the year

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°C)	25	25	23	24	18	16	15	16	18	24	23	24
Rainfall (mm)	167	161	44	88	69	69	54	48	48	74	95	129

These numbers tell us the temperature for each month of the year



Next, you need to know about a line and column graph separately. Now turn to the next page and take a look at the line graph.

Line Graph

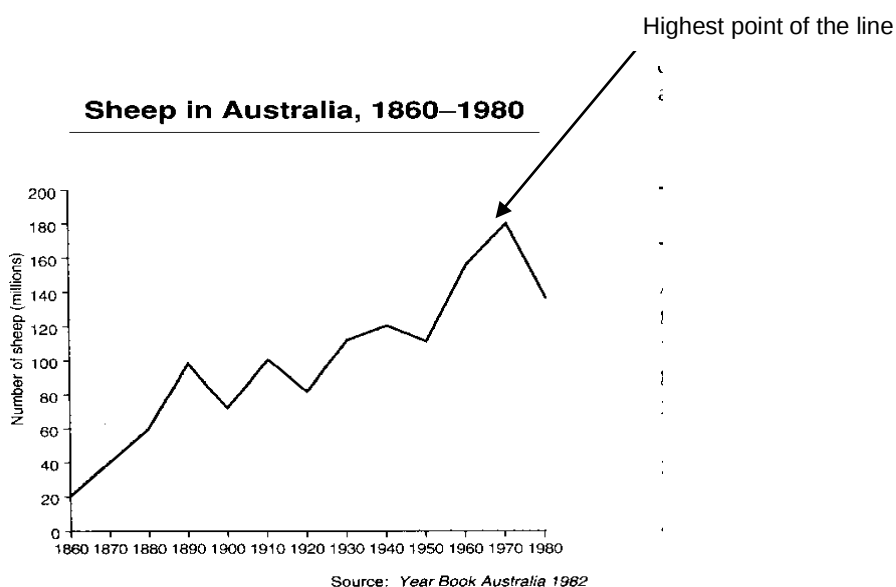
A line graph is a graph which has one or more lines running across it from left to right. Line graphs normally show:

- rises and falls over a long period of time
- differences between one thing and other things over a period of time
- changes from one period of time to the next

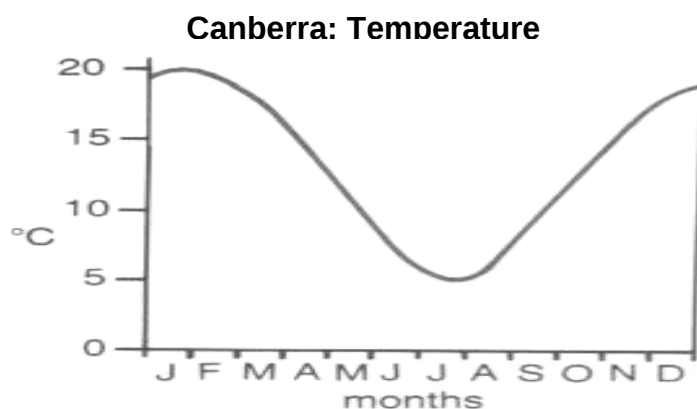
Line graphs are usually drawn on a graph paper or a ruled grid paper.

Reading a Line Graph

A.



B.



You must first look at the main parts of the graph. A line graph has a title, it may have a source, it shows what is measured along the vertical and horizontal axis and the unit of measurement used in the vertical axis and by what amount the numbers on the vertical axis increase each time.

First of all, you need to look back at the example of the line graph and answer these questions.

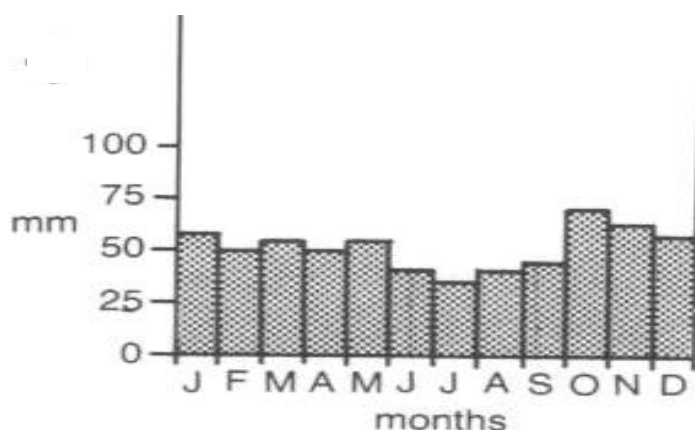
- When was the largest number of sheep found in Australia as shown in Graph A?
- What should you look for? Look for the highest point on the line. Use a ruler to read the year that corresponds to the highest point. *Your answer is 1970.*

Next, you will read a column graph.

A column graph has columns that run up and down on it. It is often used to compare things. Column graphs show the:

- differences between two or more things at a particular time
- changes in one thing over a period of time

C.



To read the column graph correctly, you have to study the rainfall figures and the months in which they occur. You need to also spend time to study the main parts of the column graph as you did with the line graph.

Now let us look at this example of a column graph.

- In what year was the highest amount of rainfall recorded in Canberra?
- What should you look for? You look for the highest column because it will show the month with the highest rainfall. You will find that the highest rainfall was recorded in *October*.

Remember to read the scale correctly when reading graphs

Now do the Activity on the next page. Answers are at the end of the Summary.



ACTIVITY 1

Use the climatic table below to draw and read a climatic graph. The steps of drawing a climatic graph are in the Supplementary Notes. Firstly, you need to spend some time to study the steps in the Supplementary Notes carefully. Then follow those steps to draw your graph. Rule your paper to scale and draw your graphs. Check your answers **ONLY** after you have finished.

CLIMATIC TABLE for NEW DELHI, INDIA

	J	F	M	A	M	J	J	A	S	O	N	D
Temperature (°C)	14	16	22	28	33	34	32	30	29	26	20	15
Rainfall (mm)	23	18	13	8	13	74	180	173	117	10	3	10



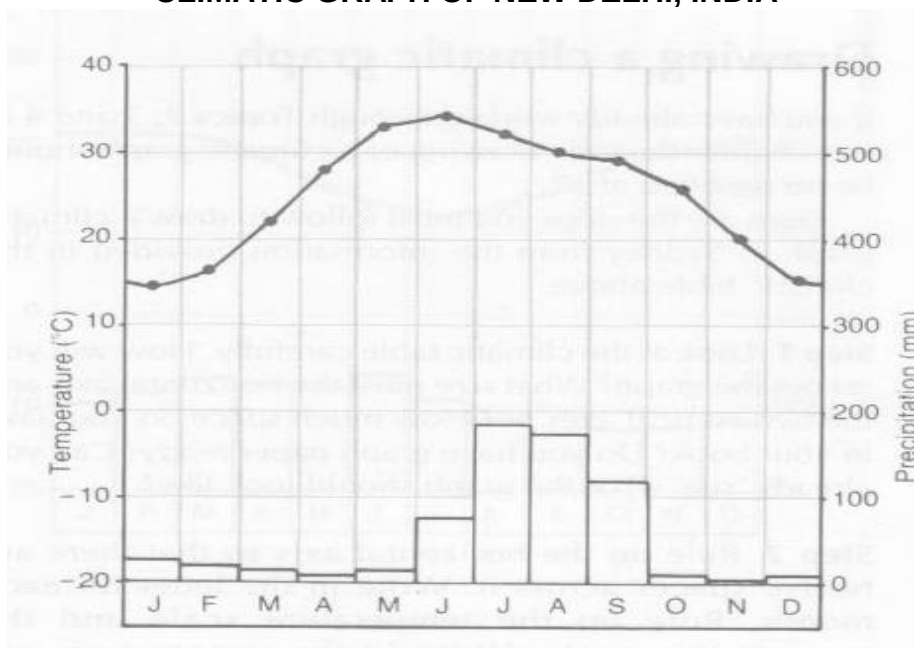
Summary

You have come to the end of lesson 6. In this lesson you have learnt that:

- A climatic graph is a graph which shows the average *temperature* and *precipitation* (rainfall) for a place over a year.
- A climatic table basically has the average temperature and rainfalls readings for each month of the year.
- A climatic graph is usually drawn from a climatic table
- Climatic graphs are a combination of a line graph that shows the distribution and pattern of the average monthly temperatures, and a column graph represents average monthly precipitation.
- A line graph is a graph which has one or more lines running across it from left to right
- Line graphs show rises and falls over a long period of time, differences between one thing and other things over a period of time and changes from one period of time to the next
- A column graph is a graph which has columns that run up and down on it. It is often used to compare things.

ANSWERS TO ACTIVITY 1

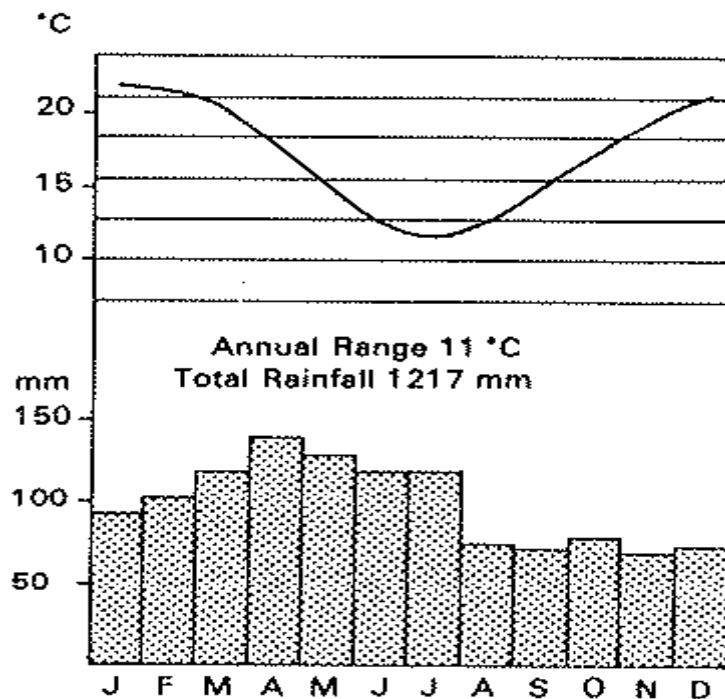
CLIMATIC GRAPH OF NEW DELHI, INDIA



Practice Exercise 6

Study the climatic graph below and then answer the questions that follow.

CLIMATIC GRAPH FOR SYDNEY, AUSTRALIA



1. What is Sydney's highest temperature and in which month was it recorded?
(a) _____ (b) _____
2. What is the lowest temperature and when was it recorded?
(a) _____ (b) _____
3. In which month does most rain fall and how much rain falls during this month?
(a) _____ (b) _____
4. When do you think Australia experiences its wet season?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1

Lesson 7: What Makes Climate Different?



Welcome to Lesson 7. In this lesson, you will learn about the different factors that influence climate.

Your Aims

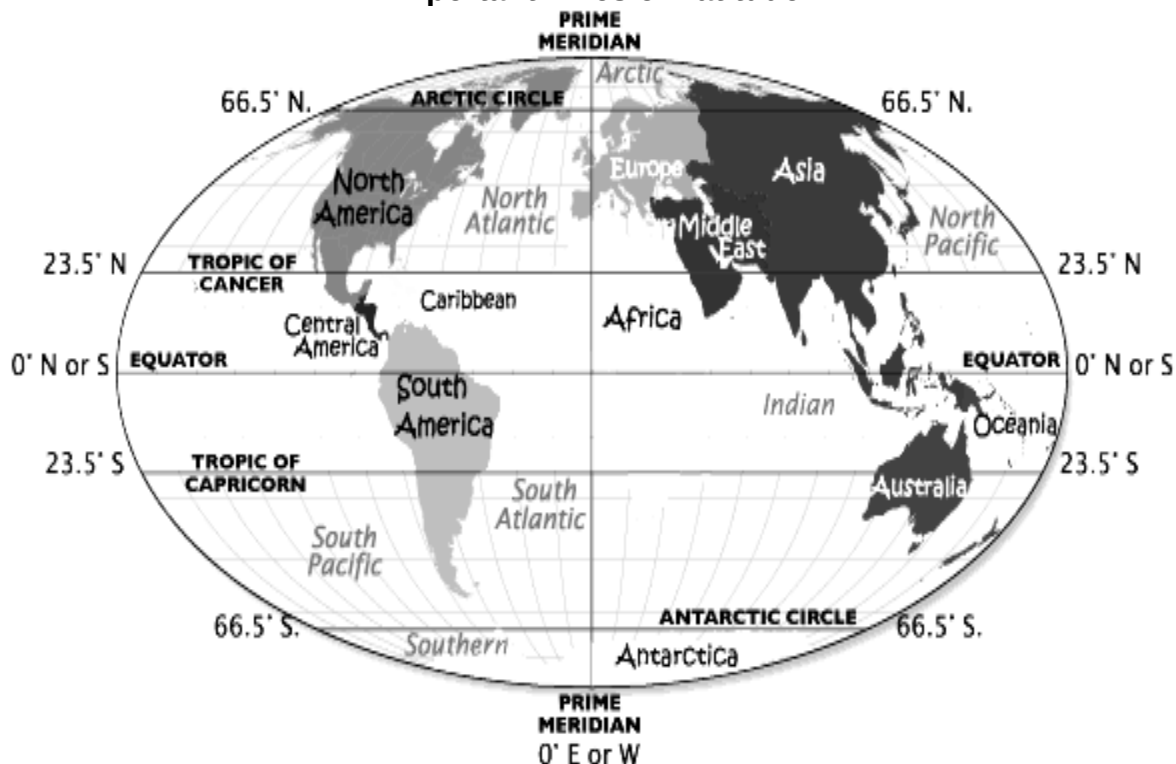
- define and explain the factors that affect climate
- show the climatic region of Papua New Guinea on a map
- identify the major climate types of Papua New Guinea
- describe factors that influence or affect climate in Papua New Guinea
- list factors that cause temperature to change from place to place

In your previous lessons, you learnt about temperature and rainfall and the effect of differences in sun's heating. This affects climate and create seasons. In this lesson you will continue to study the factors that influence climate in Papua New Guinea.

Factors that Influence Climate in Papua New Guinea

Latitude is the distance from the equator and it has a big influence on climate. The latitude of a place tells you how far north or south the place is from the equator, shown as degrees north or south. Papua New Guinea is in the tropical region, but a little below the equator. You can see that in the map below.

Important Lines of Latitude



The **Equator** is an imaginary circle and the longest line of latitude, dividing the earth into the northern and southern hemispheres. You can see this on the previous map. It is located at zero degrees latitude and runs through countries like Indonesia, Ecuador, northern Brazil, the Democratic Republic of the Congo and Kenya. Places above the equator line are in the northern hemisphere while those below are in the southern hemisphere. The North Pole has the latitude of 90 degrees north, while the South Pole has latitude of 90 degrees south.

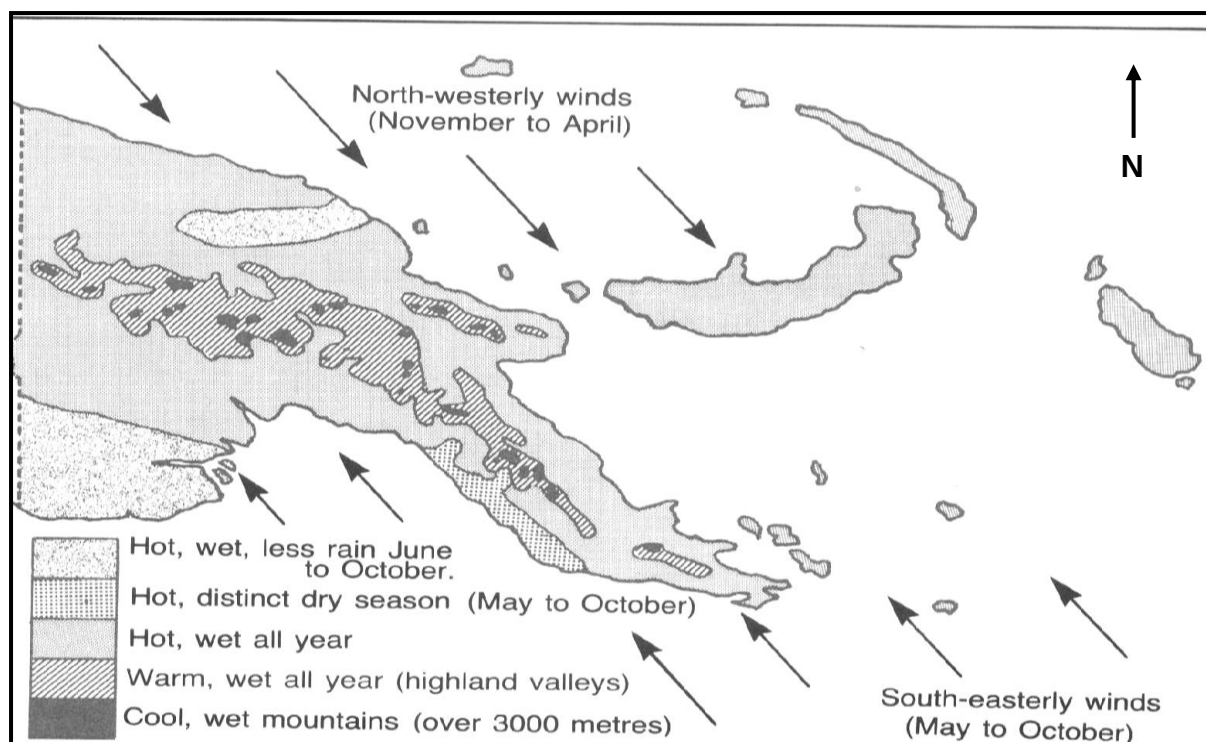
Tropical equatorial regions receive more heating from the sun than places far from the equator, near the poles. Papua New Guinea has a *tropical hot, wet climate* with high rainfall and temperatures all year round. There are local changes in climate because of factors such as altitude and landforms.

The other factor that influences climate is *Wind*.

Wind is moving air. The differences in heating by the sun causes different pressure systems to be build. This in turn causes winds to blow from high pressure areas to low pressure areas. Cold air is associated with dry conditions while warm air brings rainy conditions. Some winds operate on a smaller scale while others on large scale.

Take a look at the map below. You will see that, Papua New Guinea has two main winds that blow at different times of the year.

BROAD CLIMATIC REGIONS OF PAPUA NEW GUINEA



From November to April, the winds blow mainly from the **North West** and are called the **North West Monsoons**. They bring a lot of rain to the north eastern coastal regions of Papua New Guinea.

From May to October, the winds blow mainly from the **South East**. These winds are called the **Trade Winds**. They bring rain to some parts of the south eastern coasts. If there are mountains, the winds are forced to rise. The higher the winds rise, the more the air

condenses to bring heavy rain on the *windward* side (mountain side that the wind is blowing towards). This type of rainfall is called **Orographic** or **Relief Rainfall**.

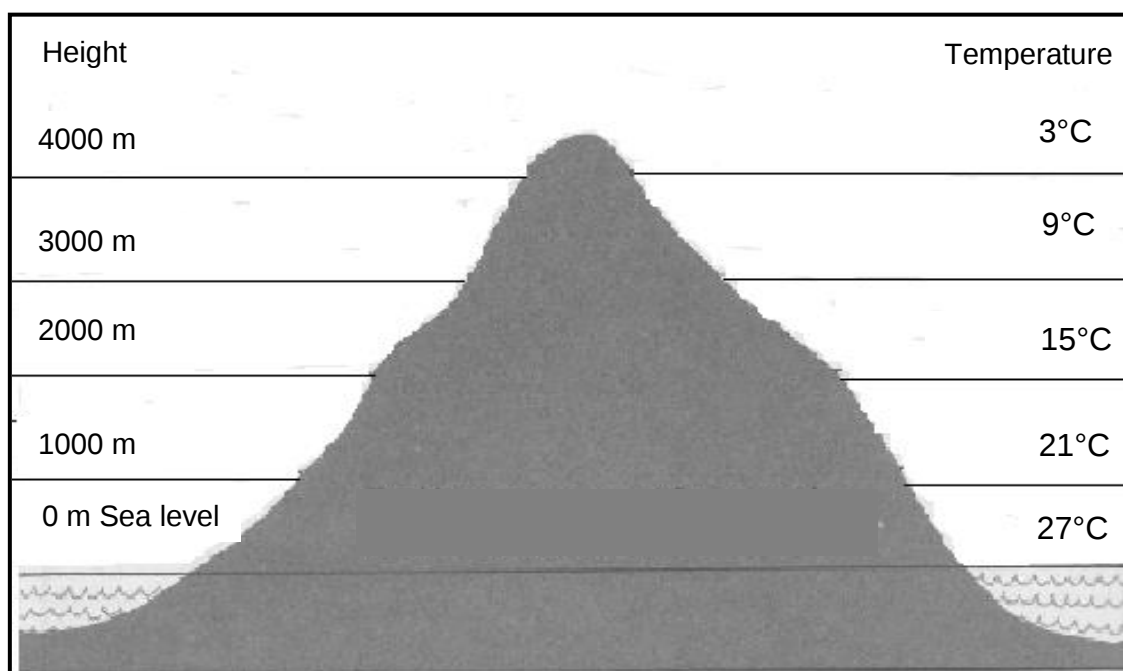
Port Moresby has no mountain ranges for the air to rise. It remains dry around this time and experiences its dry season.

Monsoon winds are seasonal winds that blow from opposite directions in two different seasons in a year. Trade winds always follow a regular path all year.

Distance from the sea refers to how close a place is from the sea. It does not mean the same thing as altitude. Some places are closer to the coast while others are further inland. Places closer to the sea have climates that are affected by the winds blowing in from the sea. When it's hot, places closer to the sea will be cool while places further away will be very hot.

Altitude, as you have seen in earlier lessons is the height above sea level. The higher up the mountain you go, the lower the average temperatures. Cooler temperatures are associated with the rise in altitude. You can see that the highland areas of Papua New Guinea are not as hot as the lowland areas.

The mountains in the centre of Papua New Guinea mainland receive a lot of rain throughout the year, totalling between 2500 and 4000 millimetres.



Temperature decreases as altitude increases. The HIGHER up the mountain you go, the lower the average temperature will be.

Knowing about changes in weather and climate can help people plan their activities. For example, people on the coast would want to know what clothes to wear for a visit to the Highlands, or when strong winds occur to make fishing difficult. The climate can also affect the type of houses people build, the food they grow and the general way of life.



Summary

You have come to the end of lesson 7. In this lesson you have learnt that:

- Climate in Papua New Guinea changes from place to place because of the changing wind patterns and the height of different landforms
- The two main winds that influence the climate of Papua New Guinea are the south-east trade and north-west monsoons
- Average temperature decrease with height above sea level
- Both weather and climate affect the way people live including the type of houses people build, the type of food cultivated and the clothes worn
- Places closer to the sea have climates that are affected by the winds blowing in from the sea.
- It is generally hot and wet on the coastal lowlands for most part of the year
- Most parts of Papua New Guinea receive a lot of rain during the North West Monsoon

NOW DO PRACTICE EXERCISE 7 ON THE NEXT PAGE



Practice Exercise 7

1. What is climate?

 2. A climate graph shows;

 3. What happens to the average temperature as altitude increases?

 4. What do you think happens to temperature as you move closer towards the equator?

 5. What is an equator?

-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1
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Lesson 8: Vegetation in Papua New Guinea



Welcome to Lesson 8. In this lesson, you will learn about vegetation types and the factors that influence its distribution in Papua New Guinea.

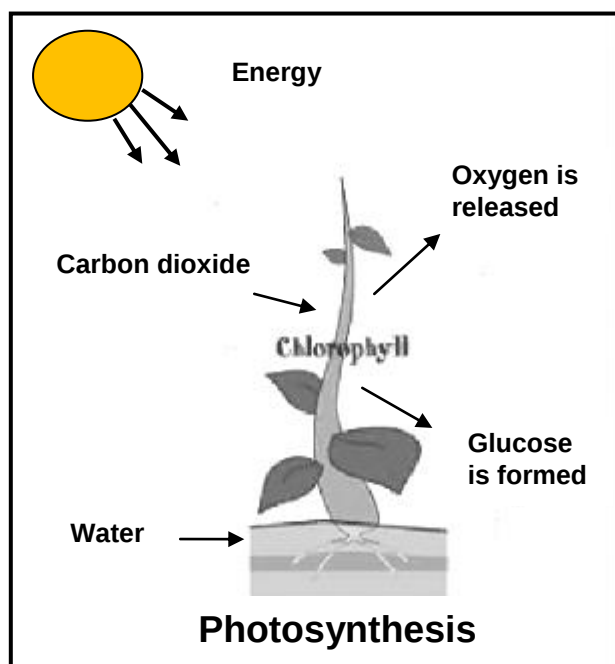


Your Aims

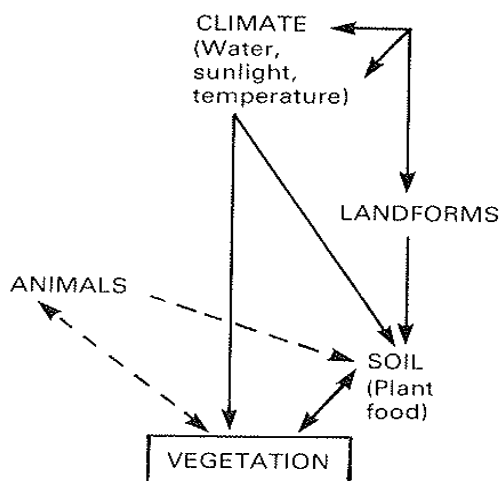
- define vegetation and photosynthesis
- discuss the importance of vegetation
- identify and explain vegetation types in Papua New Guinea
- explain the major influences of vegetation in Papua New Guinea

Importance of Vegetation

The **vegetation** of an area is a group of plants growing in that particular place. Vegetation is important to our environment in a number of ways. For example, the roots of plants help form soils. Their leaves give-off water back into the air. Plants use up carbon dioxide from the air, sunlight and water to produce food. This process is called **photosynthesis**. In this process, oxygen is produced and is taken in by humans. Plants provide nearly all our food. For these reasons, plants are called *producers* and animals including humans *consumers*.



THE CONTROLS OF VEGETATION

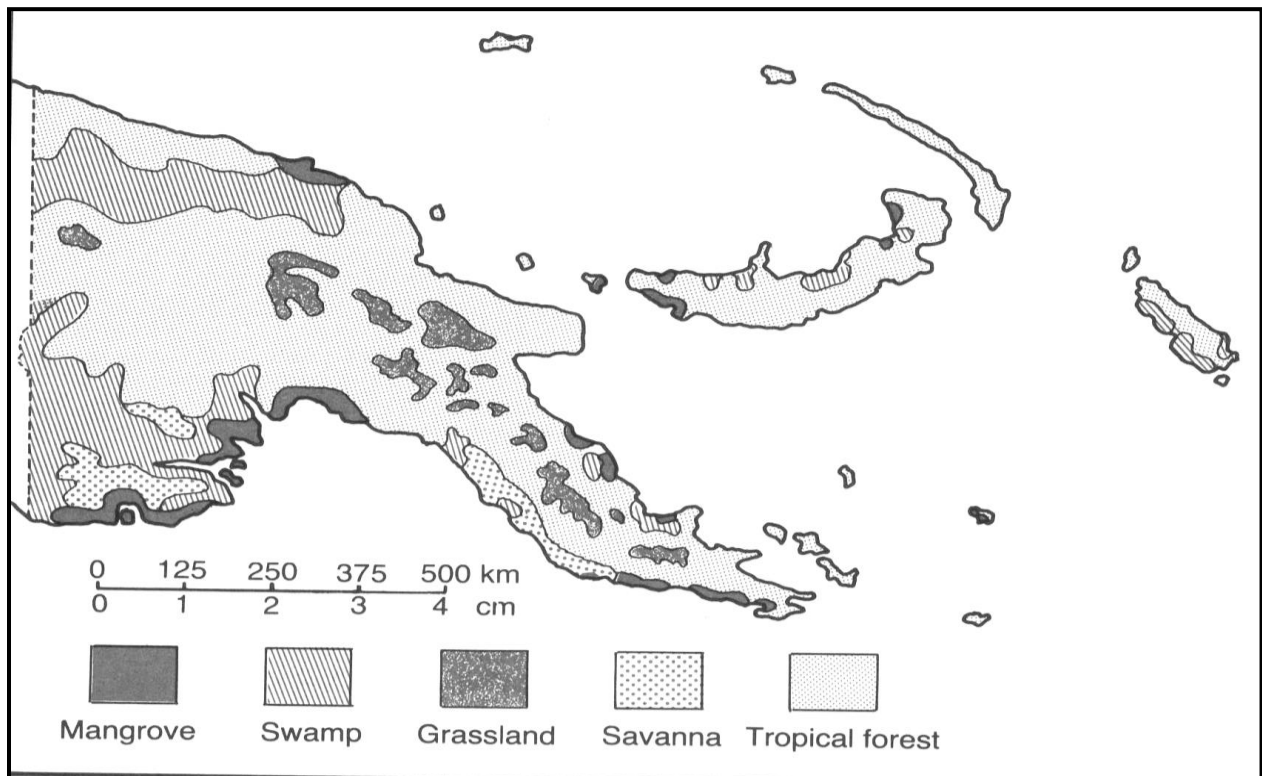


Plants are also *adaptable*. This means they can slowly change to make the best use of their environment. However, they are easily destroyed by the activities of people. You learnt in Lesson 1 that other factors affect the way in which vegetation grows. The most important are climate (provides sunlight and water), soils (provide food for plants) and landforms (can affect the amount of water or sunlight getting to a plant). All these things control the way vegetation grows. We call them *Controls of Vegetation*.

Vegetation in Papua New Guinea

Papua New Guinea has several types of vegetation. The presence of mountains and the different climatic factors have a big influence on the changes in vegetation types as you move away from the coastal lowlands to the highlands. The coasts are warmer and the forests are dense than the forests in high altitude. Grasslands are found in places with low rainfall.

Take some time to study the Vegetation Map of PNG below.

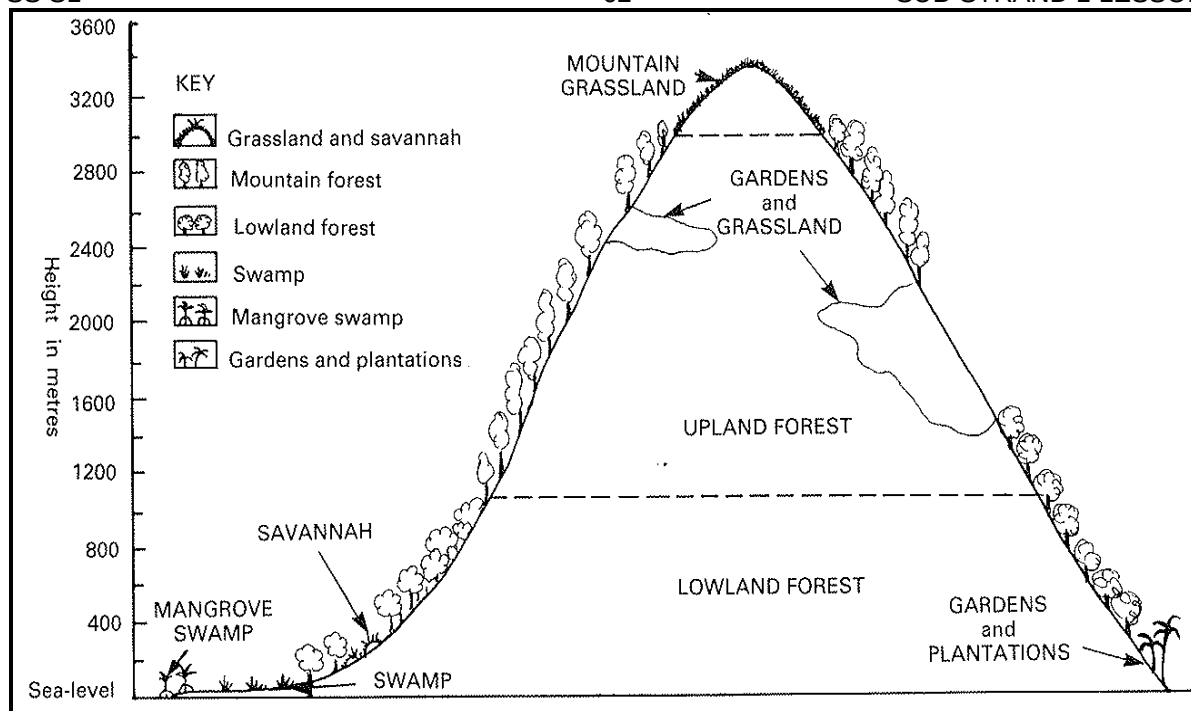


Vegetation Regions in Papua New Guinea

The map above shows the five main vegetation types in Papua New Guinea. You need to read the correct key to identify the vegetation of a place.

Here is a summary of the vegetation types in the map.

- **Mangroves** are found in hot, wet coastal lowlands. They grow in salty water between levels of the tide
- **Swamp** is found in hot, wet lowland areas not affected by the sea, particularly in floodplains of the Fly and Sepik Rivers. Swamp areas are usually fed by nearby rivers.
- **Grassland** is associated with cool mountain climates and dry lowland area.
- **Savannah** grasslands occur in places where there is a distinct dry season such as in Port Moresby. It is a mixture of scattered eucalyptus trees, grassland and ferns.
- **Tropical Rainforests** are found in both lowland and highland areas. The lowland rainforests are taller, more dense while highland rainforests are shorter and less dense. Moss and lichens are commonly found in the rainforests.



A Cross-section of Vegetation in Papua New Guinea

If you walk from a coastal town such as Wewak up to Mt Wilhelm in Chimbu province, you will see mangrove swamps on the coasts, then pass through areas of lowland forest, mountain forest (with some gardens), mountain grassland and then back down through mountain forests, lowland forest and down to the sea again. You realise that it is easier to imagine this on a diagram than actually walk through these areas for observations. This diagram is called a **Cross-Section** because it shows what can be found along a line cutting across a piece of land. It also shows changes in the way the land is used.

The average temperature and average rainfall patterns change as we go higher up to the highland areas and this in turn determine the type of vegetation that grows there. Each type of vegetation is made up of different types of plants. Some plants are found only in certain types of landforms or in certain climates and each type has different characteristics.

In many cases the natural vegetation has been changed by people. Rainforests is used in many ways by our rural people. They collect fruits and nuts; medicinal plants; timber for making canoes and houses; and firewood. Today, more vegetation is cleared because the population is growing very fast. People need money and food so more land is cleared for gardens, cash crops and *commercial logging*. We need to use our rainforests in more *sustainable* ways and plan for the future.



Commercial Logging of Tropical Rainforests

Sustainable use of rainforests means using the rainforest without destroying the natural processes and ecosystem.



A newly cut road for transporting timber

Nowadays, many foreign logging companies cut down large areas of forest for timber. Timber is sold overseas (exported) for money but the rural landowners receive very little money. People have always cleared forests but the speed at which trees are cut down today is faster than the trees can replace itself by natural processes.

When the natural vegetation is cleared, it will grow back again quickly as long as people no longer use it. In many drier parts, it takes very long time for this to happen. In many parts of Papua New Guinea, people do not give enough time for the vegetation to grow back before clearing the land again. As a result new type of vegetation like grasslands replaces the original forest. These grasslands are not natural but *human-induced*.

Types of Natural Vegetation in Papua New Guinea



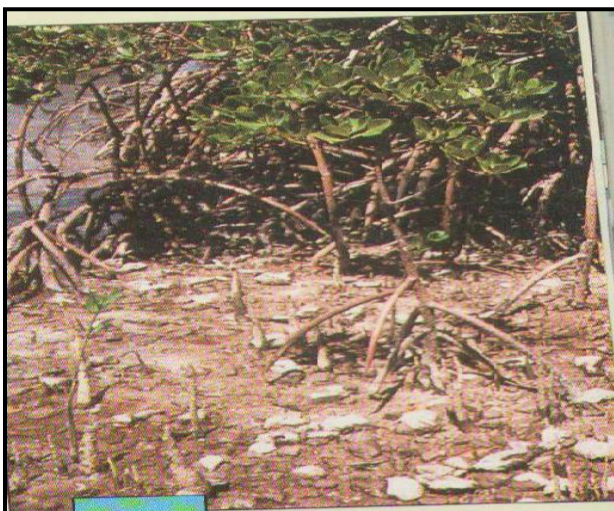
Lower Montane Forest



Savannah grassland



Alpine vegetation



Mangrove Swamps



Lower Rainforest



Summary

You have come to the end of lesson 8. In this lesson you have learnt that:

- There are five main types of vegetation in Papua New Guinea: lowland tropical rainforests, grassland, savannah grassland, swamp and mangroves
- Vegetation is influenced by climate and landforms
- Rainforests are useful to people in many ways, especially in rural areas. It serves as a source of food, medicine, and timber is used for making canoes and houses
- The temperature and rainfall patterns change as we go higher up to the highland areas and this in turn determine the type of vegetation that grows there
- The vegetation of an area is made up of plants and animals
- Plants use up carbon dioxide from the air plus sunlight and water to produce starch or food. In the process, oxygen is produced and is taken in by humans
- As population grows more vegetation is cleared for gardening, cash cropping and commercial logging

NOW DO PRACTICE EXERCISE 8 ON THE NEXT PAGE

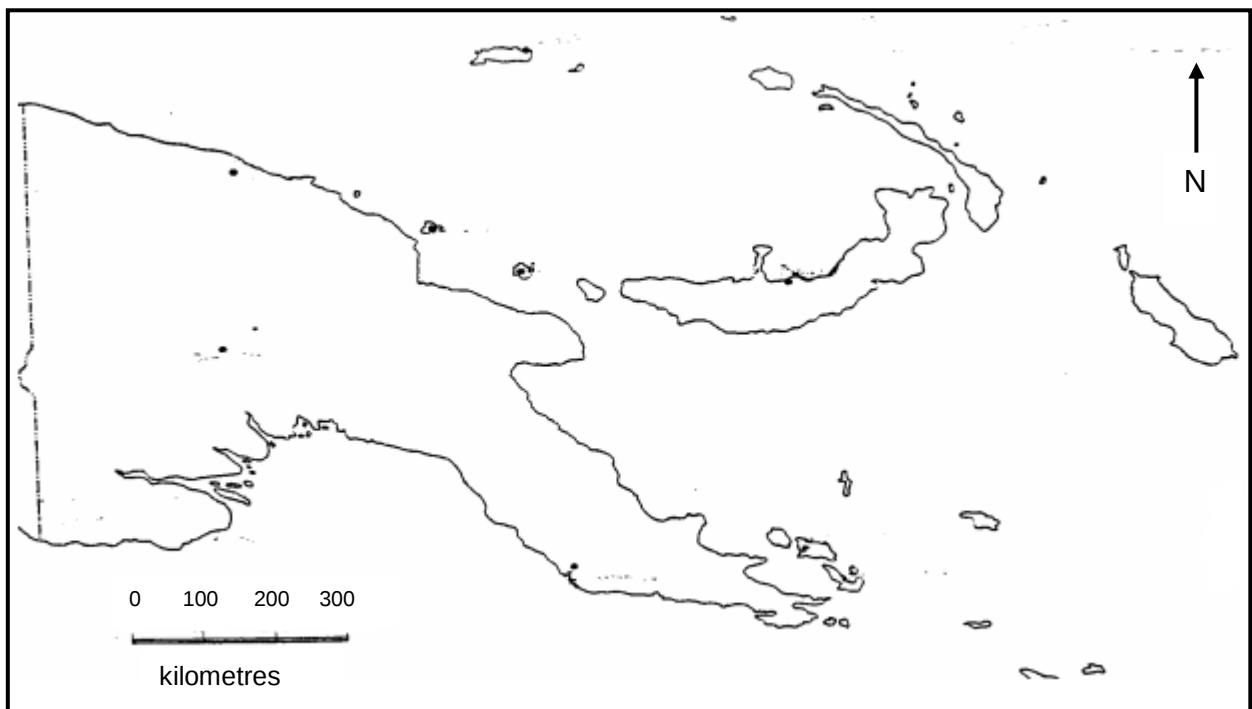


Practice Exercise 8

Fill in the missing words in the paragraph below.

1. All the plants that are found in an area make up the _____ of that place. _____ rainforest is the common type of forest in Papua New Guinea. Large areas of natural _____ is cleared for _____ and cash crops. In drier areas, it takes _____ for new vegetation to grow back.
2. List two types of natural vegetation that is in your local area.
 - a. _____
 - b. _____
3. What can be done to stop forest disappearing altogether?

4. Use the outline map below to show the *five* main vegetations in Papua New Guinea. Create a key using colours or patterns to show each of the vegetations.



NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 1

SUB-STRAND 1

ANSWERS TO PRACTICE EXERCISES 1-8

PRACTICE EXERCISE 1

1. Natural Environment
 2. The part of the environment that is not influenced or affected by people
 3. Rocks, Soil, Vegetation, Climate, Landforms, Rivers, Oceans and Animals
 4. When plants die they decay and become part of the soil. On the other hand, soil provide vegetation with food minerals taken up through the plant roots
 5. Symbols are special signs on maps that show location of certain features
 6. Towns, a swimming pool, bridges, roads (or any other man-made features)
-

PRACTICE EXERCISE 2

1. The sun
 2. Water cycle refers to how nature circulates water to all parts of the earth
 3. The living and the non-living things
 4. The earth's entire living environment
 5. Mountains, Valleys, Ocean Trenches, Mid-Ocean Ridges, Islands
(any two can be correct)
 6. Weathering is the slow breakdown of rocks by nature while erosion involves the wearing down and transportation of rock pieces broken by weathering processes
-

PRACTICE EXERCISE 3

1.
 - (i) Height: How high the land is above the sea level
 - (ii) Shape: What it looks like
 - (iii) Slope: How steep or gentle it is
 - (iv) Relief: The differences in height
2. Cone Shape
3. Mountains, Hills, Plateaus, Plains and Valleys
4. Australian and the Pacific plates
5. Australian plate
6. Damage houses and other buildings, electrical fires and death, tsunamis, (tidal waves)

PRACTICE EXERCISE 4

1. Eastings 2. Northings 3. 2430 4. Hills, dangerous rocks, lighthouse
 5. River
-

PRACTICE EXERCISE 5

1. Weather is the daily condition of the atmosphere in a short period of time (e.g. a day), and climate is the average condition of the atmosphere in a long period of time (e.g. season, a year or a number of years).
2. Temperature is a measurement of heat while heat tells us how hot or cool something is
3. The highlands of Papua New Guinea is at a higher altitude. The air is thin up there, it cannot keep heat.
4. Precipitation is any form of moisture that falls to the surface of the earth.
5. Temperature, rainfall, clouds, winds, air pressure

6.

Examples of Precipitation	State of Matter
Fog	<i>Water vapour/gas</i>
Morning Dew	<i>Liquid</i>
Snow	<i>Solid</i>
Rainfall	<i>Liquid</i>

PRACTICE EXERCISE 6

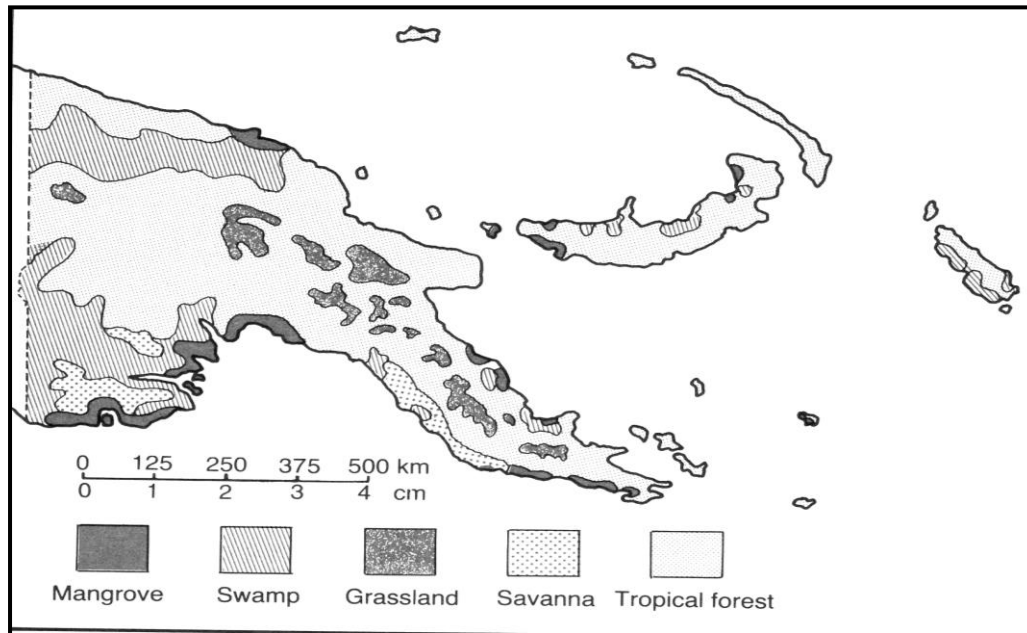
1. (a) 23-24 degrees celsius (b) January
 2. (a) 12 degree Celsius (b) June and July
 3. April received between 130 to 140 millimeters of rainfall (or nearest)
 4. From February to July
-

PRACTICE EXERCISE 7

- 1 The overall pattern of rainfall and temperature over a long period of time
- 2 The average rainfall and temperature for each month
- 3 Temperature decreases
- 4 Temperature increases or becomes warmer
- 5 Equator is the imaginary line that runs from east to west at 0°. It is the central line of all latitude.

PRACTICE EXERCISE 8

1. Vegetation, Tropical, vegetation, gardening, longer
2. Student own answers (any two below)
mountain grassland, savanna grassland, mountain forest, highland forest, swamp vegetation, mangrove vegetation
3. Sample Answers include; sustainable ways of using forests such as planting new trees, selecting only older trees, stop bush fires, clear less forest for gardening.
- 4.



SUB-STRAND 2

THE HUMAN ENVIRONMENT

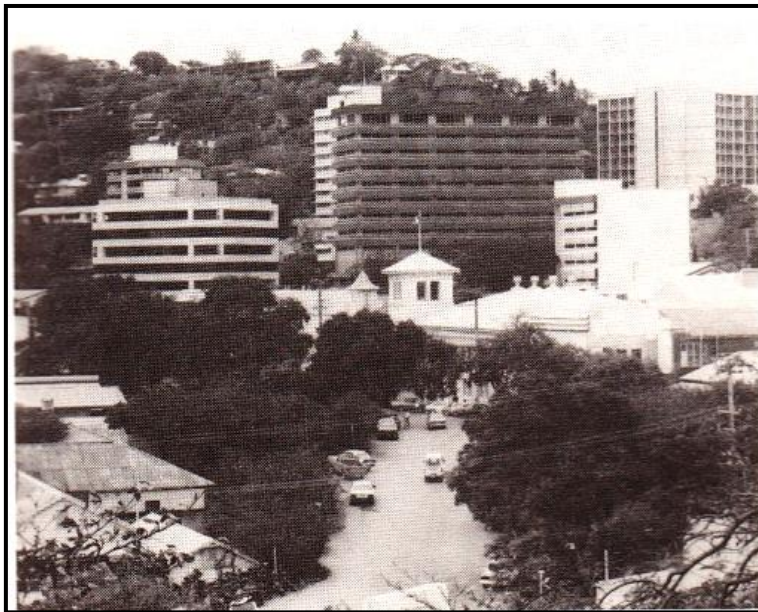
In this Sub-strand you will learn about:

- **Settlement Patterns**
- **Directions**
- **Factors Influencing Population Density**
- **Urbanisation: Its Causes and Effects**
- **Resource Industries in Papua New Guinea**
- **Using Map Scales**

Sub-Strand 2: Introduction

In this **Sub-strand**, you will learn about man-made environments such as settlements and settlement patterns, population density, urbanisation and resource industries in Papua New Guinea.

The human environment is made up of things that are strongly influenced by humans. It is often associated with terms such as human, cultural or the man-made environment. Hence, you will be studying how people influences and changes the natural environment. You will also be learning mapping skills.



Port Moresby City

Lesson 9: Settlement and its Patterns



Welcome to Lesson 9. This is the first lesson of Sub-strand 2. The Human Environment. You will learn about different types of settlements and the patterns they form.



Your Aims

- differentiate between settlements and settlement patterns
 - discuss reasons for different settlement patterns
 - identify and describe the factors that influence human settlement patterns
-

What is a Settlement?

In Papua New Guinea, settlement is used to describe the areas in towns and cities where squatters or *illegal settlers* live. However, the word settlement also refers to a place where people live. Settlements can be small or large, ranging in size from a few houses, through to villages, towns and cities. Settlements are man-made features and are part of the *built environment*. The built environment is any thing that is added to the land surface by people.

Early settlements were often temporary because people were still *nomadic* hunters and gatherers. They moved from place to place in search of food. There are still some people who are nomadic today who live part of their lives in temporary settlements. This is true with some tribal communities in the rural Papua New Guinea and the other parts of the world.

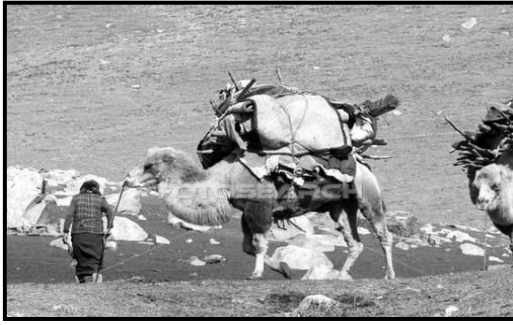
Have a look at the photographs below. They show examples of nomadic lifestyles.



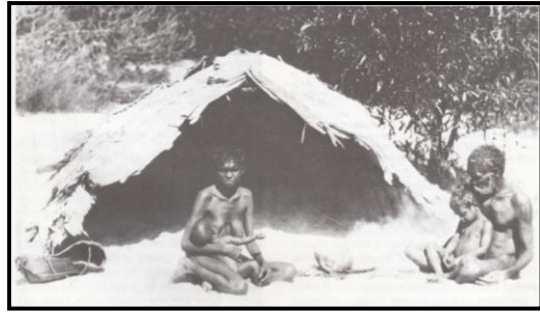
Some Tribal Communities in Papua New Guinea Still Live Nomadic Lives.



The San Nomadic Tribe of Kalahari Desert, Africa.



Nomadic Herdsman, China



An Aboriginal Family

When people became settled in one place, they cultivated food crops and looked after animals. More food was produced and the population grew. Settlements also expanded in response to the increased population.

The two main types of settlements are *rural* and *urban* settlements.

1. In a **Rural Settlement**, most people earn their living by cultivating the land or otherwise using the natural environment to meet their basic needs. In Papua New Guinea, these are mostly the villages. Here, most people are involved in primary activities such as fishing and gardening.
2. In an **Urban Settlement**, most people do not depend fully on their natural environment to earn their living. Examples of urban settlements are towns and cities. Most people work in manufacturing industries, postal, banking services and other office jobs.



Sweet Potato Farming in a rural Highlands village.

In Papua New Guinea, there are other types of settlement. These are places like mission stations, patrol posts, schools and plantations. The settlements are located in rural areas but the people living there are not farmers. This term is not commonly used in other countries, although it is quite useful in describing this type of settlements.



Do settlements form patterns?

The study of rural settlement shapes or patterns can tell us many things about how societies are organised. It can also tell us about the problems or needs a village may have. Changes in settlement patterns can tell



Linear Settlement along a Coastline in Port Moresby

Do you have the Papua New Guinea, Secondary School Atlas? Turn to page 49 and study the Settlement Patterns.



Here are some more descriptions of settlement patterns:

1. **Nucleated Settlement** pattern is formed when villages are grouped closely together. Sometimes it is for defence and protection in times of war. It is also easier to cooperate and obey village rules if people are grouped together. It makes it easier for government to supply services such as water, schools and aid posts when settlements are together. Nucleated villages can vary in size, with ten or twelve houses while others may have hundreds. The bigger the village, the more difficult it is to organise people and resources. This settlement pattern can also be around areas of natural resources like rivers.
2. **Dispersed Settlement** is formed when houses are some distances from the nearest village. In most parts of Papua New Guinea villages are not nucleated but the houses are scattered about, hundreds of metres apart. Even members of one family may live in houses which are quite separate. Difficult physical conditions and hardships will support few people. Shortages of water, forests, gardening soil, less transport networks all contribute to disperse patterns in parts of Papua New Guinea. Land ownership in some areas of Papua New Guinea also influences certain families to live on their own land away from the main village and their closely related families.

3. **Linear settlement** is common in Papua New Guinea. This pattern is formed when houses are built to form a line along a road, river or a coastline. People often select these sites to build their houses so that they can easily access the resources or services. For example, people build their houses near the coasts in order to have access to both the land and sea resources or to use the sea as a means of transport.

You will find linear patterns of settlements along the coasts of the Gulf province, coastal areas of the Sandaun and East Sepik provinces and along the banks of the Sepik River. Linear settlement is also found along the Sepik and the Highlands Highways. The traditional patterns of settlement have changed a lot due to new developments.



Summary

You have come to the end of lesson 9. In this lesson you have learnt that:

- Settlement is where people live
- The two types of settlements are rural and urban settlements
- The three main types of settlement patterns are nucleated, dispersed and linear.
- Dispersed settlements patterns develop in areas where natural resources are of short supply and not enough to support many people.
- Major causes of nuclear settlement or grouping together was for defence and protection.
- The more extreme physical conditions and possible hardships of an area there are, the more likely the settlement will be dispersed or scattered.

NOW DO PRACTICE EXERCISE 9 AT THE END OF SUB-STRAND 2



Practice Exercise 9

1. What is a settlement?

2. Why do people create nucleated settlement pattern?

3. What is the difference between rural and urban settlement pattern.

4. List the three main types of settlement patterns.

- (i) _____
 - (ii) _____
 - (iii) _____
-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2
--

Lesson 10: Directions



Welcome to Lesson 10. In this lesson, you will learn another map skill that will help you to read and understand the location and position of a place or person on a map correctly.

Your Aims

- define direction, compass and compass point
- identify the different compass points
- locate places using compass points

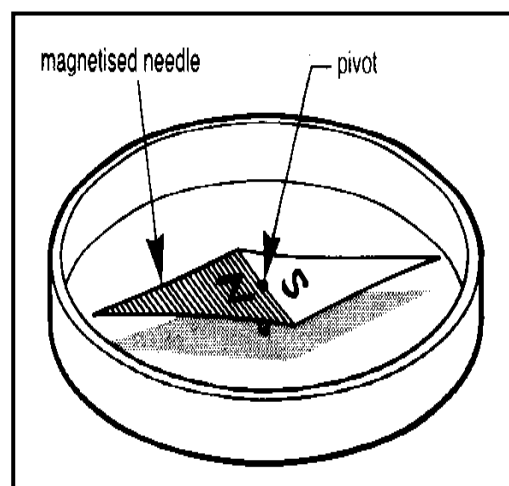
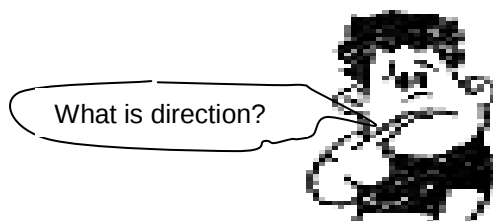
Direction and Compass

Direction refers to the general position of a place or person in relation to another. If you travel to a place where there are no easily recognised features, a map is of little use. Imagine you are walking through two villages separated by a thick jungle.

Even if you have a map you will still be lost. Ancient explorers who sailed through unknown seas faced a similar problem. They use stars at night to continue their journeys. In a thick jungle, even the stars will be hidden and would be hard to see. This is when the use of a *compass* is needed.

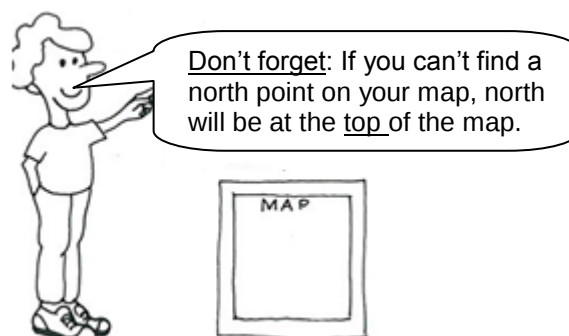
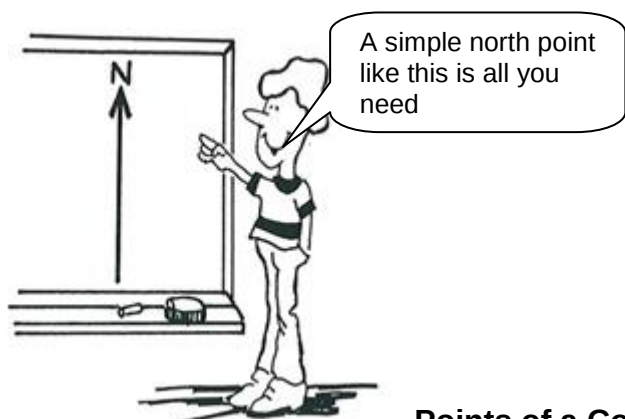
The main part of a compass is a *magnetized needle* which can spin around. The earth has a magnetic field, like a huge magnet inside it. Because the compass needle is magnetized, one end of it is attracted to the earth's North Pole and the other end to the earth's South Pole.

So, wherever a compass is, its needle will always point to the North Pole. The end of the needle that points to the north is always clearly marked by color or by a letter 'N'.



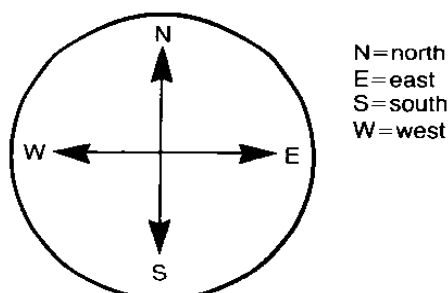
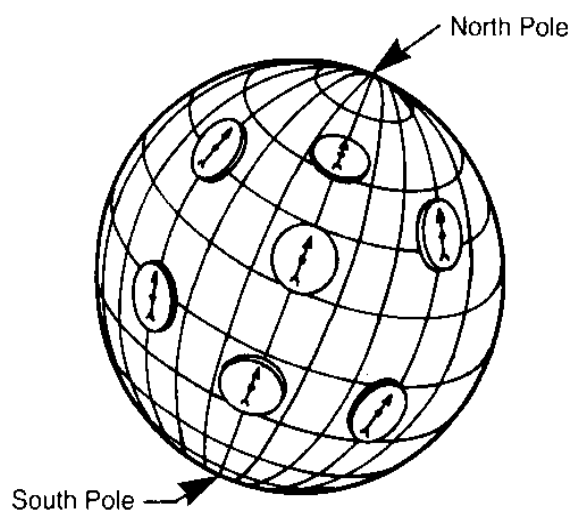
A Compass

A compass is an instrument for finding directions, usually with a magnetised needle that automatically swings to the magnetic north.

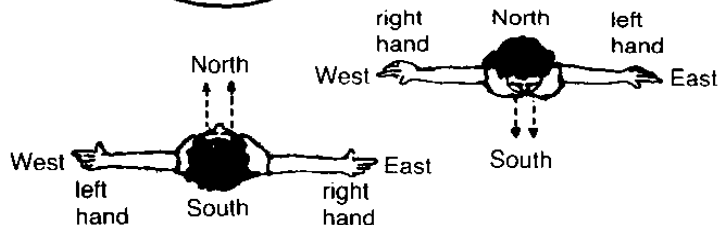


Points of a Compass

A compass has four main points known as **cardinal points**. They are; North, South, East and West. If you are facing north, then south is behind you and east is to your right. If you are facing south, then north is behind you and west is to your right. You can see these in the diagrams below.



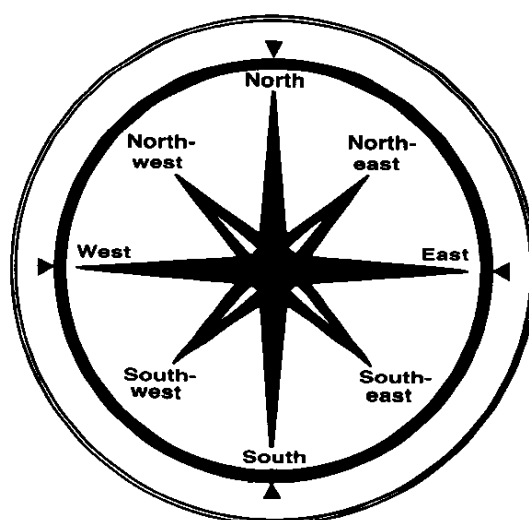
N=north
E=east
S=south
W=west



The **intermediate** or **inter-cardinal points** lie *in between* each of the cardinal points. They are North-east, South-east, South-west and North-west.

A compass with only four cardinal points would be of little help. These intermediate cardinal points increase the number of compass directions to eight. These compass directions can be used to find direction of travel or the position of features in relation to another on a map.

More accurate than an eight-point compass is a sixteen-point compass.





Summary

You have come to the end of lesson 10. In this lesson you have learnt that:

- Direction refers to the general position of a place or person in relation to another
- A compass has four main points known as *cardinal points*. These are *north*, *south*, *east* and *west*
- Wherever a compass is, its needle will always point to the North Pole
- The Intermediate or Inter-Cardinal Point lie *in between* each of the cardinal points and they are *north-east*, *south-east*, *south-west* and *north-west*
- The main feature of a compass is a *magnetized needle* which can spin around
- Compass bearings gives compass direction in degrees and are more accurate than compass bearings

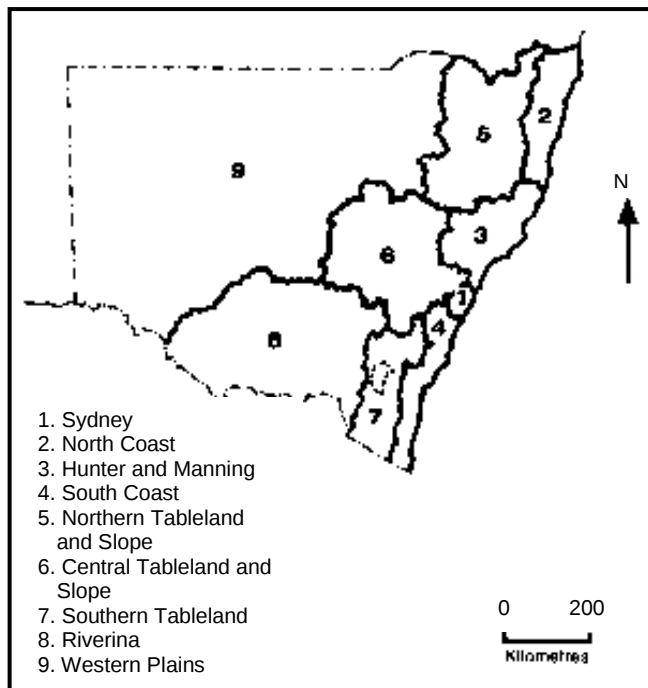
NOW DO PRACTICE EXERCISE 10 ON THE NEXT PAGE



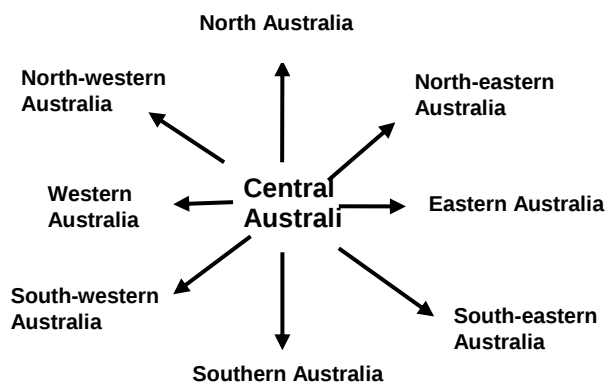
Practice Exercise 10

Use the map below to answer questions.

THE REGIONS OF NEW SOUTH WALES



MAP OF AUSTRALIA



- Which regions in New South Wales have a compass point as part of their name?

- Which regions do not use compass points in their name?

- How does the use of a compass point in a name give us an idea of where that place is on a map?

Use the maps on compass point on page 77 to answer these questions.

- What direction is opposite of east? _____
- What direction is halfway between west and south? _____
- What direction is halfway between North and East? _____
- What direction is opposite of north-west? _____

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2

Lesson 11: Population



Welcome to Lesson 11. In this lesson, you will learn human population, their numbers and factors influencing where they settle. You study also look at population density and factors influencing it.

Your Aims

- distinguish between population and population density
- define census
- discuss the importance of census
- distinguish between densely and sparsely populated areas
- calculate population density of a given place
- identify factors that influence population density



What comes to your mind when you hear the word population?

People, of course!



How many people are they? Where are they? How old are they? Are they moving from one place to another? How fast are they increasing in numbers? These are all questions about population.

The study of human population is called **demography**. It is important to know the number of people who live in a country and the skills, knowledge and ability they have. The people of a country with its skills and abilities are the human resource of that country. If the government wants to plan properly, it must know the answers to all the above questions about the people. Good planning of the government means having good knowledge of all aspects of the population so that allocation of resources can be done fairly.

To get information about the total number of people in a country, governments count the number of people. This process is called **census**. In Papua New Guinea, the National Statistics Office is responsible for carrying out census every ten years. The last census was supposed to have been conducted in 2010. Unfortunately, it did not take place as planned. The country's population according to the census of 2000 was **5, 190 786**.



Now study the table below. It shows the population of each province in 2000.

POPULATION STATISTICS FOR PAPUA NEW GUINEA, CENSUS 2000

Table 1: Population and Household Distribution by Region and Province, 2000 Census, PNG.

PROVINCE	Household	Persons	Males	Females	% of Total Population	Crude. Pop. Density/sq.km
PAPUA NEW GUINEA (PNG)	1,008,969	5,190,786	2,691,744	2,499,042	100.0	11
SOUTHERN REGION	182,755	1,041,820	549,330	492,490	20.1	5
Western Province	25,744	153,304	79,240	74,064	3.0	2
Gulf Province	18,004	106,898	55,529	51,369	2.1	3
Central Province	32,254	183,983	96,062	87,921	3.5	6
National Capital District (NCD)	42,403	254,158	138,974	115,184	4.9	1052
Milne Bay Province (MBP)	41,784	210,412	109,668	100,744	4.1	15
Northern Province	22,566	133,065	69,857	63,208	2.6	6
HIGHLANDS REGION	413,999	1,973,996	1,013,953	960,043	38.0	31
Southern Highlands Province (SHP)	96,461	546,265	278,331	267,934	10.5	23
Enga Province	53,022	295,031	153,146	141,885	5.7	23
Western Highlands Province (WHP)	100,723	440,025	224,697	215,328	8.5	52
Chimbu Province	58,384	259,703	134,928	124,775	5.0	42
Eastern Highlands Province (EHP)	105,409	432,972	222,851	210,121	8.3	38
MOMASE REGION	269,304	1,433,432	738,567	694,865	27.6	10
Morobe Province	102,607	539,404	280,710	258,694	10.4	16
Madang Province	64,294	365,106	190,322	174,784	7.0	13
East Sepik Province (ESP)	69,180	343,181	172,012	171,169	6.6	8
West Sepik Province (WSP)	33,223	185,741	95,523	90,218	3.6	5
ISLANDS REGION	142,911	741,538	389,894	351,644	14.3	12
Manus Province	8,812	43,387	22,401	20,986	0.8	21
New Ireland Province (NIP)	24,753	118,350	62,760	55,590	2.3	12
East New Britain Province (ENB)	42,624	220,133	115,704	104,429	4.2	14
West New Britain Province (WNB)	33,574	184,508	99,015	85,493	3.6	9
North Solomons Province (NSP)	33,148	175,160	90,014	85,146	3.4	15

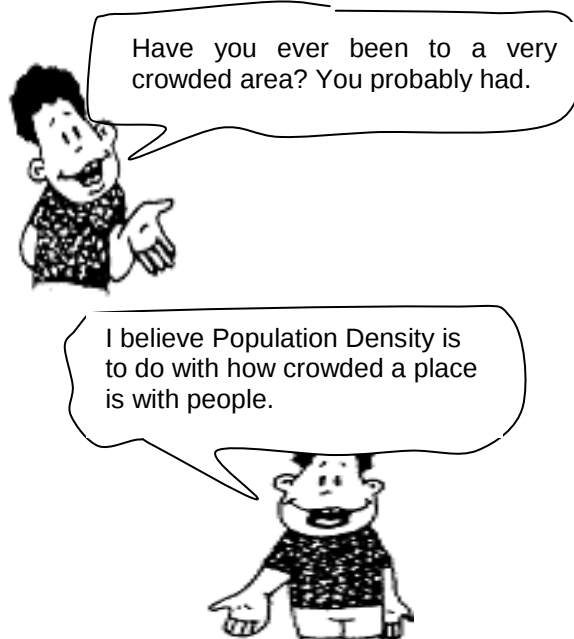
You can see from the table that some regions and provinces have more people than others.

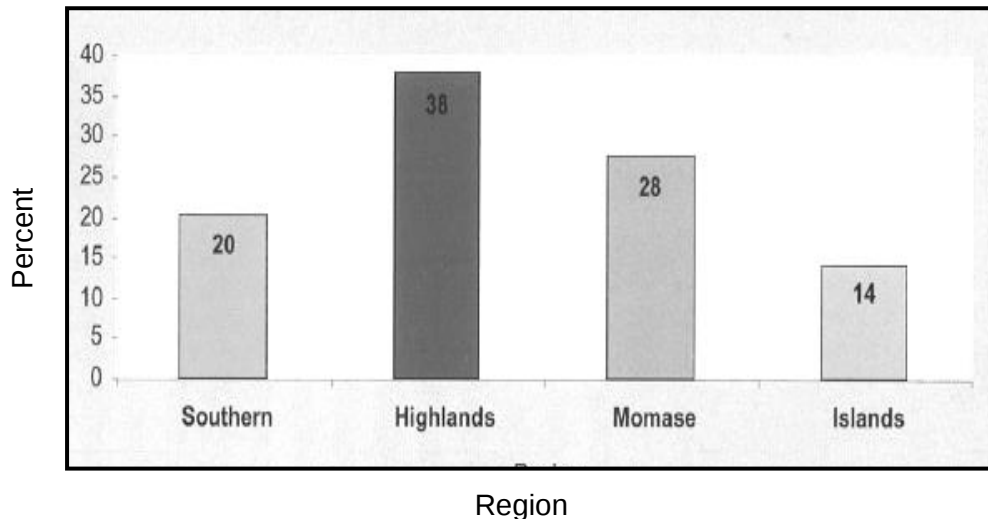
Population Density describes the number of people living in a particular area in relation to the amount of land available.

To calculate the population density of an area, you divide the total number of people in an area by the number of square kilometres in the area.

The formula for calculating Population Density is:

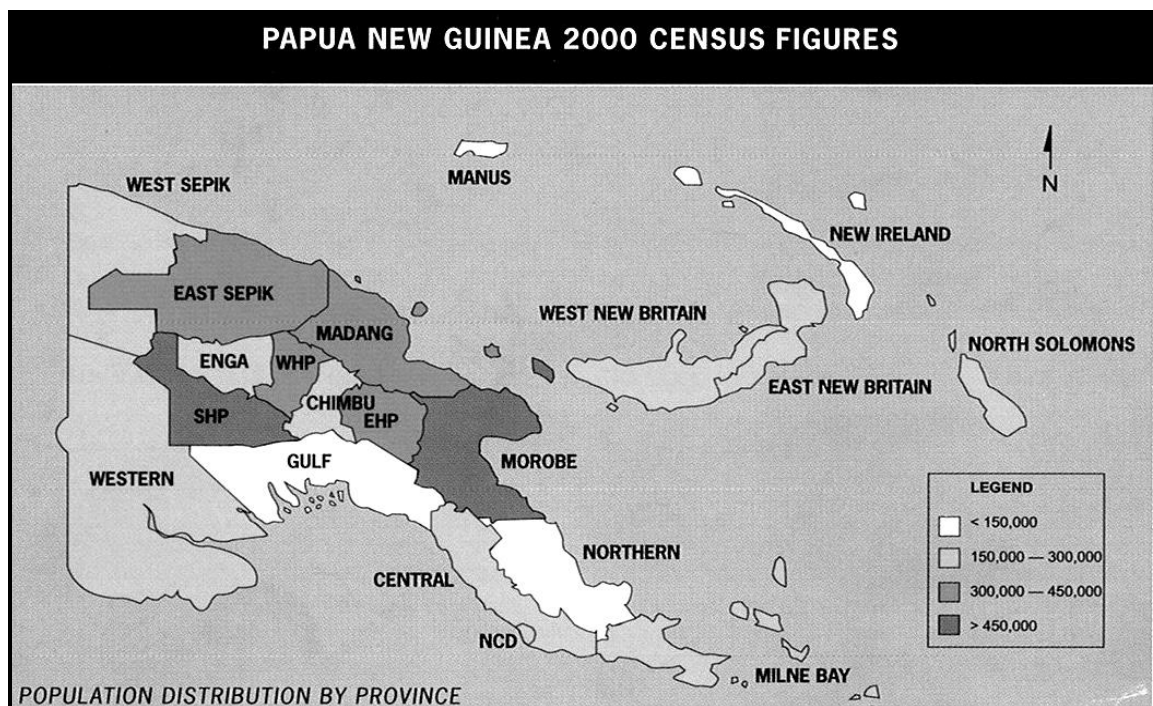
$$\text{Population Density} = \frac{\text{Total Population}}{\text{Total Land Area}}$$



POPULATION DISTRIBUTION BY REGION, PNG, 2000

Population Distribution is the way in which people are spread out across the land surface.

You can see in this graph and the map below that more people live in the Highlands than the other three regions of Papua New Guinea. Therefore, the distribution of people over Papua New Guinea is *uneven* and there are many differences in its density.



Sparsely populated - less people living on a square kilometre of land.
Densely populated - more people living on a square kilometre of land



Can you think of reasons why the population of Papua New Guinea is so *unevenly* distributed?

In Lesson 1, you learnt about the physical features of the natural environment. This uneven distribution of people has got a lot to do with the influence of these features.

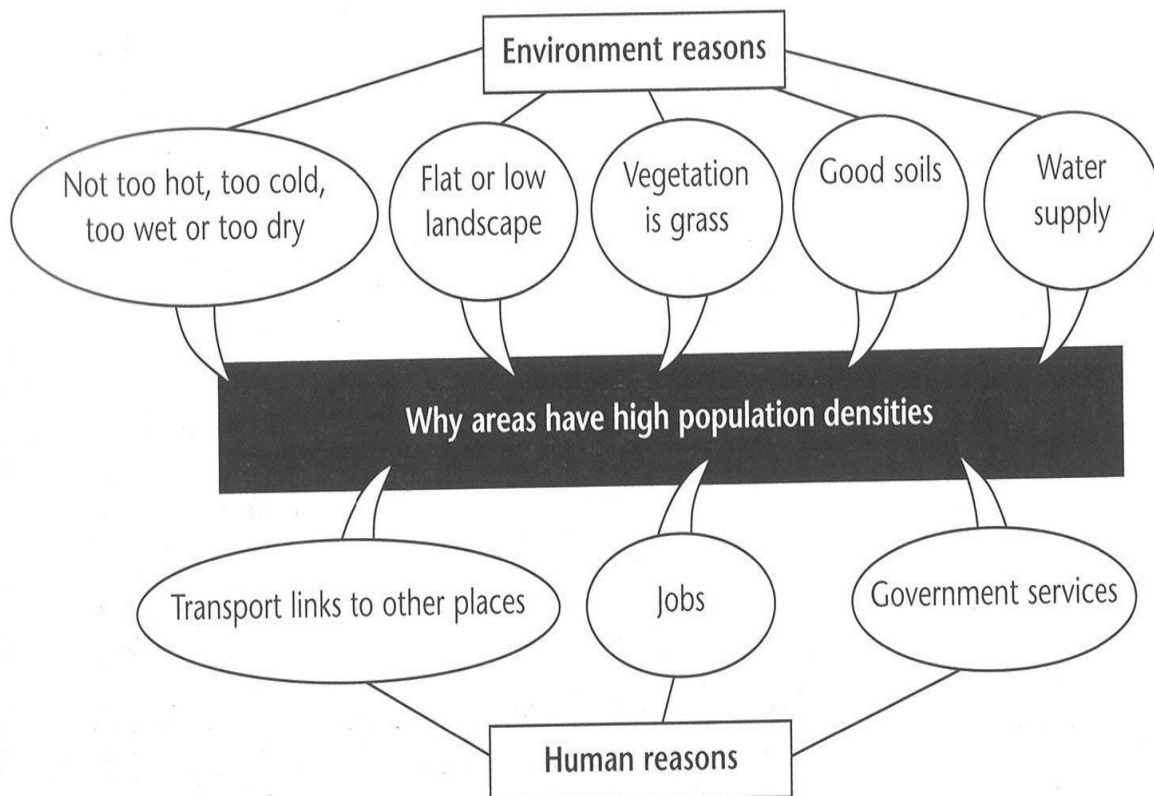


You learnt about settlements in Lesson 9. By now, you should understand why people select a particular *site* to settle and how this gives rise to the different settlement patterns.

For example, favourable climate, vegetation and landforms will attract people to settle in that particular area.

If you look back at Lesson 1, you will also see that the *densely populated* areas of the Highlands have cooler and moderate rainfall with fertile valleys. The Western Province is very *sparsely populated* because the land is too swampy and not suitable for agriculture. It is also very far from the urban areas. Therefore, it is unattractive for people to settle in.

Take a look at the flow diagram below. It shows a list of *environmental* and *human* factors that cause high population density (densely populated areas).



Here are some factors that contribute to *low population density* (sparsely populated areas):

- climates that are too hot, cold, dry or too wet
 - natural hazards such as droughts and floods
 - soils that are not good for growing food
 - steep and rugged landscape
 - dense and isolated rainforests
 - many diseases such as malaria
 - lack of good water supply
 - lack of natural resources that could be creating jobs for people
 - isolated from government services such as schools, aid posts, police etc.
 - poor transport links
-



Summary

You have come to the end of lesson 11. In this lesson you have learnt that:

- Demography is the study of human population
 - Census is the process of counting the total number of people living in a country
 - Population density describes the number of people living in a given place
 - Population density usually describes the number of people in relation to the amount of land area in a place
 - Population density is calculated by dividing the number of people in an area by the total land area of that place
 - Population distribution refers to the way in which people are spread out across the earth surface
 - The distribution of peoples over Papua New Guinea is uneven and there are many differences in its density
 - Natural features such as climate, vegetation and landforms influence where people settle
-

NOW DO PRACTICE EXERCISE 11 ON THE NEXT PAGE



Practice Exercise 11

1. Discuss two ways climate influence population density.

(i)

(ii)

2. What is census?

3. Calculate the Population Density of Australia if the land area is 7 500 000 Square Kilometres while its total population is about 12 million people. Remember, in million you have six zeros (000 000). Work out your answer in the box below.

4. List five factors that influence population density?

(i)

(ii)

(iii)

(iv)

(v)

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2

Lesson 12: Urbanisation, its Causes and Effects



Welcome to Lesson 12. In this lesson you will learn about urbanisation, its causes and effects.



Your Aims

- define urbanisation and rural-urban drift
 - distinguish between pull and push factor
 - identify and explain factors that contribute to rapid urban growth
-

Papua New Guinea urban areas are the towns and cities while rural refers to the villages and farmland. Cities are bigger in size and have more functions than towns. For example, we call Port Moresby a city while Wewak is a town. One of the world's largest cities, Tokyo has more people than the entire population of Australia.



What is Urbanisation?



The word *urban* is in the word urbanisation. So, I think urbanisation is to do with towns and cities.

When more people move from rural areas to live in the towns and cities, the population of towns and cities increase. This process is called **urbanisation**, and the movement of people from the rural areas to towns and cities is called **rural-urban drift**.

During the last one hundred years, the world's population has grown rapidly. People are moving from rural to urban areas at a faster rate. This is happening mostly in the poorer, developing countries. In 1950, about 30 percent of the world's population lived in urban areas.

In 1995 this figure increased to 45 percent. It is estimated that, by 2025, this proportion will be more than 60 percent. As well as the growth in population, there has been a rapid growth in *Urbanisation*. It is predicted that about half the world's population now live in the cities.

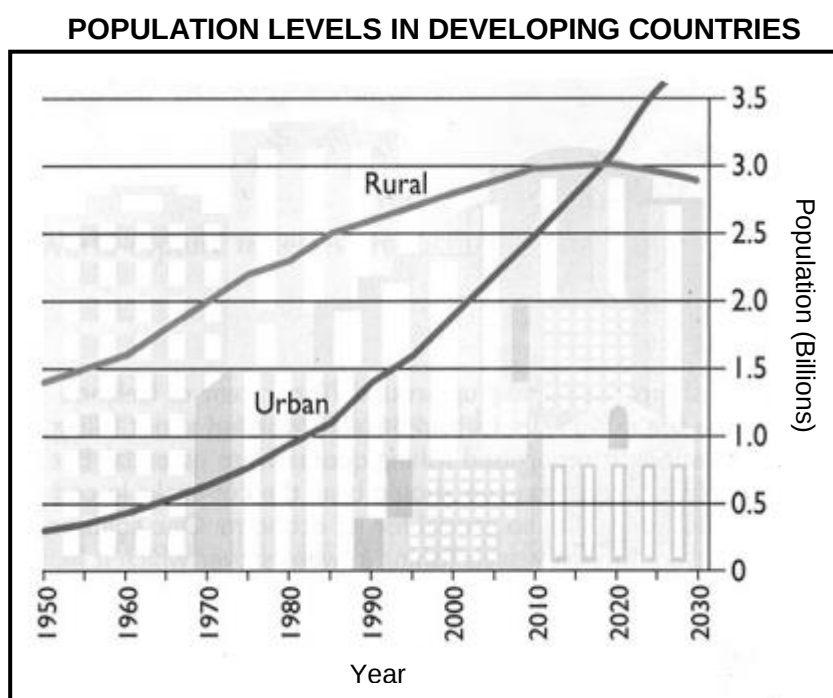
Different countries have their own definition of urbanisation. For example, a settlement with 500 people in South East Asia is a rural area while the same in Papua New Guinea is an urban area. In Papua New Guinea, an urban area is officially defined as a settlement which:

- has at least 500 people living there
- has a population density of at least 195 people per square kilometre whose people, in general do not earn their living as farmers.

Can you recall what you learnt about **Line Graph** in Lesson 6? Now, study this line graph on population levels in developing countries.



- This graph shows that the urban population of developing countries has steadily increased as of 1990.
- The rural population levelled off around 2007. It is predicted to further decline from 2015 onwards.



Source: International Food Policy Research Institute

Why are Towns Growing so Quickly?

When the early foreigners came to Papua New Guinea, they set up settlements. These people were mainly missionaries, traders and the colonial government officials. Some of the early towns in the Papuan Region included Daru, Abau, Samarai and Port Moresby while Finschafen, Madang and Kokopo were in New Guinea. They eventually increased trade activities, alluvial mines and set up plantations for cash crops.

This opened up opportunities for employment as labourers were required in most of these centres. These men went out to villagers recruiting young man to work. Eventually more men started migrating from the villages to these settlements in the hope of getting a job. The small towns grew into bigger towns as more attractions like goods and services, cash and entertainment became increasingly abundant.

The bigger the town, the more attractive it became to different groups of people. Many people move away from rural areas because of **push and pull factors**. For example, people *migrate* (move to) to cities and towns because of natural disasters, tribal warfare or even lack of money earning opportunities. People are attracted to the 'bright lights' of the city where they hope to find a job and a new life. The factors that attract them to the cities are called **pull factors**. They may also look for jobs, entertainment or better services. Cities generally offer the possibility of better opportunities.

Now do the activity below. Check your answers at the end of the Summary.



ACTIVITY 1

1. List three examples of push and pull factors in the table below.

Push Factors	Pull Factors
(i)	(i)
(ii)	(ii)
(iii)	(iii)

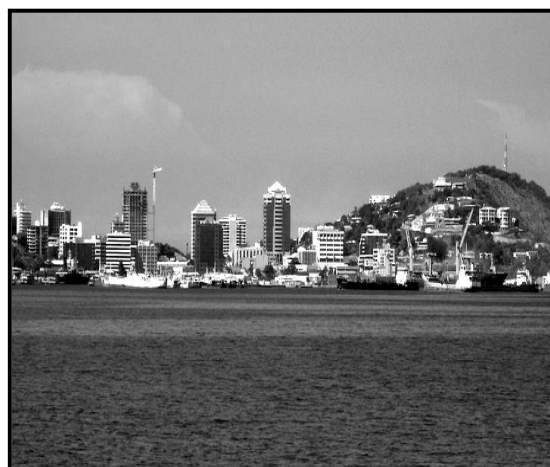
There was no urbanisation in times before the arrival of Europeans. Today, the rate of urbanisation in Papua New Guinea has increased. Many more people are moving to live in towns and cities. However, they do not always find answers to their problems when they go to the cities. They face many problems such as not enough food, overcrowding, lack of good water supply, no electricity and lack of proper sewage disposal methods. Many young men tend to commit crimes to making a living.

Moving to Port Moresby City

The capital city Port Moresby is the largest city in Papua New Guinea. This is where you find the national government offices, industries and the head offices of trade and business. The capital city offers many job opportunities for people.

If you have the chance of visiting Port Moresby, you will find four different types of places where people live.

Now turn to the next page and study the different types of places.



Port Moresby City

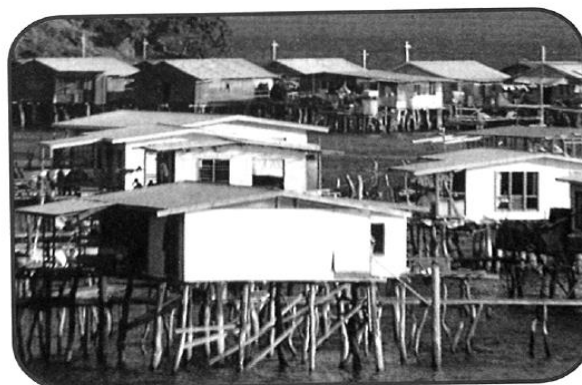
Four Different Types of Places

1. The **suburbs** are residential areas with basic services such as a market, clinic, shops and postal services. Examples of suburbs in Port Moresby are Gerehu, Tokarara and Hohola. The suburbs with cheaper houses include Tokarara, Gerehu, Hohola and Erima.
2. **Traditional villages** are those which originally existed long before urban settlements were built around them. The Motuan villages of Hanuabada and Pari in Port Moresby are an example.
3. **Shanty towns** or **squatter settlement** are areas where illegal settlers built houses using scrap metals, off-cut timber and corrugated iron sheets. Squatter settlements are found all around Port Moresby. Some of these are built on customary land (land owned by local people); others are built on unused government land. Examples of squatter settlements in Port Moresby include Sabama, Horse camp and Tete at Gerehu.
4. **High Covenant houses** are large quality houses with enough space for a whole family.

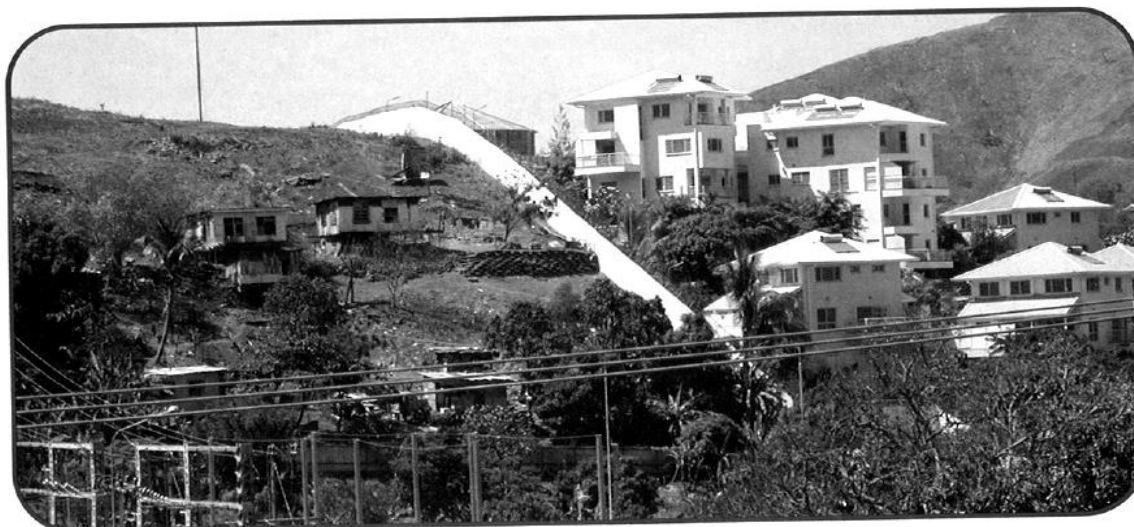
Here are some photographs of these places where people live.



A High Covenant Home



Hanuabada: A Traditional Village



Ranuguri settlement on the left, next to the Australian High Commission Compound at Konedobu, Port Moresby

Today, more Papua New Guineans occupy high covenant houses which were once occupied by expatriates. Most Papua New Guineans live in medium and low covenant houses.

More and more people are migrating to Port Moresby and other towns of Papua New Guinea in the hope of finding jobs and better life. When they are not able to find jobs some engage themselves in informal business activities. In Port Moresby alone, many informal betelnut markets have increased. General cleanliness of the city is a big concern for the National Capital District Commision.

Most of these people are unskilled and are not able to find proper jobs. They end up staying with relatives or *wantoks* in the *settlements* or *suburbs*. This is not good because more burden is given to the relatives to feed and accommodate them.

Lack of housing is one growing problem, which results in overcrowding and leads to family conflicts. Unemployment rate in cities and towns are increasing each year. The population has increased, and prices of goods and services have also gone up.

Unemployed parents find it hard to send their children to school because of the increased cost of schools fees. This leads to school aged children leaving school without completing it. Many children drop out of school due to poor living conditions that cannot meet their basic study needs. These young people eventually turn to to illegal activities, like smoking marijuana, drinking alcohol and homebrew, prostitution, destroying public properties and pick- pocketing. The government needs to come up with more practical solutions to these social issues.



Summary

You have come to the end of lesson 12. In this lesson you have learnt that

- Urbanisation is the process by which existing towns and cities expand to cater for increasing population and development needs.
- Rural-Urban Drift is when people move away from the villages into towns.
- Cities are bigger in size and functions than towns.
- The bigger the town, the more attractive it becomes to different groups of people.
- The factors that cause people to move away from rural areas are called *push factors*.
- *The factors* that attract people to the cities are called *pull factors*.
- Squatter settlements are illegal settlements on government or private land. Houses here are usually built with scrap materials such corrugated iron, off-cut timber, matels and etc..

ANSWERS TO ACTIVITY 1

Push Factors	Pull Factors
(i) Natural disasters	(i) Entertainment
(ii) Tribal warfare	(ii) Job opportunities
(iii) lack of money making opportunities/jobs	(iii) Better services like education, health, electricity etc.
(iv) lack of services	(iv) Better accommodation

NOW DO PRACTICE EXERCISE 12 BELOW

**Practice Exercsie 12**

1. What is the difference between push and pull factors?

2. List three problems found in squatter settlements in Papua New Guinea.

- (i) _____
- (ii) _____
- (iii) _____

3. what is Rural-Urban Drift?

4. What is a squater settlememt?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2

Lesson 13: Resource Industries in Papua New Guinea



Welcome to Lesson 13. In this lesson you will be studying Resource Industries and how they develop and use natural resources in Papua New Guinea.

Your Aims

- define resources and explain their uses
 - explain resource industries and their importance in Papua New Guinea
 - identify major resource industries and explain how they develop natural resources in Papua New Guinea
 - discuss the impact of using these natural resources
 - locate the distribution of resource industries in Papua New Guinea
-

What is a Resource?

Some resources occur naturally while others are man-made. The people of a country are called the *human resources* of that country. This includes the skilled people, the capital such as buildings and technology such as computers. Resources are used to satisfy the needs and wants of people in a society. *Natural resources* are those useful things that come from the natural environment. Examples are timber from forests, precious minerals from the land (eg. gold and copper), fuel wood, wind and solar energy and fish from the oceans and rivers.

A resource is anything that is important, valuable or useful to man.



A Wind Mill

Wind is an energy resource. A **windmill** is a machine which makes use of the resource by changing the energy of the wind.

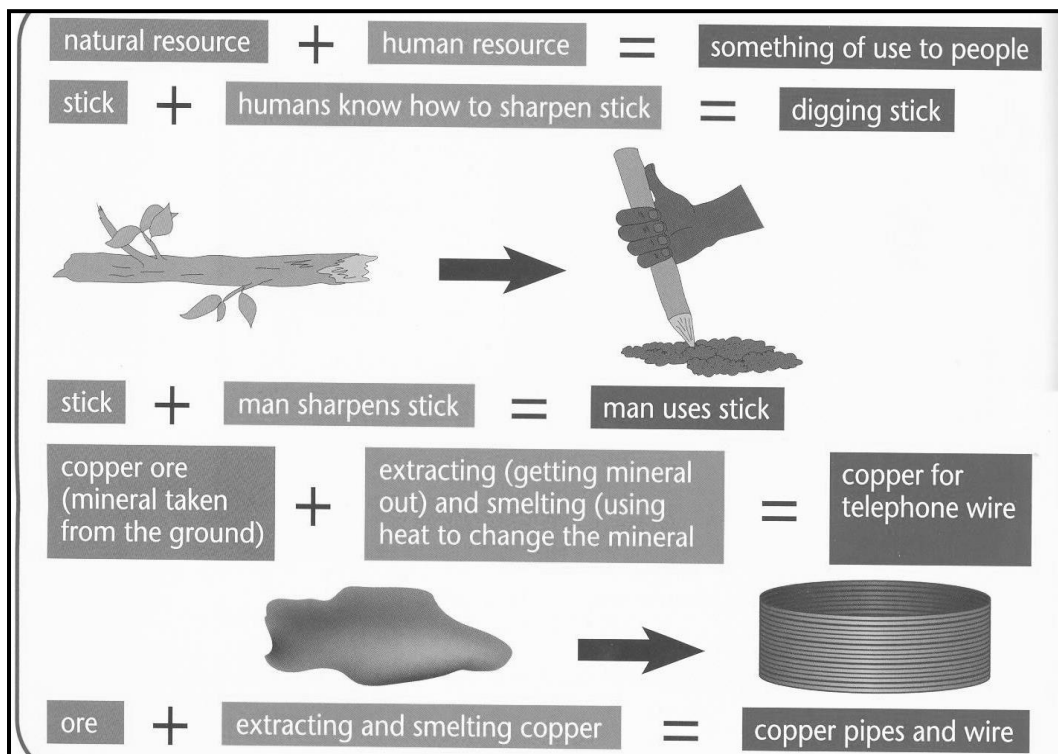
The main use of windmill in Papua New Guinea is to

- obtain fresh water from underground.
- produce electricity in remote areas.

Wind is a *renewable energy resource* that has plenty of other uses.

Renewable natural resources are those that are able to replace themselves by natural processes over a shorter period of time. **Non-renewable** natural resources are those that cannot be replaced by natural processes in a shorter time but may take many hundreds and thousands of years. Wind and solar energy are renewable sources of energy. Most minerals including natural gas, crude oil and coal are some examples of non-renewable sources of energy.

Study the diagram below. It shows how natural resources can be made useful.



What are resource industries?



Resource industries refer to big businesses that take out natural resources from the natural environment to produce goods and services and sell for money. For example, in mining industry, copper ore is taken out from the ground to produce copper wires.



You are correct. We hear and read about the mining, fishing and logging industries. They are all examples of resource industries.

Most of the companies that develop these resources in Papua New Guinea are owned by foreigners. They harvest and sell the natural resources to overseas markets. In return, the country gets its share of the money.

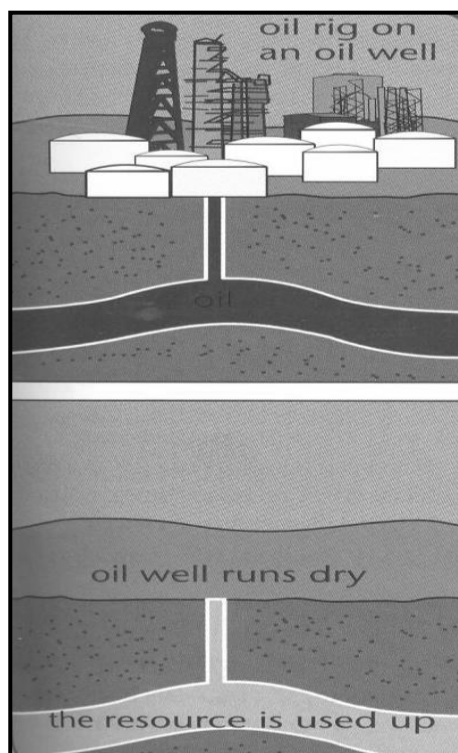
These industries provide employment for the people. With the money people get they are able to help improve their living standards. For example, they pay school fees for their children and buy good food for their families.

Different companies develop the natural resources in these industries. For example, Rimbunan Hijau is a well known logging company. It started with logging and has gone into other businesses like supermarkets, daily newspaper production, and real estate in Port Moresby.

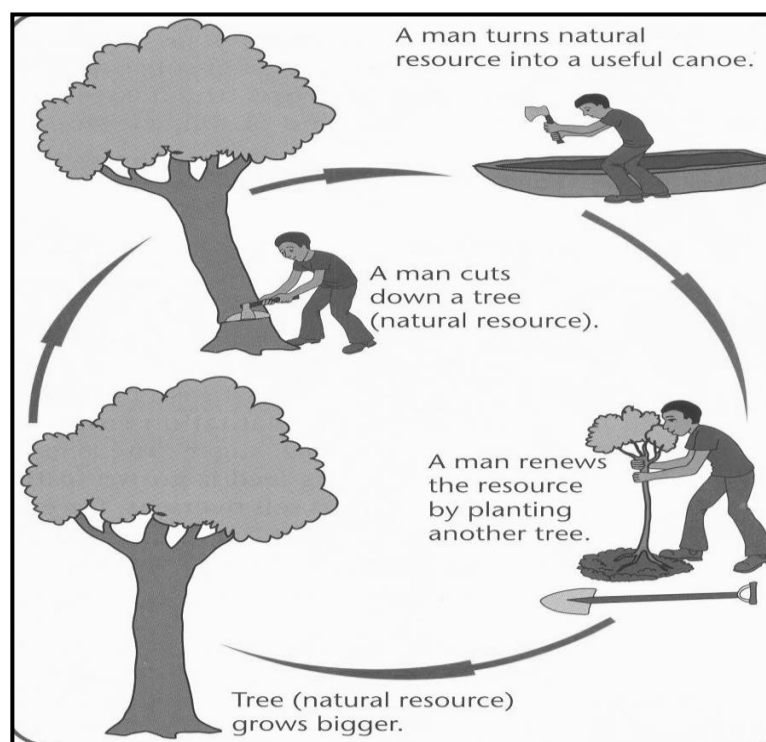
The money people get is not always used in the right way. Some people use the money to buy things that destroy their lives like alcohol, gambling, partying and prostitution. With the money the government gets it is able to built good roads and bridges, schools and health centres etc.

When we remove resources from the natural environment there are also *bad* things that happen to the natural environment. For example, after cutting trees for timber, trees need to be replanted in the same place so that they can be used later in the future. If the land is left bare without vegetation, erosion can take place and the soil becomes unsuitable for making food gardens.

Erosion is the process of washing away of soil on bare land



A Non-Renewable Resource (oil)



A Renewable Resource (Trees)



Next, you will study some examples of resource industries and what they do in PNG.

Mining

There are different methods of mining that are used to get minerals from the ground. Some of these methods of mining can be found in Papua New Guinea.

1. **Open Cut Mine** is practiced when minerals are near to the earth's surface. Vegetation is removed and a big hole is dug to dig out the minerals.
2. **Deep or underground mining** is used when minerals lie very deep in the earth. Tunnels are built underground to dig out minerals. Vegetation or the environment on the surface is untouched.
3. **Drilling** is another method of mining that is used in removing natural gas and petroleum (crude oil). Currently, all the oil and gas fields in Papua New Guinea are located in the Hela Province with new gas fields still to be developed in the Gulf and Western Provinces. There are currently four mines operating in the country and they include Porgera (Enga Province), Ok Tedi (Western Province, Simberi and Lihir (New Ireland Province).

Mining is the removal of valuable minerals under the earth's surface.



Now study the table on the next page that shows the current (June, 2009) operating mines in Papua New Guinea. Are you living near one of these mines?

If so, then very good! You can arrange with your relatives or your Provincial Coordinator to go for a visit to the mine site.



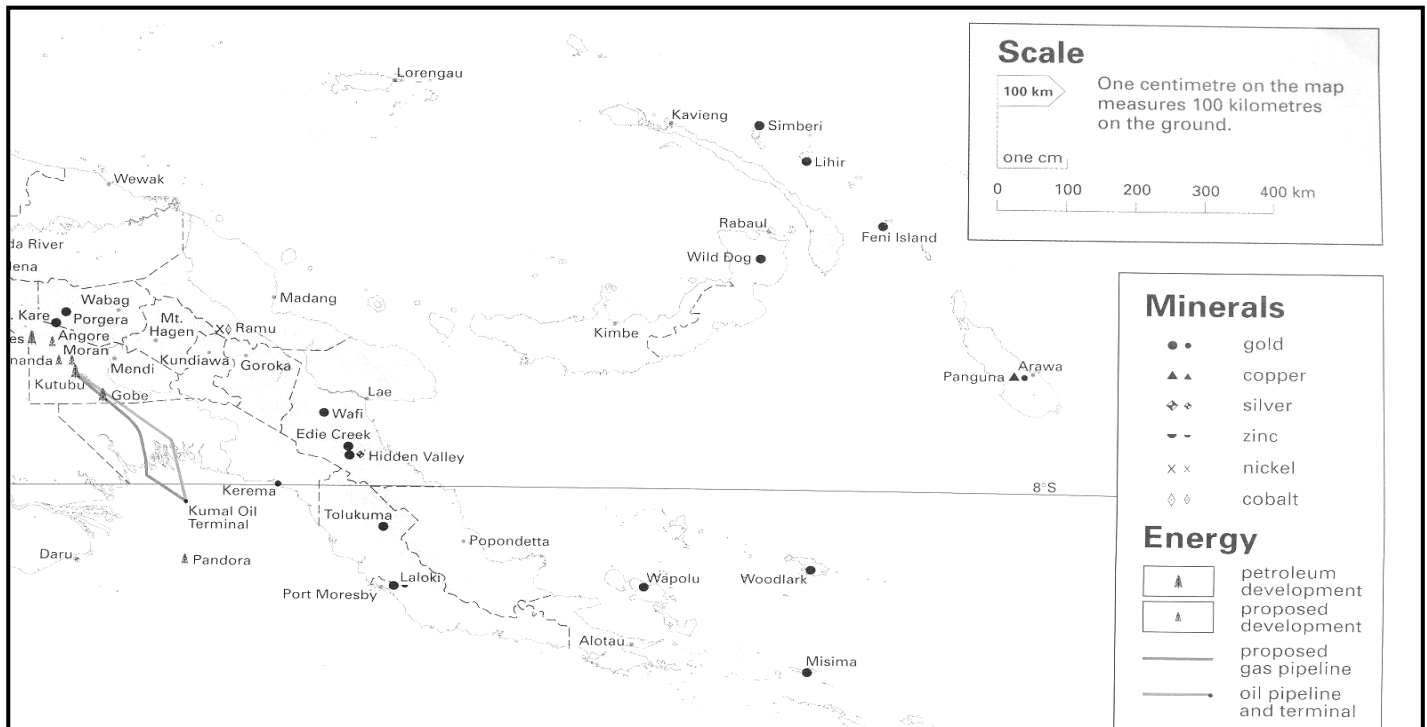
PRODUCING MINES IN PAPUA NEW GUINEA

Mine	Location/Province	Operator	Product	Start- Up Date
Porgera	Enga	Placer Dome	Gold	1990
Lihir	New Ireland	New Crest	Gold	1997
Ok Tedi	Western	Ok Tedi Mining Ltd	Copper	1984
Simberi	New Ireland	Allied Gold	Gold	2008

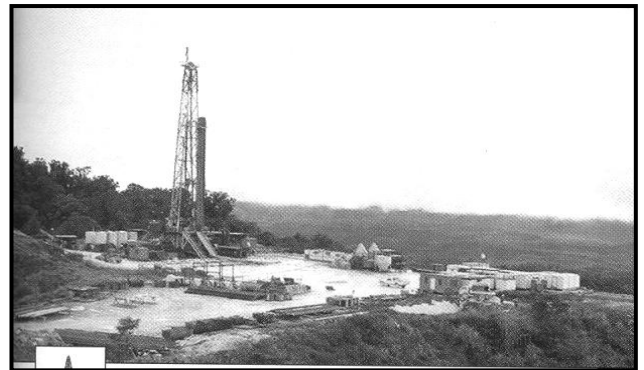
PRODUCING PETROLEUM FIELDS IN PAPUA NEW GUINEA

Field	Location/Province	Operator	Oil/Gas	Start- Up Date
Hides	Hela	Exxon Mobil	Gas	1991
Kutubu	Southern Highlands	Oil Search	Oil	1992
Gobe	Southern Highlands	Oil Search	Oil	1998
SE Gobe	Southern Highlands	Oil Search	Oil	1998
Saunders	Hela	Oil Search	Oil	2004
Moran	Hela	Oil Search	Oil	1998
NW Moran	Hela	Oil Search	Oil	2005

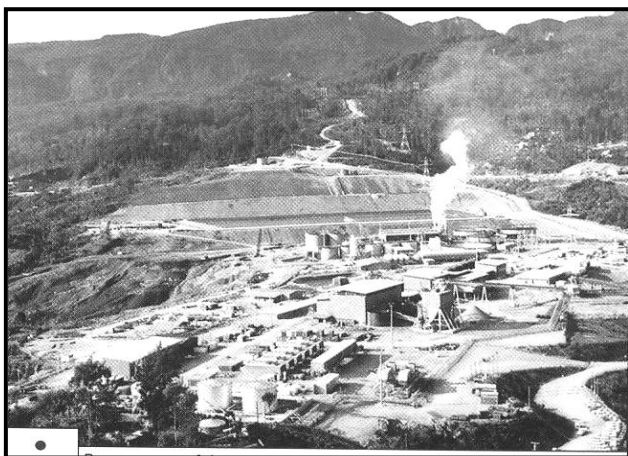
MINERALS AND ENERGY RESOURCES IN PAPUA NEW GUINEA



Ok Tedi, mine Western Province



Oil Rig, Southern Highlands Province



Poregera, one of the world's largest gold mines

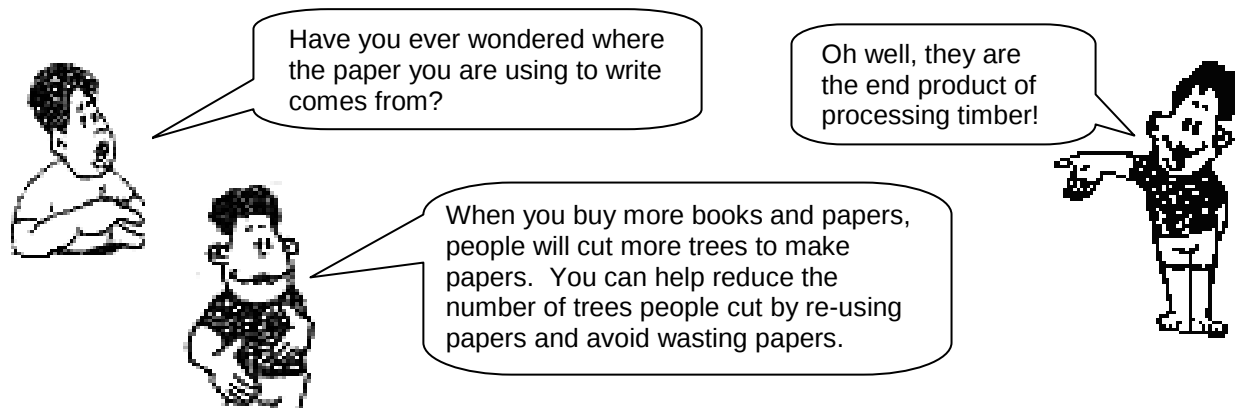


Kumul Oil Terminal, Gulf Province, Oil is piped to this terminal where it is taken away by ships.

Forestry

Papua New Guinea is one of the few countries in the world that has original virgin rainforest remaining, but it is fast disappearing. These rainforests serve many different purposes for the rural Papua New Guineans. Trees are used for building houses, firewood and making canoes and bridges.

Logging trees for cash brings many benefits to landowners. Services such as roads, bridges, clinics and schools are usually provided by the companies. Today, more and more foreign logging companies are cutting down trees to export overseas for money.



This timber is made into useful products such as paper and plywood. Some valuable tropical trees are rosewood, kwila, taun, ebony and klinki.



Selective Logging in Vanimo



Small Scale Logging in Morobe Province

Some methods of logging are bad because they can kill and destroy the **habitat** or homes of plants and animals. Some of these plants and animals are **endemic** (about to disappear) and are unique to Papua New Guinea. For example, the giant bird wing butterfly is unique to Papua New Guinea and feeds only on a certain type of vine.

There is a need to protect or *conserve* these resources. Some companies practice *selective logging* while others do *clear felling*. The logging method of *clear felling* will make the land to become bare and left exposed to wind and rain to cause soil erosion. *Re-forestation*, planting of new trees is another way to allow forests to grow back to their original state, replacing trees that have been cut down.

Selective Logging involves cutting down trees of commercial value only while **Clear Felling** is cutting down all the trees even if they are of no value.

Fisheries

The main source of protein for coastal and island communities are fish and other sea resources. Coastal fishermen and women catch fish for their own use. People who live along the Sepik and the Fly Rivers also use fish as their main source of protein. Some of these fish are sold at the markets for money. The money they get is used to meet their needs like school fees, buying clothes and store goods from their local trade stores.

On a *commercial* scale, there are fish canneries in Wewak, Madang and Lae. Fish is processed and put into cans and sold in shops. Coastal people have increased their catches to sell at these canneries for money. The other seafood exports (sold overseas) are prawns, lobster tails, sea cucumber and barramundi. PNG has a big area of sea with a large natural supply of tuna. Japan is our biggest tuna market.

***Commercial* basically means something you can sell to get money**

Illegal fishing by foreign fishing boats and ships has been a problem for the country. There is a need to have strong *sea surveillance* to prevent illegal fishing. **Over fishing** is another big concern as some methods of fishing such as the use of large drift nets and dynamite are unsustainable and can reduce the numbers of fish very fast.

If the rate of harvesting fish is greater than the rate at which nature can replace, it will lead to little or no fish left for future generations. With many big companies and improved fishing methods, more fish can be taken. Therefore, PNG needs to have strong laws to manage the fisheries resources wisely.

***Sea Surveillance* refers to keeping a closer watch over the seas of PNG from illegal foreign fishing boats.**

***Illegal Fishing* is the act of fishing in PNG by foreigners without our government's permission.**

***Over Fishing* means harvesting more fish than what the nature can replace it.**

So far you have learnt many things about resource industries in PNG. Now turn to the Summary points on the next page and study them.





Summary

You have come to the end of lesson 13. In this lesson you have learnt that:

- Resources are anything important, valuable or useful to man
- Human resources include the skilled people of the country and the capital (buildings) and the technology (computers) people have
- Examples of natural resources from the land include fertile lands, minerals such as gold and copper, timber from forests and fish from the sea
- Renewable natural resources are those that are able to replace themselves through the natural processes over a shorter period of time
- Non-renewable natural resources are those that cannot be replaced in a shorter time period but may take many hundreds and thousands of years
- Resource Industries are those sectors of the economy that harvest and develop natural resources
- Removing natural resources from the environment can cause a lot of negative impact on the environment
- The government makes money from selling the natural resources from markets within PNG and overseas
- The producing mines in PNG are Ok Tedi, Porgera, Lihir and Tolukuma
- The highest number of producing oil fields is in Southern Highlands Province
- Mines in Papua New Guinea are either *open cut* or *underground*
- **Drilling** is another method of mining used in removing natural gas and oil from the earth
- Papua New Guinea is one of the few countries in the world with virgin rainforests remaining but the forest is fast disappearing

NOW DO PRACTICE EXERCISE 13 ON THE NEXT PAGE



Practice Exercise 13

1. Name three provinces gold is currently mined.
 - (i) _____
 - (i) _____
 - (ii) _____
 2. Which province in Papua New Guinea is rich in oil (petroleum)?

 3. State two ways which forests can be renewed.
 - (i) _____
 - (ii) _____
 4. Briefly discuss one *negative* effect of inland mining on the environment.

 5. Name one open cut mine in Papua New Guinea.

 6. What method of mining is used to remove oil and gas from beneath the earth?

 7. Discuss a major concern in the fishing industry in Papua New Guinea.

-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2
--

Lesson 14: Using Map Scales



Welcome to Lesson 14. In this lesson, you will learn about map scales and how to use them. You are expected to concentrate in this lesson because it is an important map skill that requires a lot of thinking and attention.

Your Aims

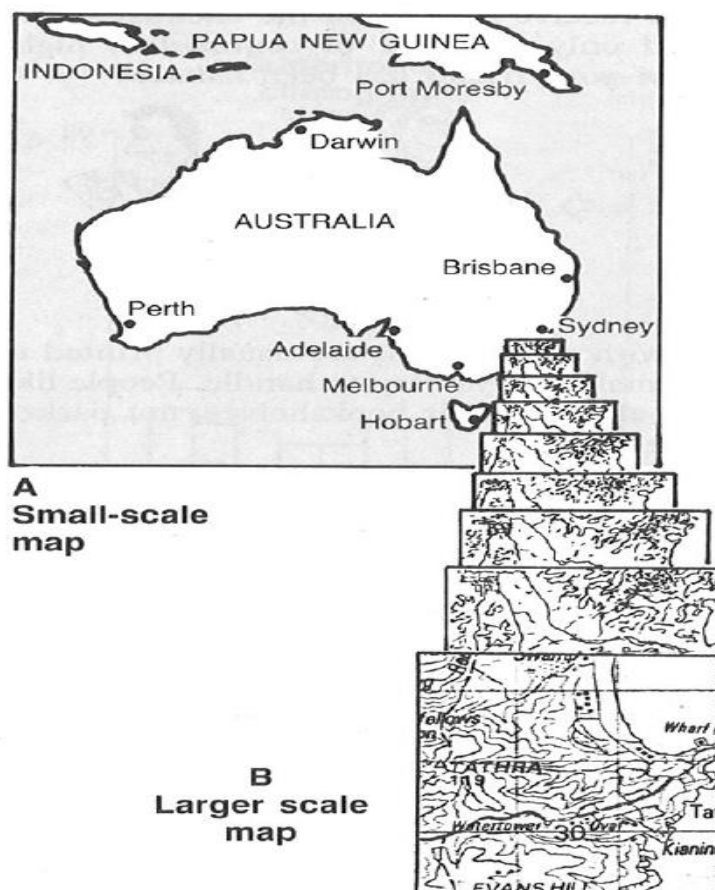
- define map scale
- identify the different types of map scales
- distinguish between small and large scale maps
- identify and describe types of scales
- calculate distance using scales

What is a Map Scale?

A map scale shows how distance on a map relates to real life distance on the ground

A map scale shows large areas of the earth's surface on a small piece of paper. A *cartographer* is a *map maker*.

On this map of Australia, the cartographer has been able to show the whole island on less than half a page in a book. The shape of the feature remains the same, but they are drawn smaller by using a scale.



Remember: *Small-scale maps* show big areas of land and water with little details, while *Large scale maps* show smaller areas with more detail.

Now have a look at the examples below.



Theme Park Map

This map has a large scale.
It gives more detail..



Road Map

A road map has a smaller scale.
This one shows where to find
Theme park map. It gives very
little details about the Theme
park.

The idea of making things smaller than they really are, is important in *map-making*. Maps must always be drawn correctly. How *much area* and *detail* shown on a map will depend on the scale that has been used.

Selecting the correct scale is important. Ground area, rivers, lakes, roads and distances between features must be reduced to a smaller size than they really are.

You will see a map scale in most maps given as a **fraction**, $\frac{1}{10000}$ or a ratio (**1: 10 000**), or

in a linear form 

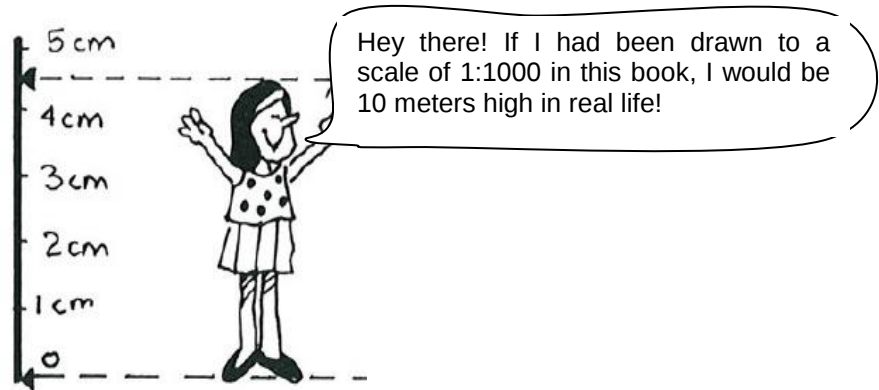
The fraction scale means that 1 unit of measurement on the map represents 10,000 of the same units on the ground. If the scale were 1:60,000, then 1 cm on the map would represent 60,000 metres or kilometres on the ground.

Many areas have been mapped at different scales.

The scale of a map tells us the relationship between distances on the map and distances in real life.

We can show this scale by:

1. writing it in *words*.
2. showing it in *numbers and as representative fraction or ratio*.
3. drawing it as a *line scale*.



1. The Scale in Words.

The scale of a map can sometimes be written in words. An example of this would be *1 centimetre to 1 kilometre*. This means that 1 centimetre on the map represents 1 kilometre in real life on the ground.

Other examples of scale in words are:

- 1 centimetre to 1 metre
- 1 centimetre to 10 metres
- 1 centimetre to 200 metres



2. Scale as a Representative Fraction

The scale of a map can also be shown in numbers. This type of scale can be shown as either a

representative fraction as in $\frac{1}{1000}$ or as a **ratio in 1:1000**.

Here are more examples of representative fractions and ratios.

Representative Fraction	Ratio
$\frac{1}{200}$	1:200
$\frac{1}{25000}$	1:25 000
$\frac{1}{50000}$	1:50 000
$\frac{1}{100000}$	1:100 000

If a map has a scale of 1:1000, then it means *one* unit of distance on the *map* is one *thousand* times bigger in *real life*. A scale of 1:1000 means a number of things:

- 1 millimetre on the map represents 1000 millimeters (or 1 metre) in real life.
- 1 centimetre on the map represents 1000 centimetres (10 metres) in real life.
- 1 metre on the map is representing 1000 metres (1 kilometre) in real life).

Many people think that representative fractions and ratios are difficult to understand, however, the secret lies in being able to *change* them back into words. Have a look at these examples below.



"Never say 1 centimetre equals 1 kilometre." This is not possible! It only represents.

3. Line Scales

The scale of a map can also be shown by a numbered line called a line scale or linear scale. Line scales are the most popular way of showing scale. They are also the easiest to understand and use.

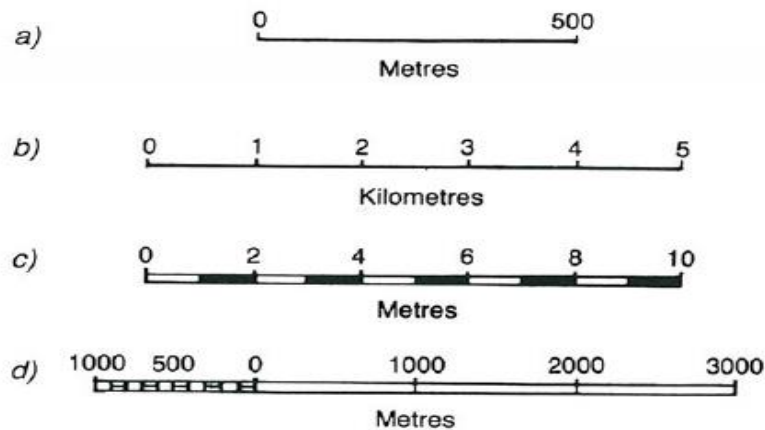


Remember this! Map distances are usually measured in centimetres while real life distance is measured either in metres or kilometres

Now have a look at some examples of line scales on the next page.



Examples of Line Scales



Summary

You have come to the end of lesson 14. In this lesson you have learnt that:

- A map scale shows how distance on a map relates to distance on the ground
- Small-scale maps show big areas of land and water, while large scale maps show smaller areas in more detail
- Maps must always be drawn as accurately as possible
- How much information shown on a map depends on the scale that has been used to draw it
- The three main types of scales are *scale in words*, *scale as representative fraction* and *line scale*
- In a representative fraction or ratio, the first number (map distance) is *always 1* while the second number (ground distance) is different for each scale

NOW DO PRACTICE EXERCISE 14 ON THE NEXT PAGE



Practice Exercise 14

1. Complete the following table by putting these scales into words.

Scale	Meaning in words
1:10	1 centimeter to..... centimetres
1:100	1 centimeter to..... centimetres
1:1000	1 centimeter to..... centimetres
1:1000	1 centimeter to..... metres
1:50 000	1 centimeter to..... centimetres
1:50 000	1 centimeter to.....metres
1:50 000	1 centimeter to.....1 kilometre

2. Complete these statements about scales.

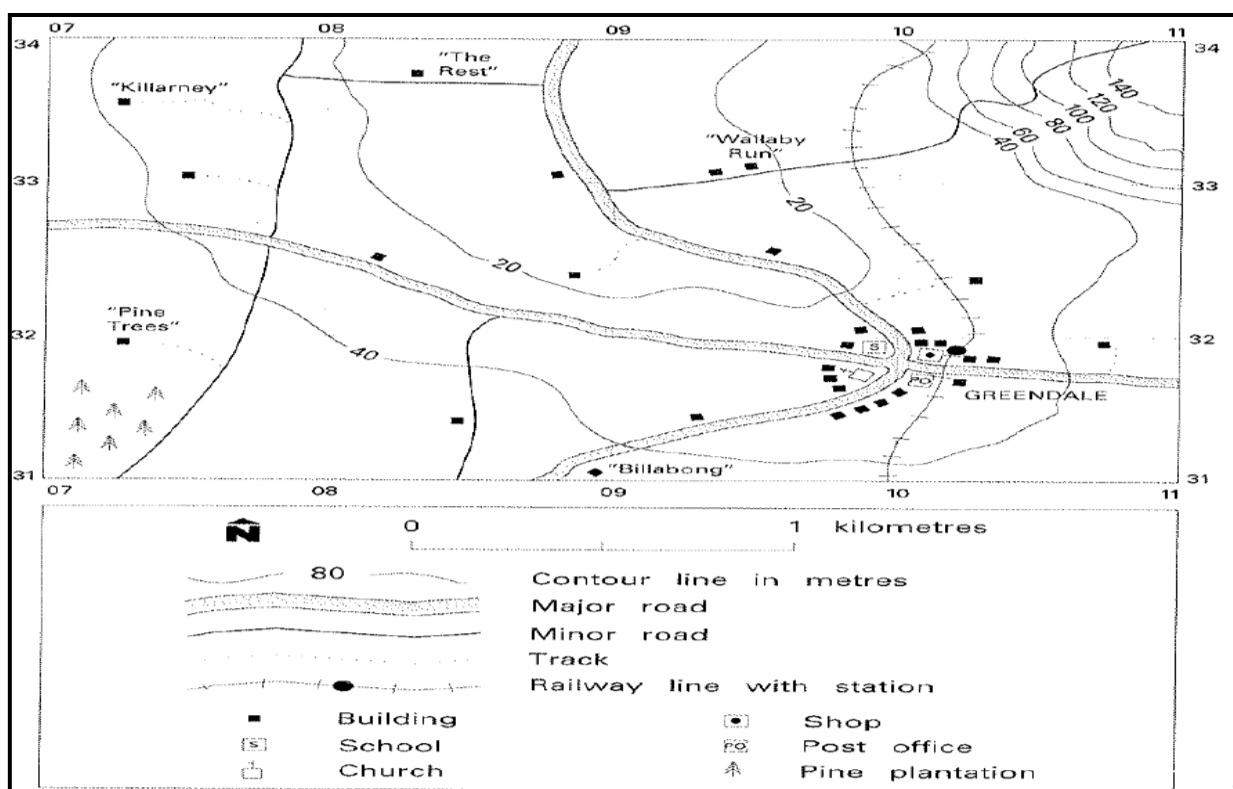
A scale of 1:10 000 means that:

- 1 millimetre on the map represents _____ millimetre in real life.
- 1 centimetre on the map represents _____ centimetres in real life.
- 1 metre on the map represents _____ metres in real life.

3. A scale of 1:1000 means that:

- 1 centimetre on the map represents _____centimetres on the ground.
- 2 centimetres on the map represents_____ centimetres on the ground.
- 10 centimetres on the map represents _____ centimetres on the ground.

Refer to the sketch map below to answer Question 4.



4. (a) What type of scale is used on this map? _____
- (b) What is the real life distance between the Pine Trees and Killarney?

- (c) According to the map scale, how many centimetres on the map represent 1 kilometre in real life?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 2
--

SUB-STRAND 2

ANSWERS TO PRACTICE EXERCISES 9-14

PRACTICE EXERCISE 9

1. A settlement is where people live.
 2. For defense in times of war, for cooperation in terms of obeying village rules and to make it easier for government to supply important services.
 3. In rural settlements people, most people earn their living by cultivating the land or using the environment while in urban settlement, most people do not depend on their natural environment to earn their living.
 4.
 - (i) Nucleated
 - (ii) Dispersed
 - (iii) Linear
-

PRACTICE EXERCISE 10

1. Regions 2, 4, 5, 6, 7, and 9
 2. Region 1, 3 and 8
 3. It points out the general compass direction of a place
 4. West
 5. Southwest (SW)
 6. Northeast (NE)
 7. Southeast (SE)
-

PRACTICE EXERCISE 11

1. Places with enough rainfall will have a lot of people while places with little rainfall will have few people. Similarly, very hot and dry areas (deserts) are sparsely populated while warm and cool climates have more people.
2. Census is the process of counting the total number of people in a country at a particular time.
3. Population Density of Australia = $\frac{12\,000\,000}{7\,500\,000}$ km

$$= \frac{120}{75}$$

= 1.6 rounded off to the nearest whole number is 2.

Therefore, Australia's population density is **2 people per square kilometre** or **(2/km²)**

4. Climate, natural hazards, water supply, type of terrain, availability of natural resources.

PRACTICE EXERCISE 12

1. The factors that causes people to move out of the villages or rural environment are called *push factors* while the factors that exist in the towns and cities which attract people to towns and cities are called *pull factors*.
2. Not enough food, overcrowding and poor freshwater, not enough electricity and ways of getting rid of sewage and rubbish, criminal activities, prostitution.
(Any three from this list).
3. The movement of people from rural areas (villages) to urban areas (towns and cities) is called *rural- urban drift*.
4. Squatter settlements are illegal settlements on government or private land.

PRACTICE EXERCISE 13

1. (i) Western Province –Ok Tedi mine (ii) Enga Province-Porgera mine
(iii) New Ireland Province- Lihir and Simberi mines
2. Southern Highlands and Hela Province
3. (i) Selective logging (ii) Reforestation (iii) Afforestation (any of the two answers)
4. Pollution of rivers by disposal of finely crushed rock wastes and untreated mining chemicals called *tailings*.
5. Ok Tedi Mine, Porgera Mine, Lihir or Simberi Mines.
6. *Drilling* is the method of mining that is used in removing natural gas and petroleum (Crude oil) from the earth.
7. Overfishing (taking too many fish) can lead to little or no fish left for future generations.

PRACTICE EXERCISE 14

1.

Scale	Meaning in words
1:10	1 centimeter to 10 centimetres
1:100	1 centimeter to 100 centimetres
1:1000	1 centimeter to 1000 centimetres
1:1000	1 centimeter to 10 metres
1:50 000	1 centimeter to 50 000 centimetres
1:50 000	1 centimeter to 500 metres
1:50 000	1 centimeter to 0.5 kilometres

- 2 (a) 10 000 millimetres (b) 10 000 centimetres (c) 10 000 metres
- 3 (a) 1000 centimetres (b) 2000 centimetres (c) 10 000 centimetres
- 4 (a) Line or linear scale (b) Between 21.3 km and 22 km ($4.3 \times 5 = 21.3$; $4.4 \times 5 = 22$)
(c) 5 centimetres

SUB-STRAND 3

THE IMPACT OF RESOURCE USE

In this sub-strand you will learn about:

- **Impacts of resource use on the environment**
- **Solutions to negative impacts of resource use**
- **Impacts of resource use on the human settlement patterns**
- **Ok Tedi Mine: Case study on the physical and human environment**

SUB-STRAND 3: INTRODUCTION

The Impact of Resource Use

In this Sub-strand, you will learn about the impact of resource use on the human (man-made) and physical (natural) environments. You will also identify the good and bad effects of developing natural resources and the importance of using resources wisely.

Lesson 15: Impact of Resource Use on the Physical and Human Environment



Welcome. This is Lesson 15. You will learn about the impacts of resource use on the physical and human environment in Papua New Guinea.

Your Aims

- define impact
- list and explain the positive and negative impacts of resources use on the physical and human environment
- identify examples of positive and negative impact of resource use in Papua New Guinea

Impact refers to a noticeable effect or influence. For example, people cut down trees to make food gardens. If trees are not replanted then the land is bare. When rain falls, the water washes away the top soil leaving the soil unproductive. This is an impact of cutting down trees.



Let us take a look at the meaning of *impact*.

You will recall the difference between human and physical environment that you learnt in Lesson 1. The **human environment** is everything in the surroundings that are made or changed by man and the **physical environment** is everything in the surroundings made by nature. You also learnt that all the elements in the natural environment are **interdependent**. This means the existence of one depends on the other.

People change the natural environment when they use the land for different purposes. We call this *land use*.



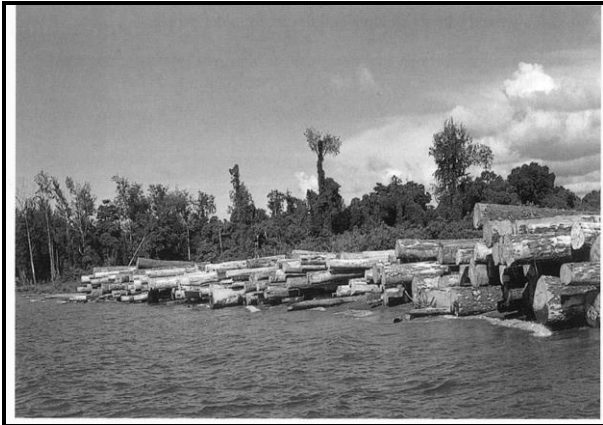
How do people change the natural environment?

In many cases the changes are *negative* or *bad*. An impact in the physical environment can bring *positive* or *good* changes to humans. We call these *positive impacts* or *benefits*.

You have already learnt that natural resources are either *renewable* or *non-renewable*. This is the reason why it is important to use these natural resources in such a manner that it will not run out quickly. The harmful impact of these changes should be reduced. Stronger penalties should be given to those who do not follow good environmental practices.

The rural people of Papua New Guinea use the natural resources of the rainforests to meet their needs. They gather fruits and nuts to eat; they collect fuel wood for making fire, and use timber from bigger trees to build fences, houses and canoes. Logging reduces food sources of the people.

However, there are also *benefits*. When logs are sold, the government receives income while landowners receive **royalty payments**. The people earn money when they get jobs with the logging companies and use the money to buy better goods and services they need in life.



Logging in East Sepik Province, PNG



Logging of Coniferous Forest

When trees are cut for timber, the homes of animals and their food sources in the forest are destroyed. Animals often die due to the stress while those that can move, migrate to other places. This kind of change is *bad* or *negative*. The process of cutting down trees is called **deforestation**.

Did you know, animals have their own homes just like you and I? What would you do if your home was destroyed?



Off course, I will be upset and stressed. I see! The animals will be stressed too!

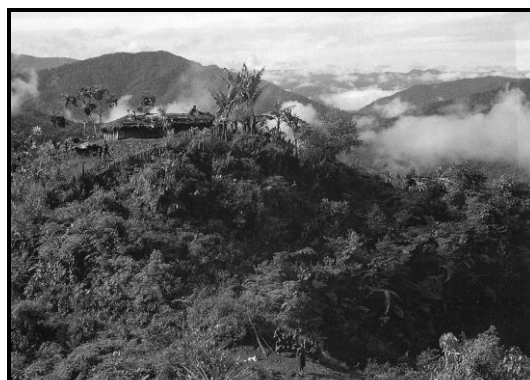
Deforestation contributes to *global warming* and *climate change*. Trees take in carbon dioxide and give off oxygen. Trees reduce the extra amounts of carbon dioxide given off by the burning of fossil fuels. Carbon dioxide and methane can trap the sun's heat. The trapping of the sun's heat will causes the earth's temperature to increase. This leads to *Global Warming and Climate Change*.

You will learn more about Climate Change in Grade 8 Project 2.

Land Use



Shifting cultivation in a Tropical Rainforest



An Isolated hamlet in the Highlands of PNG

1. Shifting Cultivation

Land is also used for subsistence farming. The method of cultivation used by our rural people is **shifting cultivation** –sometimes called *slash and burn*. In this type of farming, the area of the rainforest is cleared and left to dry and later burnt. A mixture of crops such as sweet potatoes, taro, bananas and corn are usually planted. After the crops are harvested, the land is left to regain its nutrients. This period of time is called *fallow*.

The population of Papua New Guinea is growing very fast. Many people including babies are now living due to better health services. The increase in population is putting a lot of pressure on the land. The same plot of land is frequently cultivated leading to low harvests. More sustainable farming methods such as crop rotation need to be introduced to our rural people.



Shifting Cultivation, Simbomie Village, ESP.

2. Plantation Agriculture

Plantation Agriculture involves large scale use of land. Large areas of vegetation are cleared for planting cash crops such as rubber, tea, cocoa, coconut and oil palm and coffee. There is a big change to the natural environment.

Coconut and cocoa plantations are common in all coastal lowlands of Papua New Guinea.



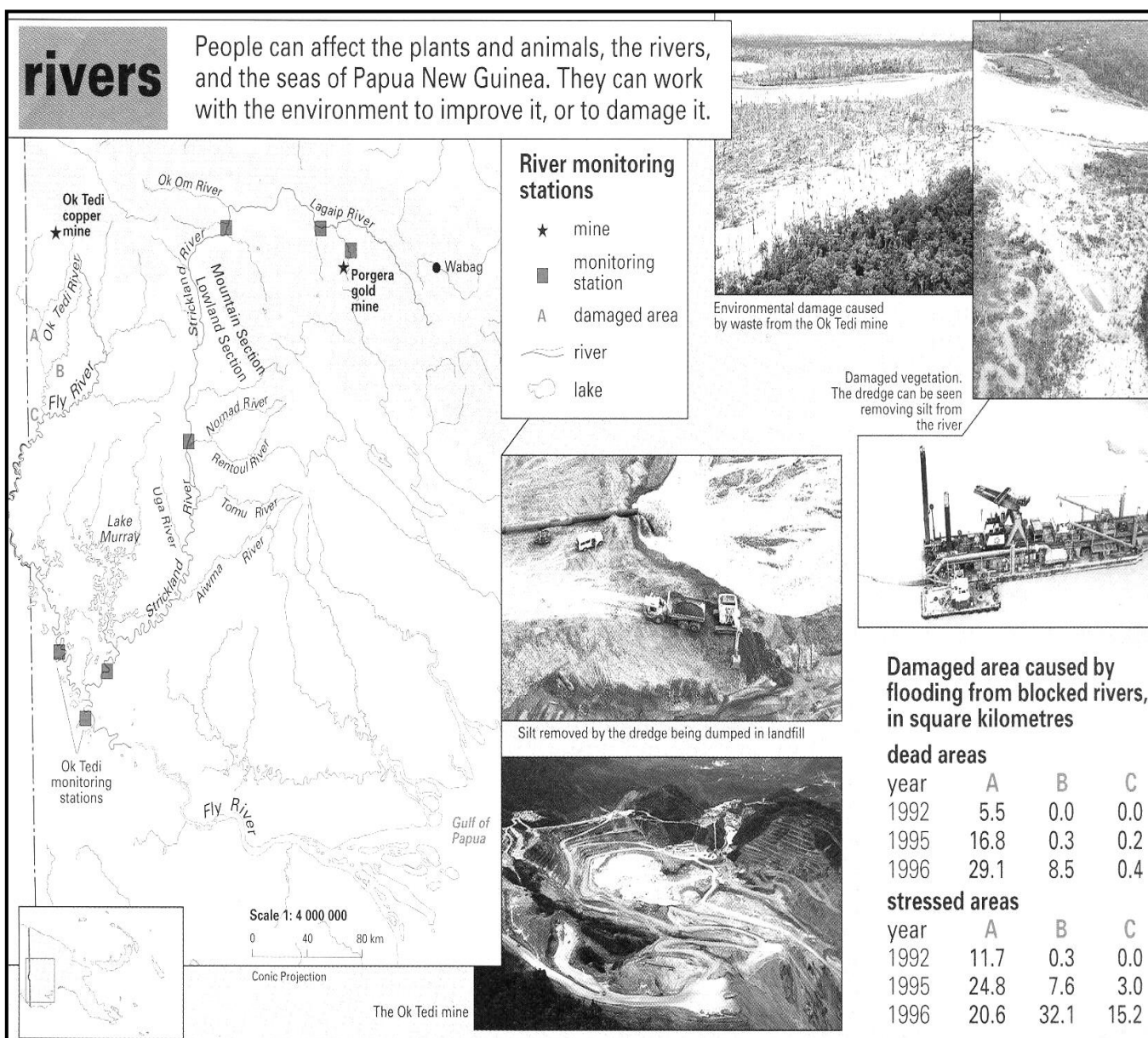
A Coconut Plantation

3.Mining

Mining activities also involved removing large areas of vegetation. *Inland mining* of valuable minerals have an impact on the natural environment. Minerals such as gold, copper, nickel and cobalt are currently mined in PNG. The land surface with all the vegetation on it is cut away to get the minerals. Waste rock and poisonous chemicals (tailings) from the mines are dumped into the nearby rivers and seas. This can kill fish and other life forms in the water. People cannot drink and wash in the river due to the pollution. However, mining also bring *benefits* to the people and the government. The government receives a lot of money from mining alone as revenue to run the country.

You learnt about the operating mines that are operating in PNG. Have a look at the photographs below that show some impacts of mining in PNG.

IMPACT OF MINING



Ok Tedi Mine; Papua New Guinea

Here are some impacts of resource use.

Positive impacts

- Government receives money or revenue in the logging industry
- Employment for people
- People earn money to buy goods and services
- Roads, schools, and hospitals are built

Negative impacts

- Logging results in deforestation which leads to soil erosion and global warming
- Large scale mining destroys the environment.
- Landowners who get a lot of money sometimes become lazy and misuse money. E.g. In the 1990's at Ok Tedi Mine when landowners receive their royalties, many just spend on alcohol and cause a lot of social disorder.
- Big companies use unsustainable fishing methods like drift net fishing to catch too many fish. This leads to over-harvesting of our fish resources.

Positive Impact refers to the *benefits* people get from the use of the natural resources while **Negative Impact** refers to the bad things that occur when the natural resource is developed

Now do the activity below. Check your answers at the end of the summary.



ACTIVITY 1

You are now expected to cut, paste and label pictures and photographs of some negative and positive impacts of resource use in Papua New Guinea in the table below.

NEGATIVE IMPACTS	POSITIVE IMPACTS

NEGATIVE IMPACTS	POSITIVE IMPACTS



Summary

You have come to the end of lesson 15. In this lesson you have learnt that:

- An impact is a noticeable effect or influence
- An impact of resource use can bring either positive (good) or negative (bad) changes to the physical and human environment
- The human environment is everything in the surroundings that are made or changed by man
- The physical environment is everything in the surroundings made by nature
- The process of cutting down trees is called deforestation
- Shifting cultivation (subsistence gardening) is the most widespread form of land use in Papua New Guinea
- After the crops are harvested, the land is left to regain its nutrients. This period of time is called fallow
- People change the natural environment when they use the land for different purposes
- Positive impacts are usually benefits we get from the use of the natural resources

NOW DO PRACTICE EXERCISE 15 ON THE NEXT PAGE



Practice Exercises 15

Write short answers for the following questions.

1. What is impact?

2. List three positive impacts (benefits) and three negative impacts of mining minerals such as gold and copper in Papua New Guinea?

Positive Impacts (benefits)	Negative Impacts (Bad effects)
(i)	(i)
(ii)	(ii)
(iii)	(iii)

For the multiple choice questions, circle the correct letter of your choice.

3. Which of these are examples of the human landscape?

- A. Roads and towns
- B. The climate and weather
- C. The mountains and roads
- D. The vegetation and land forms

4. Put the following words into the correct columns as shown by the headings in the table below.

Town, canoe, tree, liana, road, garden, dam., river, rain, sunshine, cattle, tobacco, tuna and oil palm.

Part of the Natural Environment	Part of the Human Environment

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 3

Lesson 16: Solutions to Negative Impacts of Resource Use



Welcome to Lesson 16. In this lesson, you will examine ways of dealing with some of the impact of resource development and their uses in Papua New Guinea.



Your Aims

- Identify and discuss some solutions to negative effects of resource use.
 - Give some example sustainable development in Papua New Guinea
 - Identify and list some examples over-exploitation or over-harvesting
 - list ways of reducing negative impacts of each resource use or development
-

You have learnt a lot about resource use and their impact in the previous lessons. You will continue by identifying solutions and ways of managing some of these impacts you have studied.



Is it possible to prevent negative impacts of the land use changes we have learnt?



Yes! Off course! The answer lies in the way each resource industry put into practice the environmental laws of our country.

Solution is a way of solving a problem or dealing with a difficult situation

In this lesson, solution refers to the methods of reducing and preventing negative impacts brought about by the development of natural resources by the various resource industries and their developers in Papua New Guinea.

The processes of removing natural resources involve some costs to the natural environment. These costs are not always in money terms but in terms of the *negative impacts* it has on the natural and human environment.

The type of negative impact is different for each type of Resource Industry. For example the impact of *over-fishing* is different from processing copper ore in a mill.

Compliance and Standards of Practice

Over-Exploitation refers to over-harvesting or over-using of a natural resource. Furthermore, it means removing natural resources at a rate faster than nature can replace itself. Over-harvesting of non-renewable resources can leave nothing for the future generations.

The *resource developer* has a duty to take correct actions to prevent all negative impacts that may happen to the natural and human environment. It has a duty to follow the laws of Papua New Guinea. The government officers need to always check the actions and practices of the resource developer. If developers break the laws set by the government through its practices, then the government has the right to cancel the company's license so that it stops operating in Papua New Guinea.

Sustainable Logging, Mining and Fishing

In Lesson 13, you learnt about the uses and problems of the logging, mining and fisheries industries. Therefore, we will only discuss some solutions and ways to prevent bad (unsustainable) practices in this lesson.

Sustainable logging involves the following practices:

- *Reforestation* - planting new trees in areas where trees have been cut down.
- *Afforestation* - planting new trees in an originally bare land to form a forest.
- *Selective logging* - involves cutting trees of commercial value only. This means the young trees should not cut down, they should be left to grow so that they will be harvested in the future. It also means logging/cutting trees away from rivers, coastlines and lakes.

In mining, the finely crushed rock wastes from the mines are dumped into river systems. This can block rivers and cause mine waste to spread over land, destroying the vegetation as well as killing marine life. Furthermore, the waste can cause the build-up of sediments resulting in the river becoming shallow and affecting transport, including ships which use the waterway. This is the case with the Fly River in the Western Province. To allow ships to use the waterway, *dredging* or digging of mud, and silt is carried out on the river bed to maintain its depth for ships to use the river.

A **dredge** is a machine that removes silt and mud from the river so it allows the water to flow easily.

Tailings are very harmful chemical wastes from the mine. It is harmful to the environment and all life forms. Therefore, they need to be made harmless before they are released into the river systems or oceans if the mine is near the coast. Levels of dangerous chemicals such as mercury and arsenic should be measured at monitoring stations to see if these amounts are harmful for living things. Steps must then be taken to reduce impact once danger signs are recorded.

EXAMPLES OF PROBLEMS AND SOLUTIONS

Problems

Inland mines can have large effects on the river environment. These effects can be caused by the disposal of finely crushed rock waste and untreated mining chemicals into the river.

The disposal of this waste increases the amount of naturally-found chemicals in the river, to dangerous levels. Also, it can block up the river and cause mine waste to spread out over good land covering and destroying the vegetation.

Possible solutions

Chemicals used in the mining process must be made harmless before they are disposed of into the river system. Levels of dangerous chemicals, such as mercury and arsenic, should be measured at monitoring stations to see if this is effective. Acceptable levels should be set and enforced by the government.

The problem of waste rock blocking the river can be solved by making a dam to hold the waste rock or by dredging the river.

PROTECT CORAL REEFS
GREENPEACE



seas

Papua New Guinea's marine environment can be affected by mine waste, sewage disposal, over-fishing, and reef damage.

Problems

Some mines dispose of their waste rock into the sea which can cause damage to coral reefs, fish, and other marine resources.

Untreated sewage can cause pollution because it contains poisonous chemicals and bacteria which can lead to disease in both humans and the marine environment.

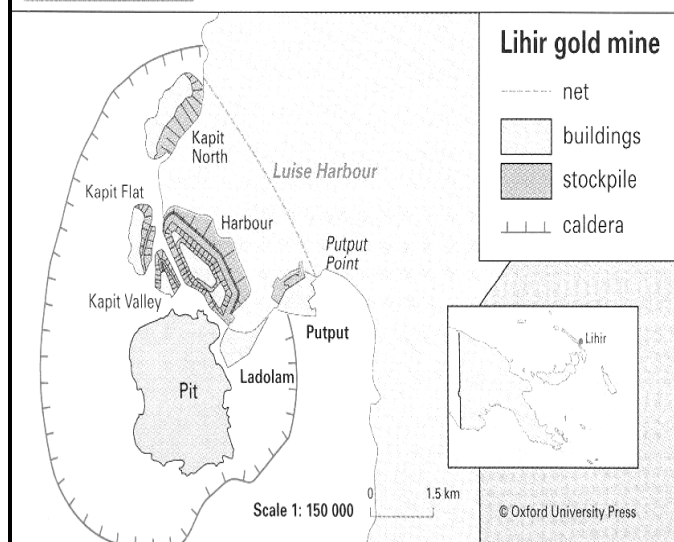
Possible solutions

Mines

- keeping waste on the land
- using **nets** to stop mine waste from spreading out to sea

Sewage

- treating sewage before it is released into the sea
- preventing industrial waste entering the sewage system
- not using chlorine to disinfect the water supply
- conserving water



We now take a look at the Fisheries Industry.

The seas and the rivers contain large numbers of sea creatures such as barramundi, prawns and reef fish to list a few. As more and more of these are caught this valuable source of food and income could be lost forever.

It is therefore important to manage these resources well for the future. Overfishing takes place when the rate of catching fish is faster than the fish are born to grow into maturity. When overfishing takes place the population of fish declines and may eventually die out. Traditional methods of catching fish did not remove large amounts of fish compared to the large commercial boats and ships that are now catching large quantities of fish.

Here are some methods of managing our fisheries resources.

- Put a limit on the number of fish caught by fishing boats.

For example, catches of prawns are limited in the Gulf of Papua by reducing the number of licences that are issued. This stops too many companies fishing. This is necessary because prawns are caught by dragging large nets behind boats. This method is called *trawling* and can catch large amounts of fish as well as other marine animals.

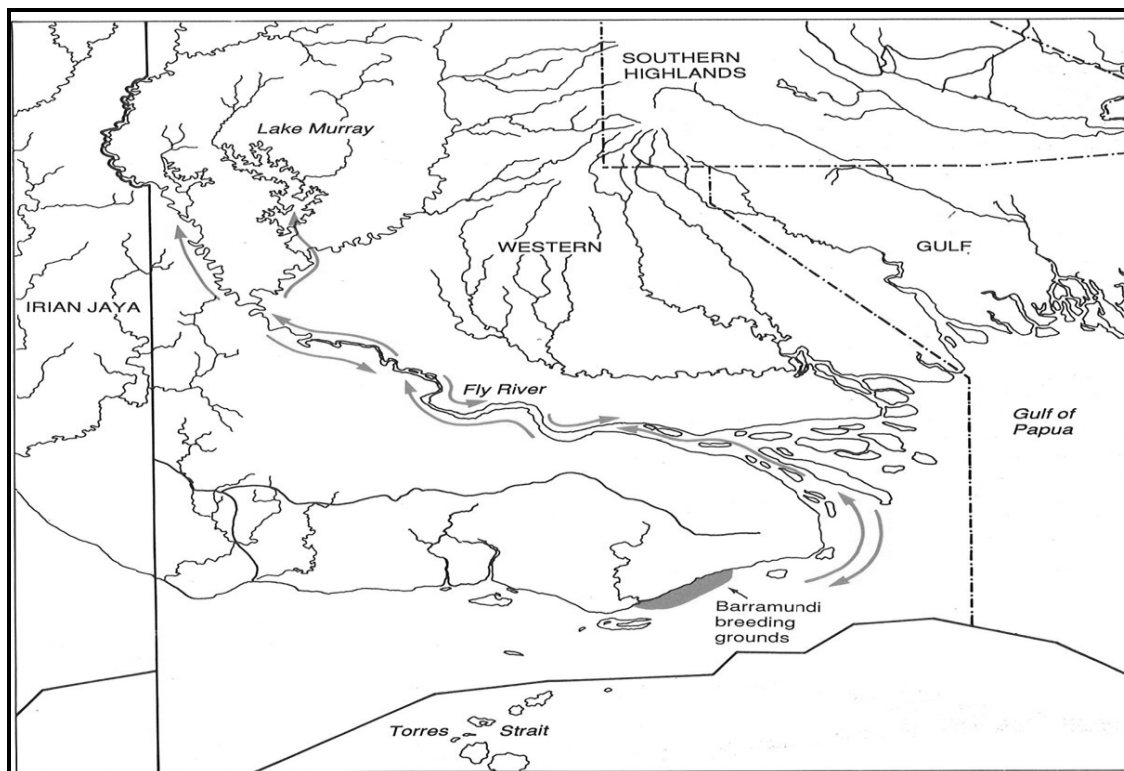
- Control the number of nets to be used on each boat and the actual size of the boats.

Young fish should not be caught and should be left as *breeding stock*. Older fish can be selectively caught by using nets with a large mesh size which allows the younger fish to swim through. A minimum net size of 7-8 centimetres has been introduced west of Daru because young fish migrating from there to inland rivers.

- Fishing may be restricted at certain times of the year, such as when the fish are breeding or migrating. Catching fish at this time will interrupt the life cycle of the fish resulting in fewer fish being born.
- Breeding grounds of fish and their migration routes need special protection from disturbances and pollution.
- The National Fisheries Authority and the Defence Force Sea Element must conduct regular patrols to prevent illegal fishing by foreign fishing vessels in PNG waters.

Study the map below. It shows the Barramundi migration routes and breeding grounds. You will see that this fish only lives in the Fly River of Western Province.

BARRAMUNDI BREEDING GROUNDS

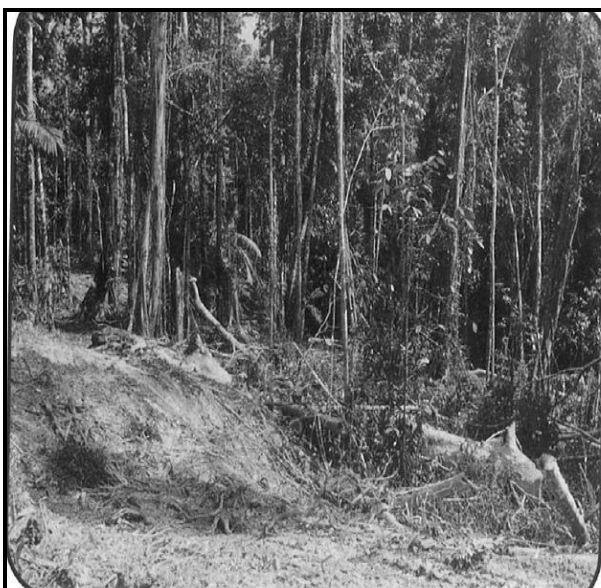


Study the cartoon below. Can you identify the picture message? If you can, then very good. Some picture messages speak louder than spoken words.

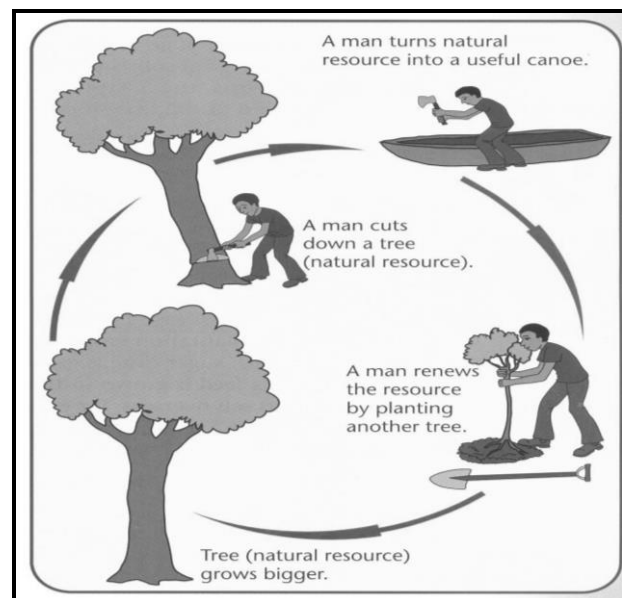


The picture message in the cartoon above is: “we can treat our forests as a non-renewable resource and destroy them or we can treat them as a renewable resource and save them for the future generations”.

You can now see the pictures below. They are examples of sustainable logging practices in PNG.



Selective Logging in Vanimo, Sandaun Province



Reforestation



Summary

You have come to the end of lesson 16. In this lesson you have learnt that:

- Solution is a way of solving a problem or dealing with a difficult situation.
- Resource Industries are the sectors of the economy that develop the natural resources by removing them from the natural environment
- The resource developer and individuals have a duty to follow with the acceptable limits of work practice set by the laws of Papua New Guinea
- If the resource developer breaks any of the laws through its practices then the government has the right to cancel the company's license
- Regular patrol and monitoring is urgently needed to avoid compromising with poor practices that harm our natural and human environment
- Sustainable Development is development that meets the needs of the present without compromising the ability of the future generations

NOW DO PRACTICE EXERCISE 16 ON THE NEXT PAGE



Practice Exercise 16

1. What is the difference between re-forestation and afforestation?

 2. What is Sustainable Development?

 3. Describe the disadvantage of using *drift-net fishing*.

 4. Name two provinces that contribute to the fisheries industry in Papua new Guinea.
(i) _____
(ii) _____
 5. What can be done to prevent illegal foreign fishing fleets in Papua New Guinea waters?

 6. What measures can be taken to prevent over-fishing by foreign fishing vessels?

 7. What is drift net fishing?

-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 3
--

Lesson 17: Impacts of Resource Use on Human Settlement Patterns



Welcome to Lesson 17. In the last lesson, you learnt about solution to negative impacts of resource use on the Human Settlement Patterns.



Your Aims

- recall the meaning of Human Settlement Pattern.
- list the positive and negative impacts of resources use on human settlement patterns.

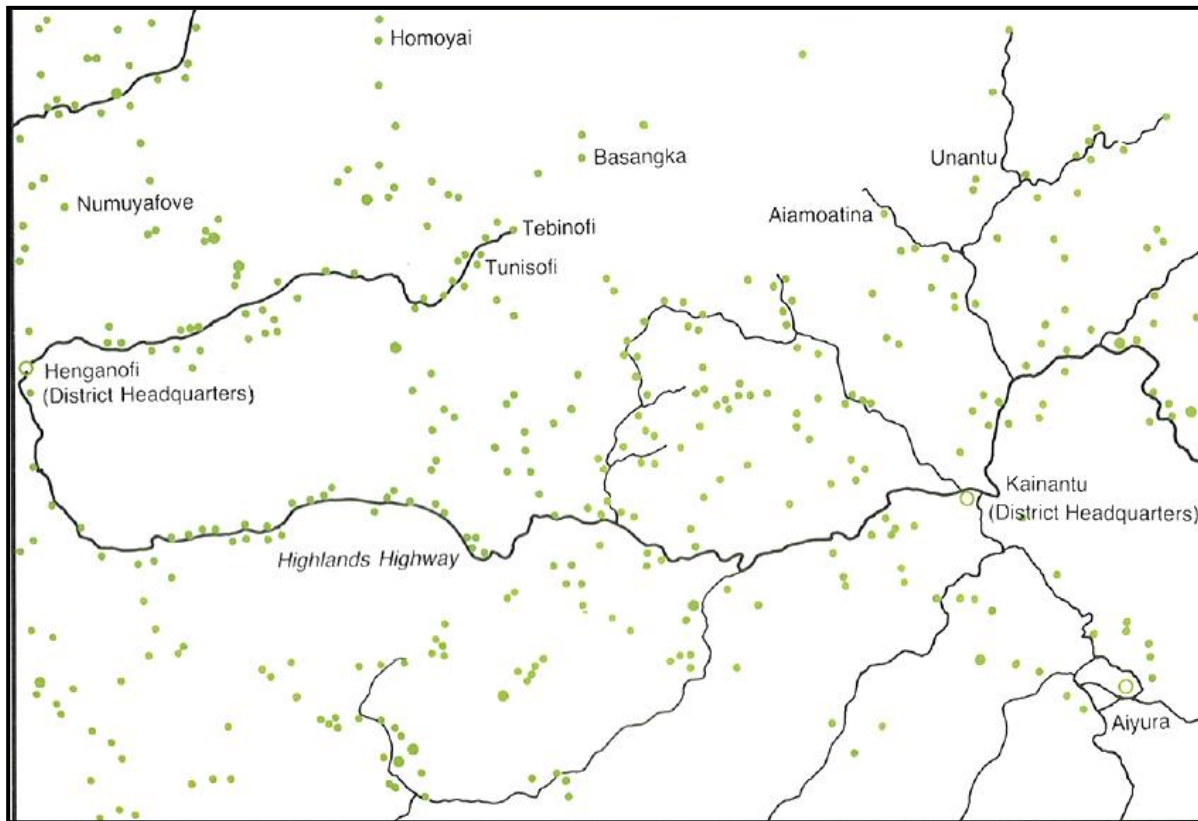
The settlement patterns of the community show the social, economic, cultural, political and spiritual influences of the people and the community at large.

Settlement patterns are also influenced by the *physical environment* and the needs of people who live there. Good factors attract people to live in a place because they can benefit from these factors. Others are *bad* so people decide not to live in that place because life could be made difficult by those factors.

In Papua New Guinea, our physical environment has the most effect on where most people live. People will only live in a natural environment that helps meet their basic needs such as water, food and defence against enemies. These days, the towns and cities and areas of natural resource development are attracting more and more people to live and work there.

Villages are the most common type of rural settlements in Papua New Guinea. Villages usually have few houses, a food store, a church and a place where the whole community can gather. They are found mainly in areas where people use the soil for growing food crops for their own consumption.

Urban Settlements are called towns, cities or conurbations. A town is the product of man's activities. A city is a large town and a conurbation is a very big city formed by several cities joined together.



A section of the Highlands Highway Between Kainantu and Henganofi. Each Dot on this Map is a Village

When you study this map, you will see that each dot on the map stands for a village. Hence, there can be many small villages in one area. Notice that many of these villages are close to the road forming a *linear pattern of settlement*.

How Can Resource Use Influence Settlement Patterns?

The benefits of the resource development in a particular area will always attract people to move into that area. The negative effects of areas having little or no resource development will force people to move away from the area. This influences where and how people settle.

Some towns in Papua New Guinea have been established near areas of mineral wealth to meet the needs of the people working in the mines. We call them *mining towns*. Current examples of mining towns include Tabubil, Lihir and Porgera. There are more of these types of settlements now in the oil-rich Southern Highlands Province such as Moro, Kutubu and Hides. People move to these towns to find jobs and to have access to the services such as entertainment and health. The mining activities attract a lot of people from neighbouring provinces which at times leads to cultural indifferences and fights with the local ethnic groups.

Most people who migrate freely do not have jobs but stay with relatives or in squatter settlements in these towns. They often cause social problems like stealing and are involved in alcohol use and its related problems. Overcrowding is also a problem in towns like Tabubil and Porgera because of shortage of land.

Some towns in Papua New Guinea were developed near rivers and sea. The people who live near the water sources make use of the water supply in many different ways. Water is used for cooking, drinking, laundry and it also serve as means of transport. The Kiunga government town was established near the Fly River so that big ships can move up and down to transport goods and provide services for the people. This is helping the inland people of Western Province.



The LNG Project and Its Influence on Settlement

What does the initial LNG stand for? LNG as you might have guessed stands for Liquefied Natural Gas. LNG is an energy source that has much lower air emissions (or outflow) than other fossil fuels, such as oil or coal. LNG is odourless, colourless, non-corrosive (rust) and non-toxic (poisonous). Its weight is less than one-half that of water. Natural gas is the world's cleanest burning fossil fuel and it has emerged as the environmentally preferred fuel of choice.

It is a natural gas that has been supercooled to minus 162 degrees celsius. At that temperature, natural gas changes into a liquid. When in liquid form, natural gas takes up to 600 times less space than in its gaseous state, which makes it easier to transport over long distances. In the form of LNG, natural gas can be shipped from the parts of the world where it is abundant to where it is in demand.

The good news is that, the LNG project in PNG will bring a lot of benefits to the people. That is why it is the highly talked about issue in country.

Three large gas discoveries in the Hela and Western Provinces of Papua New Guinea, has led to PNG signing an agreement with Exxon Mobil, an American company, and the largest Oil Company in the world to develop the LNG Project in 2009. The Hides, Angore and Juha gas fields, is likely to have a *reserve* that will produce three to four trillion cubic feet of gas. The three fields will supply gas for the Asian market via a pipeline to a refinery at Napanapa near Port Moresby. The project's construction stage was completed in 2014 and production began in the same year and so far over 200 shipments of gas have been shipped overseas. This gas project is estimated to have a lifespan of about 30 years.

The project's main shareholder is Exxon Mobil while Esso Highlands will be the operator. The PNG government has retained the right to take a 22.5% stake in the Hides, Angore and Juha gas fields.



Now, what does the LNG project got to do with settlement patterns in PNG?

If you have world class oil and gas project in PNG, it obviously means more and more people from other countries will be coming to live and work in this country. The government is now planning to build *satellite cities* in Port Moresby, Lae and some other provincial capitals.

A Satellite City is a town or small city located near and dependent on a larger city.

These satellite cities will accommodate people who will be working in the LNG project. Industrial towns like Lae will expand in its manufacturing, processing of raw materials and the production of finished goods. These will meet the additional needs of expatriate communities who will live and work in Papua New Guinea.

The PNG government will bring a lot of foreign income from this project as a major shareholder. The project developer and the government has agreed to set aside 7000 plus jobs only for Papua New Guineans.

The average Papua New Guinean is predicted to also earn more money to meet their basic needs. On the other hand, we need to be ready to solve negative impacts of this multi-million project on the people and the environment.



Summary

You have come to the end of lesson 17. In this lesson you have learnt that:

- Settlement patterns are also influenced by the *physical environment* and the needs of humans who live there.
- A *city* is a large town and a *conurbation* is a very big city formed by several towns joined together.
- People will only live in a natural environment that helps meet their basic needs.
- Some towns in Papua New Guinea have been established near areas of mineral wealth to serve the needs of the people working in these mines.
- The Liquefied Natural Gas Project will be the biggest in Papua New Guinea with many satellites cities being build to accommodate people all over the world.
- Some towns in Papua New Guinea have been developed near river banks and confluences, sea ports, natural harbours and even near lakes.

NOW DO PRACTICE EXERCISE 17 ON THE NEXT PAGE



Practice Exercise 17

1. Use an atlas to find out the names of the provinces of these mining towns.

Mining Towns	Province of Location
Wau	
Panguna	
Tabubil	
Misima	
Lihir	
Porgera	

2. Briefly describe some impacts of the Liquefied Natural Gas project in Papua New Guinea.

3. Give two reasons why people would want to build towns near river banks and sea ports.

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 3

Lesson 18: Ok Tedi Mine: Case Study on the Physical and Human Environment



Welcome to Lesson 18. In the last lesson, you learnt that resource use will always have an impact on human settlement patterns. In this lesson, you will do a Case Study of the Ok Tedi Mine in Papua New Guinea and its impact on the human and physical environment.



Your Aims

- explain Case Study.
 - read and answer questions based on the Case Study.
 - identify from given information the positive and negative impacts of Ok Tedi mine on the physical environment and its human environment.
 - suggest ways of reducing the negative impacts of the mine on the physical and human environment.
-

What is a Case Study?

A **case study** is the work involving personal study of individuals, families or an organization that has positive and negative impacts of the physical environment. Hence, you will do a case study of Ok Tedi Mine in Papua New Guinea. You will look at the effects of the mine on the human and natural environment.

Have a look at the map below. It shows you the general location of the Ok Tedi Mine in PNG.

LOCATION OF OK TEDI MINE



The mine is located near the headwaters of the Ok Tedi River, in the Star Mountains Rural Local Level Government (LLG) of the North Fly District of the Western Province of Papua New Guinea. The Ok Tedi River drains into the Fly River which is the biggest and the longest river in the country.

Notice the darker line connecting the dot. The dot is the location of the mine while the darker line is the Ok Tedi River. Both Ok Tedi and the Strickland River to the east drain into the much bigger Fly River which flows southwards to the Coral Sea.

Located in a remote area, above 2,000 metres on Mount Fubilan, in a region of high rainfall and frequent earthquakes, mine development presented serious challenges. The town of Tabubil was built to serve the mining operation.

Take a closer look at the photograph below. You will notice in the background, is the Tabubil Township.



Satellite Image of the Star Mountains and the Ok Tedi Mine

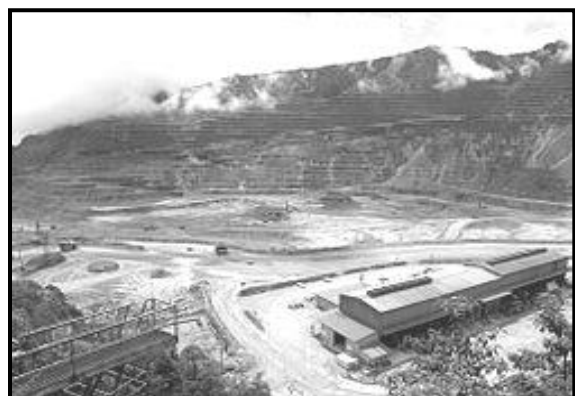
The mine is operated by Ok Tedi Mining Limited (OTML) which is majority owned by the PNG Sustainable Development Program Limited (PNGSDPL).

The mine is an open cut operation and Mount Fubilan has been reduced to a deep pit in the ground. Much of the waste rock is dumped directly into the Ok Tedi River that eventually flows into the bigger Fly River.

Photographs 1 and 2 below show the nature of Ok Tedi Mine - an Open Cut Mine.



Photograph 1



Photograph 2

History of the Mine Operation

Before mining operations began, Mount Fubilan was a copper mountain with a gold cap. Exploration and test drilling in the area began in the 1970s, and was done by the Kennecott Copper Corporation.

In the early 80s, BHP (now BHP Billiton) secured a mining lease and in 1984, began exploiting a gold cap on the mountain using cyanide extraction procedures. It was then called a *gold mine*. After the gold deposit was depleted, a much larger copper deposit was targeted underneath. At that time, this deposit was believed to be the largest copper deposit in the world. BHP entered into a partnership with the Papua New Guinea government and a Canadian company, Inmet Mining Corporation, to mine the copper deposit, although BHP maintained a majority share in the mine. Hence, it is now called a *copper mine*.

All the gold mined at Fubilan was *smelted* to produce gold at Folomian few metres away from the mine. The gold was then flown out by aeroplane. With the copper mine, there is a mill adjacent to the mine that transforms the raw material mined into copper concentrate *slurry* (watery mixture) and is piped 137 kilometres along the Kiunga-Tabubil Highway to Kiunga, the main port of the district. It is then shipped by river barge along the Fly River.

About 20 years after the beginning of mining operations, majority share ownership turned into the hands of the PNG Sustainable Development Program, in the wake of the Ok Tedi Environmental Disaster.

Smelting is the process whereby gold is purified from its ores. Rocks containing gold is crushed and melted in a very hot furnace to get the purified gold from it.

The Impact of Mining

The original Environmental Impact Study of the mine recommended a tailings dam to store *tailings*. However, a land slide in 1984 destroyed the dam. BHP then made another study on the impacts of the mine for a more sustainable method of removing tailings waste. It came up with the treatment of the tailings to make it safer before dumping into the river.

Tailings are poisonous chemical wastes from processing ore

The mine's effects are now felt much further downstream, in the Fly River as well as the Ok Tedi River. What are the physical effects of extra sediment loads in the river? Clearly, the sediments can destroy fish and plant life and cause them to die.

What are the long term effects of poisoning from heavy metal contamination, given that the waste entering the river still has 15% of its original copper?. Up to 80,000 tonnes of waste rock and 1200,000 tonnes of tailings are discharged from the Ok Tedi / Fly River system, every day. In addition, 30 million tonnes of *tailings* are discharged annually into the Fly River.



Overbank Flooding Causes Vegetation Die-Back along the Ok Tedi River



Vegetation Die-back Along the River Banks Due to Heavy Sedimentation from Waste Rock

Up to 30, 000 people living to the south of the mining site along the Ok Tedi and Fly River systems have been badly affected by the environmental impact of the mine. For example, locals have reported that they are no longer able to sell their fish and garden produce because of the effects of the mine pollution. The Yonggom, a language and cultural group of around 4,500 living in the Lower Ok Tedi area, have been particularly hard hit from the impact of the mine.

In the past, Ok Tedi's reports revealed that fish numbers in the upper Ok Tedi River had reduced between 50% to 80% compared to what existed before the mine started. The Australian Conservation Foundation (ACF) reported in the early 1990's, that the first 70 kilometres of the river is "almost biologically dead" and plants and animal numbers over the next 130 kilometres had been reduced greatly.

In 1999, BHP reported that the project was the cause of "major environmental damage". The mine operators discharge 80 million tonnes of contaminated tailings, overburden and mine-induced erosion into the river system each year.

The discharge caused widespread and diverse harm, both environmentally and socially, to the 50,000 people who live in the 120 villages downstream of the mine. Chemicals from the tailings killed or contaminated fish, which later caused harm to all animal species that live in the area as well as the indigenous people.

The dumping changed the riverbed, causing a relatively deep and slow river to become shallower and develop rapids thereby disrupting indigenous transportation routes. Flooding caused by the raised riverbed left a thick layer of contaminated mud on the flood plain among plantations of taro, bananas and sago palm that are the staples of the local diet.

About 1300 square kilometres were damaged in this way. Although, the concentration of copper in the water is about 30 times above the standard level, it is still below the World Health Organization (WHO) standards.

Of course, this material dumped into the river does not just disappear. Its impacts on the rivers and rainforest are likely to last for many years to come. Mining stops in few years. How long the river will take to recover remains uncertain. BHP says 25 years while other studies say 300 years or most likely no recovery at all..



Sedimentation and Braiding of Ok Tedi River.

The Ok Tedi Environmental Disaster

The reason for this disaster is not a single problem. The original plans included an Environmental Impact Statement that called for a tailings dam to be built near the mine. This would allow heavy metals and solid particles to settle, before releasing clean 'high-water' into the river system where remaining harmful chemicals would be diluted. But the plan did not work and in 1984 an earthquake caused the half built dam to collapse.

Ok Tedi Mining Limited and BHP were taken to court by local land owners particularly villagers downstream from Ok Tedi in the Fly River system. They received US\$28.6 million in an out-of-court settlement, which was the highest of a huge public-relations campaign against the company by environmental groups. BHP was then granted legal protection from future mine related damages. This meant that BHP would not be challenged even if they continue to put mine wastes into the river system. As part of the settlement, a *dredging* operation was also put in place and efforts were made to improve the mine site.

Afterwards, the company continued operations without any dam because BHP argued that it would be too expensive to rebuild it as the mine is located in a geologically very unstable area where earthquakes are common. In other words, BHP said that the dam will still collapse during earthquakes and landslides and it was no use building it.

However, the mine is still in operation and waste continues to flow into the river system. The people in the Middle Fly District and the southern and central areas of the North Fly District believe the effect on their livelihood from this disaster far outweighs the benefits they have received from the mine's presence in their area.

What actions should be taken to minimise these Negative Impacts?

Regular sampling of water is carried along the Ok Tedi and Fly Rivers and the locals are informed of the latest information after testing the rivers.

The problem of too much sediment in the river is now managed by *dredging* sediments out of the river bed so as to allow free flow of water. Since 1996, the management has started on vegetation rehabilitation program on the exposed surfaces of the mine pit. In this process, native plants were replanted on the exposed land surfaces.

Effective checking of the environment is needed so that impacts can be accurately measured. The Mine Waste Management Project and many other environmental assessments undertaken to measure and understand the impacts of the mine have led to the need for an updating of the monitoring, environmental management and reporting system.

In late 2001, OTML submitted to the PNG Government a proposed new environmental plan. The plan puts into place a program of activities that provides a better understanding of the *cause - effect* process of impacts and encourages the investigation of potential mitigative actions. Its successful implementation ought to allow the PNG Government make decisions on the mine's continuity from an environmentally informed basis.

Mitigation methods need to be assessed and meaningful reports provided to the government regulators. Environmental monitoring and reporting at Ok Tedi started before the first operations in 1984. OTML's approach to environmental monitoring and reporting has changed significantly over time.

***Mitigation* means to make something less harsh, severe, or violent by taking measures to prevent and minimise the negative impacts.**

Here is a list of impacts caused by the mine.

Positive Impacts

- Schools, roads and Health services have been made easily accessible at affordable costs by the locals
- Royalties (money) are paid to the landowners for mining their land
- Locals and other nationals have better and well paid jobs
- Educational opportunities have improved including establishment of schools and resource facilities in schools
- Revenue (income) for the PNG economy
- Vocational training and infrastructure developments and maintenance
- Rural business development schemes to help people use their money wisely.

Negative Impacts

- Water/river pollution and this affects the food chain, including humans
- Vegetation die-back along the banks of the Fly and Lower Ok Tedi Rivers
- Clearing forest and digging large land masses
- Overburden (rock waste) and tailings are dumped straight into the river causing pollution and river aggradation (*building-up of sediment in the river*)
- Habitat for animals is disturbed/destroyed
- Air and noise pollution in once untouched wilderness
- The dumping changed the river bed, causing a relatively deep and slow river to become shallower and develop rapids thereby disrupting indigenous transportation routes
- Illegal squatter settlements built up and adding to law and order problems
- It is too expensive to live in a mining area

- Fish counts decreased along the Fly River affecting people's food sources
 - Increased social problems like drunkenness, drug use, robberies, theft and marriage break-downs
-



Summary

You have come to the end of lesson 18. In this lesson you have learnt that:

- 50,000 people who live near the OK Tedi River are affected the most, every year millions of tons of mine waste are dumped into the river system.
 - The dumping of the mine waste has changed the river-bed causing vegetation and fish to die
 - The Fly River is the biggest and the longest river in PNG
 - OK Tedi is an open-cut mine
 - Ok Tedi Mining Limited has built schools, roads and brought a lot of development to the locals
 - Up to 30, 000 people living to the south of the mining site along the Ok Tedi and Fly River systems have been badly affected by the environment impact of the mine.
-

NOW DO PRACTICE EXERCISE 18 ON THE NEXT PAGE



Practice Exercise 18

1. List four different ways by which the local people benefit from the mine.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____

2. What are tailings?

3. How much tonnes of waste rock and tailings have been estimated to be dumped into the river daily?

4. Why is Ok Tedi Mine now called a copper mine instead of being referred to as gold Mine?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 3
--

SUB-STRAND 3

ANSWERS TO PRACTICE EXERCISES 15-18

PRACTICE EXERCISE 15

1. Impact refers to a noticeable effect or influence.
- 2.

Positive Impacts (benefits)	Negative Impacts (Bad effects)
i. Employment	i. Destruction of natural landscape eg. Trees and soil
ii. Income/Royalties for landowners	ii. Pollution of rivers and seas
iii. Infrastructural Development	iii. Soil erosion, deforestation etc.

3. A

4.

Part of the Natural Environment	Part of the Human Environment
Tree, liana, river, rain, sunshine, cattle, tobacco, tuna and oil palm	Town, canoe, road, dam, garden

PRACTICE EXERCISE 16

1. *Reforestation* refers to the planting of new trees in areas of forest that were previously logged while *afforestation* means planting new trees in an originally barren land to form a forest),
2. Sustainable Development is development that meets the needs of the present without compromising the ability of the future generations to meet their own needs.
3. All kinds of sea creatures such as dolphins, dugongs, turtles, fish, and even sea birds are caught.
4. Western and Gulf Provinces.
5. Regular sea surveillance and monitoring is urgently needed to avoid compromising with poor practices that harm our natural and human environment. There also need to be regular sea surveillance by the maritime authority to apprehend illegal foreign fishing fleets who are over-fishing in PNG waters.
6. Regular Patrolling of seas
7. Drift nets are fishing nets that cover several kilometres and catch anything on its paths.

PRACTICE EXERCISE 17

1.

Mining Towns	Province of Location
Wau	Morobe Province
Panguna	Autonomous Region of Bougainville
Tabubil	Western Province
Misima	Milne Bay Province
Lihir	New Ireland Province
Porgera	Enga Province
2. The Liquefied Natural Gas project in Papua New Guinea will bring more and more people from outside the country to live and work in Papua New Guinea towns. The government is now planning to build satellite cities in Port Moresby, Lae and some other provincial capitals. These satellite cities will accommodate people who will be working in the LNG project. This project will be one of the biggest in the world and that means billions of kina will be made by the Government of PNG. The government has also promised 7000 or more jobs set aside only for Papua New Guineans. People will have a lot of money to meet their basic needs.
3. A river is an important resource. The water can be tapped for water supply to villages and towns; fishing both traditional for food and commercial for marketing; navigation is essential near deep river confluence especially for water transportation of goods and services;

PRACTICE EXERCISE 18

1. (Any four of these answers)
Locals have easy access to;
 - Schools
 - roads
 - Health services
 - Royalties (money) are paid to the landowners for mining their land
 - Locals and other nationals have paid jobs
 - Educational opportunities have improved including establishment of schools and resource facilities in schools
 - Revenue for the country
2. Tailings are poisonous chemical waste which is the by-product of the milling processes in the mills.
3. Up to 80,000 tonnes of waste rock and 1200,000 tonnes of tailings are discharged from the Ok Tedi/Fly River system every day. In addition, 30, million tonnes of tailings are discharged annually into the Fly River.
4. It is now called a copper mine because there is more copper than gold mined.

SUB-STRAND 4

SUSTAINABLE PRACTICES

In This Sub-strand you will learn about:

- **Environmental Practices and Land use in Papua New Guinea**
- **Endangered Species**
- **Conservation of Wildlife**
- **Waste Management: Recycling, Reducing and Re-using**
- **Household and Industrial Wastes**

SUB-STRAND 4: INTRODUCTION

In Sub-strand 4 - **Sustainable Practices**, you will learn about the good environmental practices and ways to conserve our natural resources.

Communities of living things interact to support each other. These communities are called **ecosystems**. Sunshine, rain, soil, plants, animals and humans are all linked together in ways that enable living things to survive.

Ecological sustainability means that the needs of the present population can be met without endangering the ability of future generations to meet their own needs.

There is a growing concern about the way in which humans are using the world's resources. Many conservationists believe that we will not be able to continue using our physical environment in the ways that we have in the past. This environmental problem is the result of the limited amount of resources that the earth have and the rate at which they are being used or destroyed.

The population of Papua New Guinea is growing rapidly and this growth puts pressure on the whole country. An increase in the number of people means an increased demand for food, water, fuel and other resources. Forests maybe cleared to provide more land for building and agriculture, but too much land clearing can damage plants and animals and affect living standards of those who depend on the natural forest.

Our natural resources are under threat of destruction due to unsustainable practices. From the agriculture, fisheries, forestry and mining industries, thoughtful management is needed to maintain our natural resource. Therefore, we must look after our natural resources. We must manage our resource wisely and plan for the future.



Mulching Garden Beds Helps Reduce Effects of Erosion

Lesson 19: Environmental Land use Practices in Papua New Guinea



Welcome to Lesson 19. In this lesson, you will learn about environmental and land-use practices in Papua New Guinea.



Your Aims

- define land use and environmental practice
 - distinguish between sustainable and unsustainable environmental practice practices
 - identify examples of sustainable and unsustainable environmental practices.
-

Humans make use of the land they live on in many different ways. People have changed the land to satisfy their own purposes. The human impact is clearly seen in the temperate and tropical regions, but even remote deserts, high mountains, and Polar Regions carry evidence of the works of people.

Deforestation of temperate regions has been a major negative impact of land use. Until more recently, significant effects of land use include the movement of people to urban areas, soil erosion, *loss of soil quality*, *the buildup of salt near or on the surface of soil* and desertification (*process of becoming desert*). In PNG, logging and shifting cultivation add to the problem of deforestation.

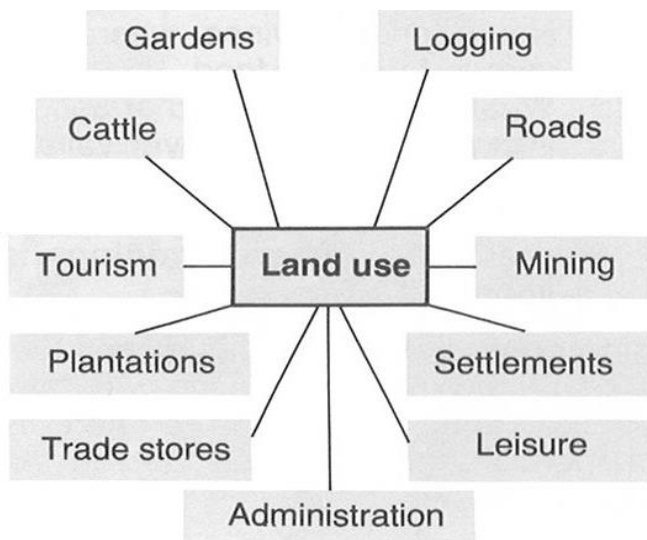
What is Land-use?

Land-Use is the human change of the natural environment into built-up environment such as fields, pastures, and settlements. It is how we use the land for different activities and purposes and the effects of using these lands. Some examples of common land uses in Papua New Guinea are farming, mining, logging, gardening, building and sports-fields. Each of these land use activities usually has negative impacts on the environment.

Environmental Practices on the other hand are the ways or methods that individuals, companies or industries do to control and decrease negative impacts and pollution that is produced as a result of resource development and land use.

In big towns and cities like Port Moresby, you will find industrial centres and major transportation networks which are the evidence of major changes of the natural environments. Land occupied by farms and plantations may seem more 'natural,' but these forms of development are the result of human activity just as surely as densely populated cities, populated and bad arrangement of factory buildings, and busy international airports.

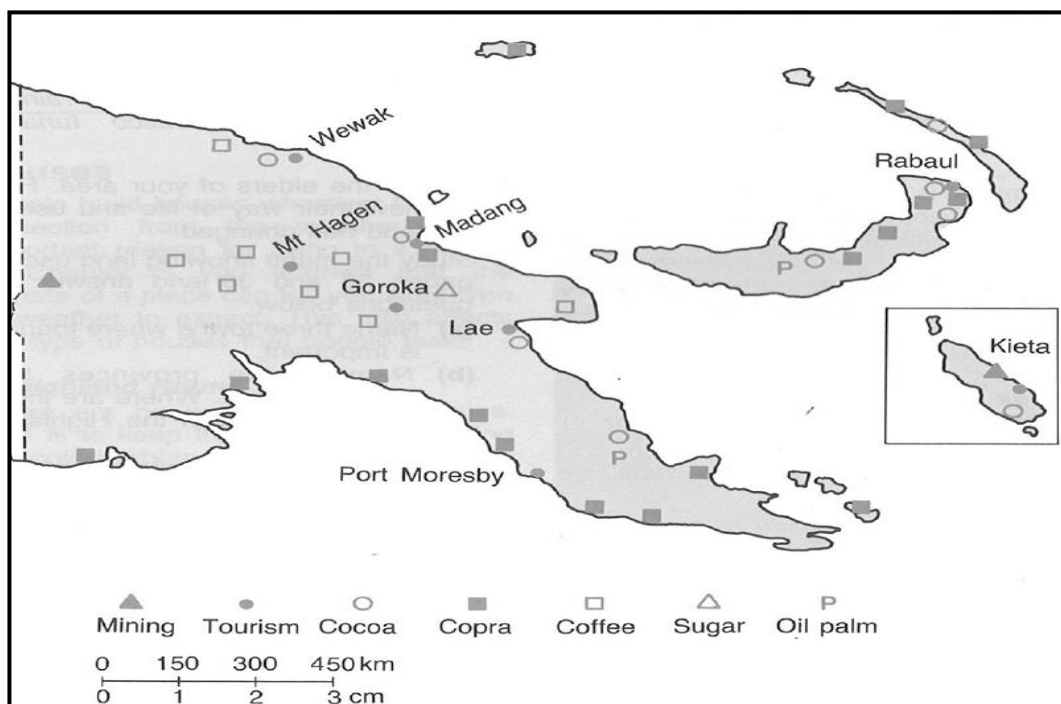
Here are some examples of land use practices in Papua New Guinea.



These land-use practices that we do can affect the natural environment by changing its beauty and appearance.

The map below shows some commercial land use activities in Papua New Guinea. Commercial means the main centres of trade and business activities.

COMMERCIAL ACTIVITIES IN PAPUA NEW GUINEA



In Japan, where most of the population is crowded onto the narrow coastal plains that lie between the mountainous interior and the sea, engineers create additional land by filling bays and harbours.

Even in PNG, much conflict over ownership of land arises as the government and resource developers offer to use land for economic development. This is because 97 percent of the land is owned by the people. Land areas closer to cities may be sought by developers to convert into suburbs, motorways, or shopping centres.

If you have the chance of visiting Port Moresby, you will see that some hills have been *terraced* (cut) to build high covenant houses, apartments and hotels. PNG and other developing countries need for money leads them to clear up their forests for timber and change the savannah areas for beef, tea, rubber, and other cash crops for export. However, they must look after these same ecosystems to make sure there is enough resources for the future.

It is therefore very important that there is proper planning for all these land use activities to make sure the quality of land is not spoiled or damaged.

Now do the activity below. Check your answers after Summary.



ACTIVITY 1

Study the photograph below and then answer the questions that follow.



- (i) Name this land-use practice in the photograph.

- (ii) Is this land-use practice sustainable? Explain your answer.

Sustainable Environmental Practice

Sustainable means to support something and keep it going. Thus, sustainable environmental practices are the land-use practices that keep or maintain the quality of the land and the environment while we satisfy our needs and wants by using them. This involves the methods of using resources in a way that will keep them going for the future generations. Examples of these include *mixed cropping*, *re-using resources*, *conserving resources*, *sharing resources*, *planting trees*, *protecting marine areas* and *organic farming*.

Let us examine these sustainable practices further:

Mixed Cropping: Growing a different kind of crops in the food gardens to take and replace nutrients in the soil. Some crops with shallow roots and others with deeper roots. Some of these crops reduce the damage caused by pests to other plants.

Re-using Resources: A good example is the use of mulch and compost to add to the soil nutrients and hold the water in the soil.

Conserving Resources: The sustainable use and protection of natural resources including plants, animals, mineral deposits, soils, clean water, clean air and fossil fuels such as coal, oil and natural gas.

When you share resources, you avoid wasting resources. If two people traveled in one boat or vehicle instead each person traveling alone, the effort and fuel use would be reduced.

Organic Farming: The use of natural materials such as cut grass, saw dust, fallen dry leaves, food waste without the use of chemicals, sprays and fertilizers.

There are many correct ways of looking after the resources. Do you live near a coastal area? How is your community protecting the coral reefs? How about those of you who live near heavily forested areas, natural grasslands or swamps? Do you take care of the wildlife there or are you carelessly destroying their homes? Think about these important questions. When you protect these natural resources, you are helping to maintain the survival of rare and endangered species of plants and animals.

Unsustainable Environmental Practice

Unsustainable practices on the other hand, are those that are not friendly to the environment and can destroy the quality of the land and environment. It can affect the natural environment in a *negative* way. In doing so, the natural environment and its resources are destroyed.

Logging areas without a reforestation program causes loss of plant diversity, natural habitats and soils. **Continuous cropping** on the same piece of land depletes the fertility of the soil, which then requires much time to recover and the use of fertilisers. Over time, fewer yields of food will be produced. Many coastal people have the habit of switching to **dynamite fishing** as an easy way of catching fish. This is dangerous as it destroys reefs and unnecessary killing of fish. It is also dangerous for the user. Many pollutants continue to enter water ways and the oceans. The chemicals from the dynamite kills the fish and other marine animals.

Now do the following activity. Check your answers at the end of the Summary.



ACTIVITY 2

Study the photograph below and answer the questions that follow.



(i) Name the environmental practice in the photograph.

(ii) Is the land-use practice sustainable or unsustainable? Explain your answer.



Summary

You have come to the end of lesson 19. In this lesson you have learnt that

- Environmental practices are ways of doing things to satisfy our needs and wants. These practices affect the environment.
- Land-use refers to the way we use land for different purposes such as agriculture and farming.
- Sustainable practices are ways that help or support the quality of the environment or land.
- Unsustainable practices are methods that do not support the environment.
- We affect the environment positively or negatively depending on our practices.

ANSWERS TO ACTIVITIES

Activity 1 (i) Shifting Cultivation or slash and burn

(ii) Repeated cultivation of the same land, shorter fallow period and over-cropping makes this farming method unsustainable practice

Activity 2 (i) The environmental practice is building stilts and beds on gardens along steep slopes

(iii) This is an unsustainable practice. These structures are built to control water erosion during rainy season

NOW DO PRACTICE EXERCISE 19 ON THE NEXT PAGE



Practice Exercise 19

1. List examples of sustainable and unsustainable environmental practices or land use.

2. List an example of a land use practice.

3. What is Sustainable Environmental Practice?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 4
--

Lesson 20: Endangered Species



Welcome to Lesson 20. In this lesson, you will learn about endangered species of plants and animals in Papua New Guinea.

Your Aims

- define endangered species and natural habitat
 - explain how human activities can destroy natural habitats
 - show distribution of endangered species in Papua New Guinea
 - differentiate between endangered and endemic species
 - identify ways to save endangered species of plants and animals
-

What are Endangered Species?

Endangered Species are groups of very similar plants and animals that are threatened and are at the risk of *extinction*. They are usually very rare or few in numbers and may occur in one particular area only.

***Extinction* means completely dying out.**

The hot, wet tropical climate of Papua New Guinea has different types of plants and animals. We have insects, fish, spiders, mammals, birds, amphibians, corals, sea-life, plants and trees of different types. We call this biodiversity. If we do not manage these land and sea resources well, our ecosystems and biodiversity can be lost for good.

***Biodiversity* is the existence of a large number of different kinds of plants and animals that make a balanced environment.**

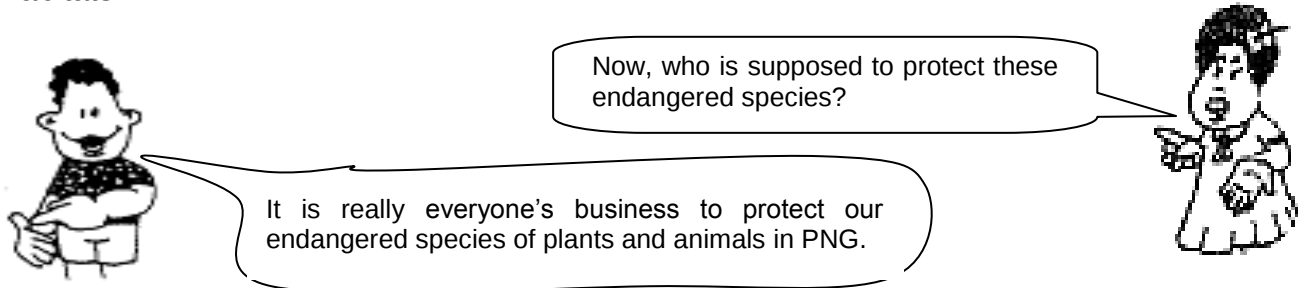
We talk more often of endangered animals than plants. Today, most endangered animals are at the highest risk of extinction because people are either destroying their *natural habitats*, *over hunting* them or *selling* them for money in their own countries or overseas. A **Natural Habitat** is the natural place where an animal lives.

Habitat is the homes of animals. For example, tadpole lives in the water and water is the natural habitat of the tadpole. Forests, grasslands, deserts, rivers, oceans and wetlands are different kinds of habitats. Many endangered animals and plants live in tropical rainforests. When people cut down rain forests, they are destroying the natural habitats. Hence, they endanger animal life.

Let us talk about crocodiles. Where do you think they live?



Off course, they live in big rivers and coastal swamps. Most of our rare species of crocodiles are found in the two biggest rivers, the *Sepik* and the *Fly*. Crocodiles are classified as endangered species and are protected by law to avoid over hunting and destruction of their habitats.



It is important for the local people to be informed and made aware of ways of protecting and preserving endangered species like crocodiles for future uses. Furthermore, crocodiles are threatened because they are hunted for their flesh and skin in overseas markets for money. PNG has signed International Agreements to manage and control the rate of harvesting or hunting of the endangered species.

Human beings are causing thousands of different kinds of plants and animals to become *extinct*. In the developed and industrialised countries, chemicals are released to pollute the environment which in turn endangers and threatens the animals. In Africa, hunters kill endangered animals such as rhinoceroses for their horns, tigers for their skins and elephants for their ivory tusks. Hunting reduces a large numbers of these animals.

Here are some examples of *Endangered Species* of animals in Papua New Guinea.



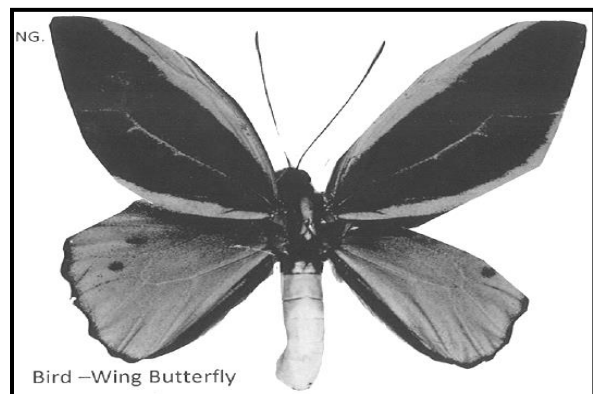
New Guinea Cuscus



Wallaby



Hornbill Bird



Bird -Wing Butterfly

Another group of animals and plants are called the Endemic Species. **Endemic species** are unique and can be found in a particular area only, such as a island, habitat type, or environment. To be endemic to a place means that it is found only in that part of the world and nowhere else. This makes them to be at a higher risk of extinction.

For example, many species of lemur are endemic to the island of Madagascar. In Papua New Guinea, we have the Bird wing butterfly, Birds of Paradise (National bird of PNG), Flame of the Forest (National plant of PNG) and the New Guinea Eagle.



Can you think of some other examples of endemic species in PNG and the island of New Guinea?

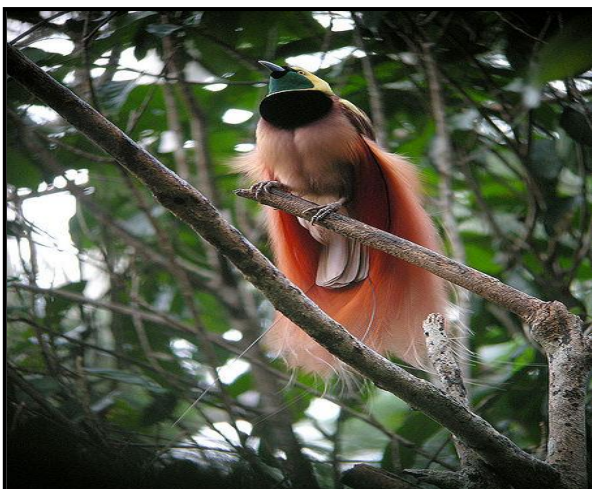
Here are some examples of *Endemic Species* of animals in PNG.



Emperor Bird of Paradise



Short-tailed Paradigalla



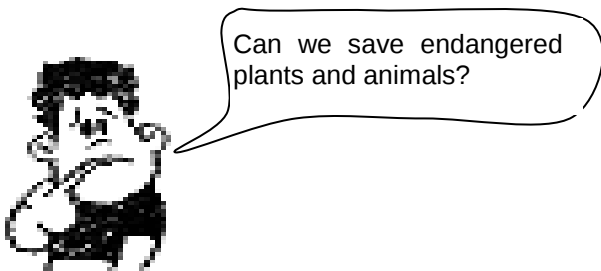
Ragianna Bird of Paradise: National Bird of PNG



Long Snorted Echidna Endemic to Australia and PNG

Javan Rhinoceros

- This Javan rhinoceros lives in thick tropical forests on Indonesia's island of Java. The rhinoceros is heavily hunted for its horn, which is used in traditional medicines. Today, over-hunting threatens the Javan rhinoceros with extinction.



Governments can pass laws that make it illegal to hunt or sell endangered animals and harvest certain plants. They can pass laws against using chemicals that harm certain animals. For example, DDT was a bug killer that once endangered the bald eagle and the peregrine falcon in USA. DDT was banned, and the populations of these birds increased.

Sometimes people try to save one kind of endangered animal. They take some of the animals to zoos or laboratories and breed the animals there. When there are enough animals, they set them free in the wild. Biologists are trying to save the Giant Panda Bears and the California Condor in this way.



California Condor

The California Condor is the most endangered bird in the United States. In the late 1980s, scientists captured a number of condors to breed them in zoos. This program has given the condor a better chance of surviving.



Giant Panda Bear

Hunting and habitat destruction have made the Giant Panda Bear an endangered species. Many people are now trying to save the Giant Pandas, which are *Endemic* to China and live in the mountains of south central China. It eats the leaves and stems of bamboo trees. The Giant Panda is an *endangered species*. There may only be about 1,000 of these animals left in the wild.

Some Biologists believe the best way to save endangered animals is to save their habitats. They work to set up wilderness areas such as parks and national forests where the animals can live. They keep the animals safe from hunters and other dangers.

One Planet, Many species

Planet earth has different types of animals and plants. Many have not yet been identified. Each year a number of species become extinct, some times before identification. These plants and animals are endangered for many reasons such as from over hunting for food, costumes, medicines or magic, loss of habitat caused by population pressure, logging or mining and others such as roads, agricultural practices and the introduction of new *Predators*.

Today, many animals and plants are endangered and are about to become extinct.

A Predator is a carnivorous animal that hunts, kills, and eats other animals in order to survive.



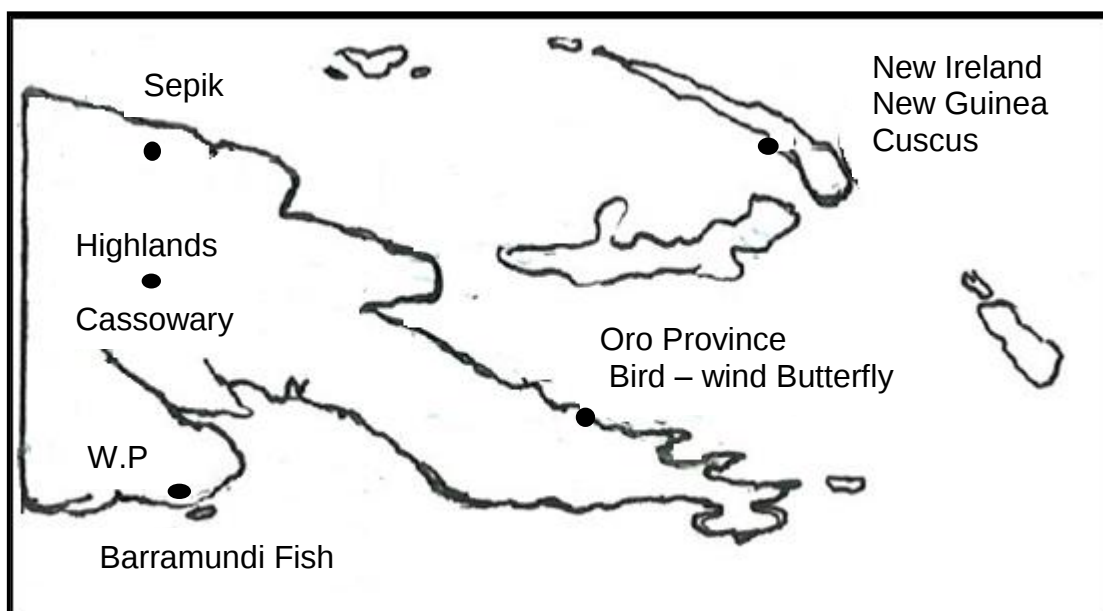
Amazon Rainforests are a Home for Many Endangered and Endemic Plants and Animal Species. Once Destroyed these Species can Become Extinct.



The Ok Tedi Copper Mine in PNG, Like Other Land-use Practices has Destroyed the Natural Habitats of Animals Living in that Natural Environment.

Now have another look at the map below. It shows the location of endangered species of plants and animals in Papua New Guinea.

DISTRIBUTION OF ENDANGERED SPECIES ACROSS PAPUA NEW GUINEA





Summary

You have come to the end of lesson 20. In this lesson you have learnt that:

- Endangered species are animals and plants that are under threat of extinction due to human activities
- Natural habitats are the natural homes of animals and plants where they survive.
- Human activities have destroyed the habitats and endangered rare species of plants and animals
- Endemism is the ecological state of being unique to a particular geographic location, such as a specific island, habitat type, nation or other defined zone
- Some examples of endangered species of animals in Papua New Guinea are Bird of Paradise, deer and echidna
- Governments can pass laws that make it illegal to hunt or sell endangered animals and harvest certain plants
- Natural habitat destruction is a major cause of endangering species

NOW DO PRACTICE EXERCISE 20 ON THE NEXT PAGE



Practice Exercise 20

1. Define endangered species and explain the three main ways by which they are threatened.

2. What is a natural habitat?

3. List five examples of endangered species of animals or plants in Papua New Guinea.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____
- (v) _____
- (vi) _____

4. List four human activities that can destroy natural habitats.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 4
--

Lesson 21: Conservation of Wildlife



Welcome to Lesson 21. In this lesson, you will learn about conservation of wildlife in Papua New Guinea. You will examine ways of protecting some of the endangered species you have



Your Aims

- define conservation and wildlife
 - explain actions taken nationally to reduce environmental damage and protect wildlife
 - discuss ways of conserving wildlife
-

Suppose you have a chocolate bar. You could eat it now, or you could divide it into pieces to eat later. Saving some of the candy bar to eat later would be a kind of *conservation*. You would be **saving**, or **conserving**, your chocolate bar so that it would last longer.

Conservationists are people who work to save the earth's natural resources and the natural environment so they will last longer.

Conservation is to do with the protection and wise use of natural resources. It means to develop ways to protect the natural environment with all its resources. *Conservation of wildlife* is the protection of wildlife (animals and plants and their natural habitats).

Wildlife refers to the animals and plants, sometimes including vegetation, occurring in a natural state that is untouched by humans.

Conservation was always important in our traditional ways of life. People developed ways of looking after the natural wildlife. Traditional ways of hunting and fishing gave wildlife more time to breed and multiply. Traditional practices have preserved our rare species of plants and animals over thousands of years.

Traditionally in Papua New Guinea, our people have a love of nature and their environment. The natural environment was part of their culture and it adds meaning to traditional life. It is their source of food, an important social and cultural site for initiation and worship, and the hiding place for sport and recreation for young people.

However, new changes and developments damaged the environment and its wildlife. Communities and overseas companies remove resources to make money and this has caused lasting damages. Land, forest, rivers, reefs and seas are being over used and destroyed. Development must be environmentally friendly to protect our natural wildlife and environment.

Long ago, people did not even have to think about conservation because there were very few people. Then, people learned to use natural resources to make their lives easier. People began to live longer. The number of people living on earth grew. Today, billions of people living on earth are using up fossil fuels and other natural resources faster than the planet can replace them.

Conservationists look for ways to save natural resources. They try to manage natural resources so that people will have enough wood, fossil fuels, water, and food. They look for ways to save endangered plants and animals.

Government Actions to Protect Wildlife and Environment

In Lesson 20, you learnt about endangered and endemic species of plants and animals in Papua New Guinea that are at high risk of becoming extinct. These plants and animals are in need of protection by law.

Papua New Guinea government through the Departments of Environment and Conservation, and Forestry, has adapted certain laws and policies to protect the natural environment and wildlife. Not all laws and policies are effective today. Many of the wildlife have been exploited and destroyed by development processes even though some of the laws are very good..

Here are some laws and policies introduced by the PNG government to protect wildlife:

- powerful countries cannot dump wastes and do nuclear testing in PNG
- Looking after and stopping the export of our rare orchids
- Law protects the rare species of Bird of Paradise, to be only hunted with traditional weapons and may not be sold to foreigners
- Reforestation policy from the Forest Department must be followed
- Protecting (endangered) birds and animals in Papua New Guinea.
 - a) Protecting cassowaries and wallabies in all regions of Papua New Guinea.
 - b) Protecting the rare species of Leather Black Turtle on the coastal regions of Papua New Guinea
 - c) Protecting Bird wing butterflies in Northern Province and Hornbills in the Highlands region

Almost all endangered and endemic species are declared and protected by law in PNG. An example of a protected plant in PNG is the Purple Orchid in this photograph.



Protected PNG Purple Orchid

The map below shows the names of Protected Areas in PNG.

PROTECTED AREAS IN PAPUA NEW GUINEA



Here are some ways of conserving wildlife in our local areas:

- establishing mini wildlife sanctuary
 - fencing around our own ancestral forest
 - do verbal awareness campaign on the endangered species
 - avoid excessive hunt, using factory made weapons such as guns
 - keeping animals as pets
-



Summary

You have come to the end of lesson 21. In this lesson you have learnt that:

- Conservation is the protection and wise use of natural resources
 - Conservationists look for ways to save natural resources
 - Conservation can protect and preserve our natural environment and wildlife
 - Development must be environmentally friendly to protect our natural wildlife and environment
 - Examples of protected animals are cassowaries, crocodiles and Bird of Paradise
 - Examples of protected plants are flame of the forest and orchids
 - Examples of Protected Areas in Papua New Guinea are Variarata National Park, at Sogeri in the Central Province and Baiyer River Sanctuary in the Western Highlands Province.
 - Papua New Guinea government through the Departments of Environment and Conservation, and Forestry, has adapted certain laws and policies to protect the natural environment and wildlife
 - Endangered and endemic species of plants are at the highest risks of extinction and are usually protected by law in many countries
-

NOW DO PRACTICE EXERCISE 21 ON THE NEXT PAGE



Practice Exercise 21

1. What is conservation?

2. Name four protected animals in Papua New Guinea.

(i) _____

(ii) _____

(iii) _____

(iv) _____

3. List two ways of conserving wildlife.

(i) _____

(ii) _____

4. Name two protected plants in Papua New Guinea.

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 4
--

Lesson 22: Waste Management: Recycling, Reducing and Reusing



Welcome to Lesson 22. In this lesson, you will learn about Waste Management methods.



Your Aims

- define waste management and creative recycling
 - identify and propose actions that will reduce waste
 - identify examples of creative ways of recycling materials
-

What is Waste Management?

Waste Management is the system of looking after the environment by reusing, reducing or recycling wastes. Instead of throwing things away, we should think of ways to recycle, reduce or reuse products. They are called the three Rs: **recycle**, **reduce** and **re-use**. We can reduce the amount of waste we produce by becoming more aware of how much we throw out, and by changing some of our habits.

We can classify solid waste as *Residential*, *Commercial*, *Institutional* or *Industrial*. Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as *Hazardous*. **Hazardous** means harmful or dangerous. All non-hazardous solid waste from a community that requires collection and transport to a processing or disposal site is called **refuse** or **city's solid waste**.



First of all, let us now learn some important terms that are related to *Waste Management*.

Refuse includes garbage and rubbish. **Garbage** is mostly decomposable food waste; **rubbish** is mostly dry material such as glass, paper, cloth, or wood. *Garbage* is highly decomposable, whereas rubbish is not. **Trash** is rubbish that includes bulky items such as old refrigerators, couches, or large tree stumps. *Trash* requires special collection and handling.

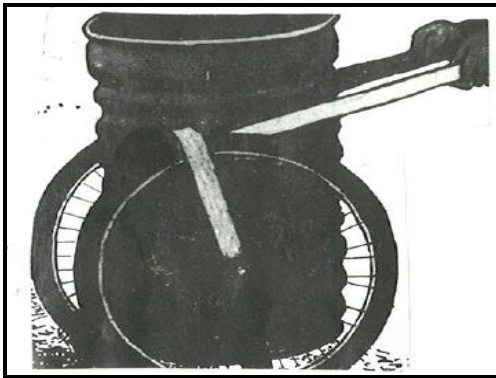
What is Recycling?

Recycling means to creatively reuse one resource to make another useful product. The old clothes, furniture, tyre, paper, cardboard, plastic, pipes, glass, and aluminum are examples of materials that can be recycled.

Listed below are some of the ways of how materials can be recycled.

- Plastic drink bottles can be cut into pieces, melted and turned into new drinking bottles.
- Empty can drinks be melted to make new cans
- Paper can be made into new paper products.
- Plastic materials can be turned into other plastic products
- Scrap metals can be turned into other metal products

Take a look at the photographs below. They show examples of Waste Management.



An Empty Drum and tyres of bicycle are reused to make rubbish trolley



Recycling Paper

Paper waste, such as old newspapers and cardboard, can be easily recycled. Here, newspaper is shredded before being Made into new paper products.

To reuse means to use a resource again, perhaps in a different way. Some examples of reuse practices are:

- Reuse empty glass jars as vases or storage containers.
- Reuse old car tyres as garden borders.
- Reuse plastics bags from stores to hold rubbish.
- Repair things where possible instead of throwing them away to buy new
- Wash and reuse disposable plastic cups, plates or utensils, don't throw after one use.
- Reuse gift papers when wrapping presents or covering books
- Paint tins can be reused as saw dust stoves
- Rice and flour bags can be made into bags for carrying things
- Cardboard cartons can be reused into storage boxes
- We can turn 44-gallon drums into ovens



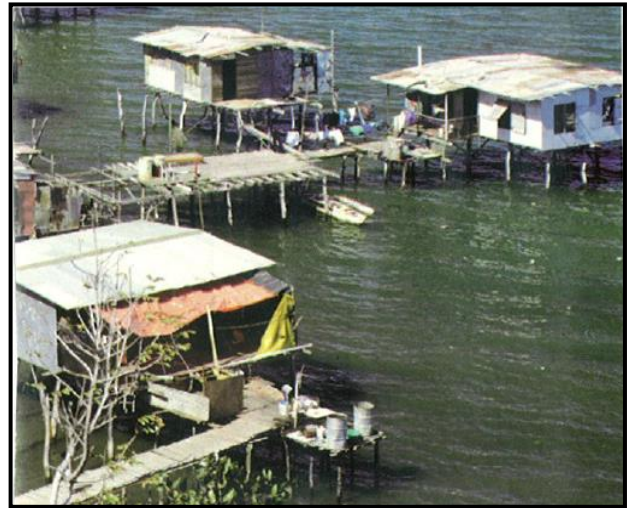
ACTIVITY 1

Study the photograph below and answer the activity questions.

Settlers built their shelters from any materials that they find locally. Many houses were built out of corrugated iron left behind after the war. Nowadays, settlers use material from rubbish dumps or old building sites.

- (i) What is the main material that is re-used to make these houses in the photograph?

- (ii) Can you name some more re-used materials in the photograph?



Wanigela Settlement at Koki, N.C.D

How to Reduce Waste

Reducing wastes involves making something smaller or using it less. Here are some of the practices that help reduce waste:

- When shopping, use bilums instead of plastic bags.
- Buy plain - package products to reduce flashy, bulky packaging.
- Buy a large size product instead of two or more smaller products to reduce packaging.
- Start a compost heap to reduce the amount of food and garden scraps being thrown into your rubbish bin.
- Use clothes instead of disposable nappies for babies
- Use cups and plates that can be washed and used again instead of paper or plastic items.
- Buy garden food rather than manufactured food that create rubbish.

Careless disposal of waste products in our towns, and along roads and beaches, is a serious problem. Betel nut spittle is an unhygienic sight that can be seen in most towns and cities of PNG.

By reducing the waste created, we reduce pollution. By reusing products, we reduce pollution. By recycling products, we reduce pollution



Summary

You have come to the end of lesson 22. In this lesson you have learnt that:

- Waste Management means to reuse, recycle or reduce products or materials wisely
- Reducing means making something smaller or using it less
- Recycle means to use one resource to make another useful product
- To reuse means to use a resource again, perhaps in a different way
- Instead of throwing things away, we should think of ways to recycle, reuse or reduce products
- We can classify sources of solid waste as Residential, Commercial, Institutional or Industrial
- Certain types of wastes that cause immediate danger to exposed individuals or environments are classified as Hazardous

ANSWERS TO ACTIVITY 1

- (i) Corrugated roofing iron
- (ii) Materials that can be seen in the photograph include corrugated steel and metals, 44 gallon drum for water storage, canvas, used timber etc.

NOW ANSWER PRACTICE EXERCISE 22 ON THE NEXT PAGE



Practice Exercise 22

1. What is Waste Management?

2. What is the difference between Reuse and Recycle?

3. Here are some reusable and recyclable products: *plastic bags, plastic bottles, can bottles and scrap metals.*

Explain how these items can be re-used or recycled:

Plastic Bags

Plastic bottles

Can bottles

Scrap Metals

Study the photograph below to answer Question 4.



4. (i) Name these products? Can you list three uses of these products?

- (ii) How can they be used to reduce waste?

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 4

Lesson 23: Household and Industrial Wastes



Welcome to Lesson 23. In the last lesson, you learnt the different methods of managing waste and the names of different types of solid waste. In this lesson we will continue to look at the household and the industrial wastes.



Your Aims

- distinguish between household and industrial wastes
 - Identify and list the differences between house hold and industrial waste
 - identify ways of disposing household wastes and industrial waste
 - suggest ways of reducing wastes
 - identify and list proper ways of disposing wastes
-

Household and Industrial Wastes

Household Wastes are the wastes and rubbish that are produced at homes. Examples include *vegetable peelings, sugarcane wastes, disposable nappies, food scraps, human urine and faeces, fluorescent light tubes, garden clippings, glass bottles and tins.*

Industrial Wastes are produced in the industrial areas by or through industrial processes. Examples of industrial wastes include *used engine oil, large empty drums and containers, toxic chemicals and chemical boxes, rusted or rundown machineries, broken industrial tools and equipments and waste smoke and gases from factories.*

The photographs below show examples of Industrial Wastes.



Mountains of Trash that can be Recycled



Clean Air Scrubbers can help Reduce the Air Pollution Caused By Burning of Coal

Selecting a disposal method depends almost entirely on costs and other factors in your environment. We need to also bear in mind that different types of waste are created when making or producing certain things. This waste can be liquid, gas, or solid.

Disposal of Household Wastes

Here are some ways of removing household wastes and rubbish. You can creatively plan about other disposal practices:

- use vegetable peelings and sugarcane wastes as compost
- feed food scraps to household pets or dogs
- avoid buying and using disposal nappies
- have health toilets for urines and human waste
- use biodegradable plastics, plastics containers, and rags, in an isolated place
- bury bottles, tins, broken glasses, fluorescent tubes in a well dug hole and cover them
- dump rubbish at the community dumping area,
- use animal waste as fertilizers for soil, mixed with plant cuttings in compose heaps.

***Disposal* is the process of getting rid of something or the process of throwing away something.**

Disposal of Industrial Wastes

Some disposal practices of Industrial Wastes are suggested below:

- dumping all poisonous chemicals and used engine oils in restricted and isolated area
- burn chemical boxes and plastics in an isolated place
- export by using empty drums and containers

Look after your environment;
throw your wastes into a proper
waste or rubbish bin.



Ways of Reducing Industrial Wastes

- avoid spilling used engine oils into streams and creeks and on path ways or at public places
- reuse big empty drums and containers to store run down industrial equipment to reduce the wastes
- store the tools in a proper place
- repair broken down machine parts



Summary

You have come to the end of lesson 23. In this lesson you have learnt that:

- Household wastes and rubbish are produced at homes
- Industrial wastes and rubbish are produced in industrial areas
- We can be creative in disposing or reducing wastes to protect our environment
- Selecting a disposal method depends almost entirely on costs, which in turn are likely to reflect local circumstances

NOW DO PRACTICE EXERCISE 23 BELOW



Practice Exercise 23

-
1. a) What are the differences between household and industrial wastes?

 - b) Give two example of household and industrial waste.
 2. Explain ways of disposing each example of household and industrial wastes mentioned above.

 3. List ways to reduce each example of wastes mentioned above.

-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 4

SUB-STRAND 4

ANSWERS TO PRACTICE EXERCISES 19-23

PRACTICE EXERCISE 19

1. (a) Sustainable practices are:
 - reforestation after logging
 - catch fish using traditional methods
 - (b) Unsustainable practices
 - clear felling without reforestation
 - dynamite fishing
 2. Sustainable farming:
 - terracing
 - crop-rotationUnsustainable farming
 - Shifting cultivation with short fallow period
 - Over-grazing
 3. Sustainable environmental practices or land use are the practices that keep or maintain the quality of the land and environment, while we satisfy our needs and wants by using them.
-

PRACTICE EXERCISE 20

1. Endangered species are rare species of animals and plants that are threatened and vulnerable to extinction. The main causes of endangering these plant and animal species include habitat destruction, over hunting and commercial exploitation/ to sell for cash
 2. Natural habitats refer to natural homes (environment) where different plant or animal species live or survive.
 3. Echidna, crocodile, deer, Bird of Paradise, Bird wing butterfly etc.
 4. Mining, farming, logging, poaching and road construction
-

PRACTICE EXERCISE 21

1. Conservation refers to protection of the natural environment.
2. Bird of Paradise , cassowary, bird wing butterfly and crocodiles

3. (i) Establishing wildlife and zoos, (ii) Protect more hectares of rainforest areas by law, (iii) Create more parks
4. (i) Flame of the forest (ii) Orchids

PRACTICE EXERCISE 22.

1. Waste Management means reuse, recycle or reduce resources in creative ways
2. Reuse means to use a resource again in different ways and recycle means to make another useful product from the used one.
3.

Plastic bags	Reuse plastics bags from stores to hold rubbish.
Plastic bottles	Reuse empty plastic bottles as storage containers and flower pots. They can also be recycled into other plastic products.
Can bottles	They can be recycled into new can bottles. Reuse as water containers or watering cans.
Scrap Metals	They can be recycled into new metal products. Reuse as building material, gardening tool, fishing and hunting tool.
4. (i) Baskets - used for marketing
 Trays - used for holding cups/glasses and for display
 Bowls - for preparing or carrying food
 (ii) They can replace plastic bags, plastic trays, laundry baskets and plastic bowls

PRACTICE EXERCISE 23

1. (i) Household wastes are wastes that are produced at home and industrial wastes are wastes produced by industries.
 (ii)

Household wastes	Industrial wastes
1. Vegetable peelings	1 Used engine oil
2. Disposable Nappies	2 Old car or machinery parts

2. **Household wastes**
 Used vegetable peelings for compost
 Bury disposable nappies

Industrial wastes
 Dig hole and bury the used oil away from the house
 Sell old car or machinery parts for recycling
3.
 - i. Vegetable peelings – do not peel vegetable that can be cooked with skin such pumpkin, potato, kaukau and banana.
 - ii. Disposable nappies – use cloth nappies
 - iii. Used engine oil – minimize the use of cars by walking and using bicycles encourage families to have only one car.
 - iv. Answer to number (iv) is similar to number (iii)

SUB-STRAND 5

HAZARDOUS NATURAL EVENTS

In this Sub-strand you will learn about:

- **Hazardous Natural Events**
- **Historical Records of Hazardous Natural Events**
- **Geological and Climatic Hazards and**
- **Response to Hazardous Natural Events**

SUB-STRAND 5: INTRODUCTION

In this Sub-strand, you will learn about Natural Hazardous Events in PNG. You will further study ways to respond to these hazards. For the convenience of this sub-strand, the natural hazards are classified under two main groups: the geological and climatic hazards.

Lesson 24: Natural Hazardous Events



Welcome to Lesson 24. In this lesson, you will learn about the Natural Hazardous Events in PNG and its neighboring regions.



Your Aims

- define Natural Hazardous Event
 - identify different types of natural hazardous events that have occurred in Papua New Guinea and its neighboring regions
 - state the causes and effects of Natural Hazardous Events
-

What is a Natural Hazardous Event?

Most of the time we are safe in our environment, but sometimes the physical landscape and climate can be dangerous. When our natural environment is dangerous, we call the danger a **Natural Hazard**. You will therefore learn in this lesson and the next two lessons about the dangers that natural hazards and natural disasters pose to humans.

A **Natural Hazardous Event** is something that happens naturally that can harm human beings and destroy properties. A natural hazard can become a natural disaster when people are not prepared. This means that if people are prepared, a hazard does not become a disaster. However, sometimes it is too expensive or difficult to prepare. In many places people have been able to prepare and have learnt to live with natural hazards.

We have all seen the awful effects of a flood or an earthquake. Most often we learn of natural disasters in the news.

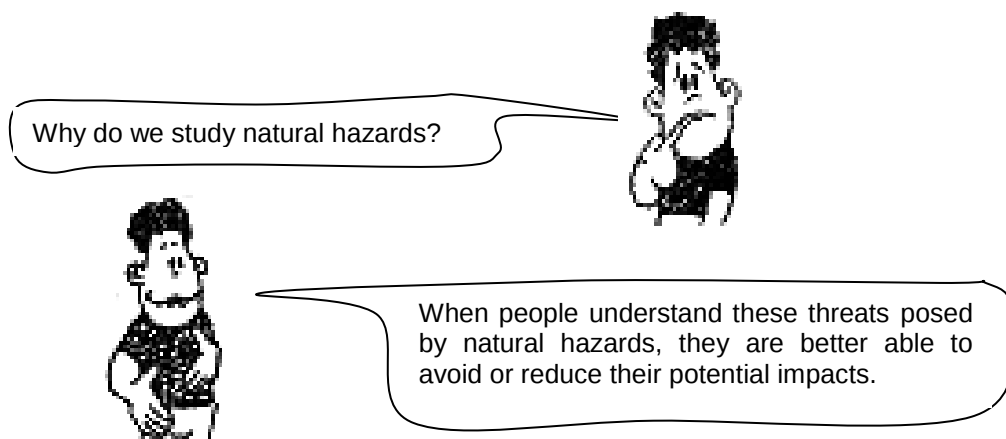


Have you, or anyone you know ever experienced a natural disaster?

According to the United Nation Development Programme (UNDP) report (2005), about 75 percent of the world's population live in areas affected at least once by earthquake, tropical cyclone, flood or drought between 1980 and 2000.

Papua New Guinea's neighbouring region is Asia. This region experiences many natural hazards such as floods, droughts, cyclones, earthquakes, windstorms, tidal waves and landslides. The many natural disasters that happen in these regions are the result of climate and seismic (earthquake) factors.

The region has suffered 50 per cent of the world's major natural disasters. Since 1990, the total number of deaths due to natural disasters in the region is above 200,000 and the estimated damage to property over this period has been estimated at K350 billion. Overcrowding in the big cities of these regions, environmental damage and a lack of planning are factors that have increased the risk of disasters.



Here is a list of natural hazards that is experienced in PNG and its neighboring regions.

Natural Hazards in Papua New Guinea and its Neighbouring Regions

- landslide and mudflows
- drought
- cyclone
- earth quakes
- flooding
- rainstorms and rain damage
- tsunami
- wind and wind storm
- volcanoes
- rapid sea level rise
- storm surge
- frost
- fires

Earthquakes, volcanic eruptions, flooding, massive landslides, tsunamis, tropical monsoon winds and heavy storms are examples of common natural hazards in Papua New Guinea.

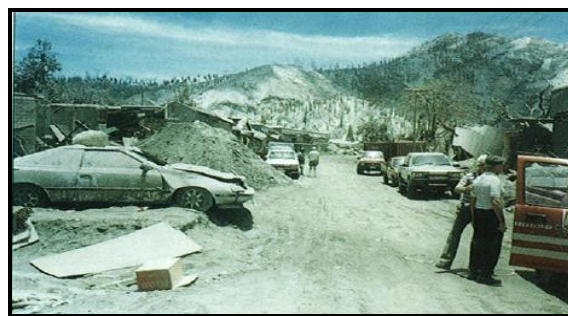
The 2008 Papua New Guinea floods displaced roughly 75,000 people, that resulted in an international response to provide support for the region. The country was hit by large sea waves on December 16, caused by "heavy storms" which affected over eight provinces and caused at least one death.

As you have learnt in Lesson 3, PNG is on the boundary of two continental plates that are in constant but low movements. As a result, we have many volcanoes and earthquakes. Earthquakes can cause a lot of injury to people and damage to buildings and gardens. It often causes landslides and *tsunamis*.

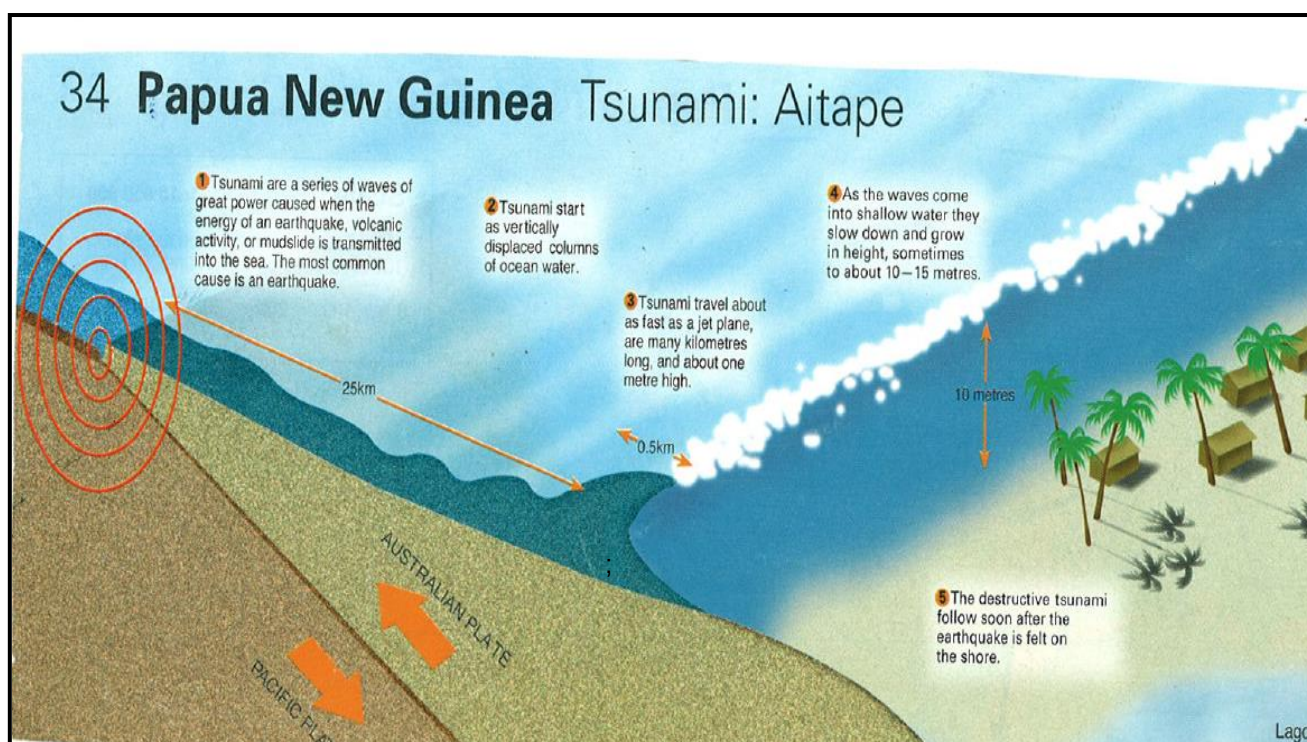
Now take a look at the pictures below. They show the effects of some natural disasters in Papua New Guinea.



Earthquake damage at Rempi village near Madang



Rabaul Town covered in volcanic ash, 1994



Aitape Tsunami, 1998

Here are some natural hazardous events that have occurred in our neighboring countries:

- Hawaii Island Tsunami 1960- triggered by a major earthquake, off the coast of Chile in South America. Waves over 10m setre high hit some parts of the island and did several hundred million dollars (US) of damage.
- Northern parts of Aceh in Indonesian were hit by tsunami in December 2004 which destroyed a lot of buildings and many lives. This tsunami has affected other countries such as Sri Lanka, Thailand, India, Kenya and Somalia. About 230 000 people were killed worldwide by a tsunami that was triggered by an undersea earthquake.
- Another tsunami hit the Coast of Java Island in Indonesia on the 17th, July 2006. It killed over 600 people and destroyed many buildings. This tsunami was caused by a powerful earthquake under the Indian Ocean.

- In 1972, cyclone *Babe* destroyed all the houses on Funafuti atoll (the main island and the capital of Tuvalu)
- On 1st, July 2002, tropical cyclone *Chat* struck Chuck (a Micronesian island county) in four hours. 50 centimeters of rain fell which caused huge flooding and 30 landslides that caught everyone by surprise. About 45 people died and many were injured. Hundreds of buildings were destroyed, leaving 2000 people homeless.

Here are some more pictures of natural hazards and their effects in our neighboring countries.

Tsunami in Indonesia

Earthquakes under the ocean can cause giant waves called *tsunamis*. Here, a tsunami heads toward the shore after an earthquake in 2004, just off the coast of Indonesia.



Flooding in Bangladesh

Countries close to the sea, like Bangladesh, could experience huge floods and even be drowned as global warming causes ocean levels to rise. In this photo, floodwaters turn parts of the Bangladesh country side into islands.



Have you heard or read about the March 2011 earthquake that hit Japan?

It was one of the most powerful known earthquakes in the world since the 20th and 21st century



The 2011 Japan Earthquake

The **2011 Tōhoku earthquake**, also known as the **Great East Japan Earthquake**, with a magnitude of 9.0 occurred off the coast of Japan at 14:46 pm on Friday, 11th March 2011. It was the most powerful known earthquakes to have hit Japan, and one of the five most powerful earthquakes in the world overall since modern record-keeping began in 1900.

The earthquake started extremely destructive tsunami waves of up to 38.9 metres high that struck Japan, in some cases traveling up to 10 kilometres inland. In addition to loss of life and destruction of infrastructure, the tsunami caused a number of nuclear accidents. Hundreds of thousands of residents close to this reactor plant were evacuated. The overall cost exceeded K600 billion, making it the most expensive natural disaster on record.

The Japanese National Police Agency has confirmed 15,421 deaths, 5,367 injured and 7,937 people missing across eighteen prefectures (or *districts*). There were also over 125,000 buildings destroyed. The earthquake and tsunami caused extensive and severe structural damage in Japan. This included heavy damage to roads and railways and fires in many areas.



Summary

You have come to the end of lesson 24. In this lesson you have learnt that:

- Natural hazardous events are disastrous events that harm us unexpectedly
 - Natural hazards can only be disastrous if we follow safety instructions and observe the signs
 - Natural hazards can kill people and destroy property worth a lot of money
 - Always be alert of natural hazards and follow safety drills or instructions to get to safe areas
 - Countries close to sea level, like Bangladesh, could experience huge floods and even be drowned sea levels to rise
 - Earthquakes under the ocean can cause giant waves called *tsunamis*
-

NOW ANSWER PRACTICE EXERCISE 24 ON THE NEXT PAGE



Practice Exercise 24

1. Explain what natural hazardous events are?

2. List five types of natural hazardous events.

- (i) _____
- (ii) _____
- (iii) _____
- (iv) _____
- (v) _____

3. List at least two natural hazards you know of or you have experienced in your local areas.

- (i) _____
- (ii) _____
-

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 5
--

Lesson 25: Historical Records of Natural Hazardous Events



Welcome to Lesson 25. In this lesson, you will learn about the historical records of natural hazardous events and discuss the extent of its impact on lives and property.



Your Aims

- identify the past records of hazardous events in Papua New Guinea
 - compare records of destructive hazardous events in Papua New Guinea and other parts of the world
-

Natural Hazards in Papua New Guinea

Papua New Guinea is always experiencing natural hazards. Many natural hazardous events have occurred in the past decades. Some of which were quite severe and disastrous while others were not. Tsunamis, tropical cyclones, landslides, earthquakes, flooding, frost, drought and volcanic eruptions are common in Papua New Guinea. Our Government is not very effective in responding to disaster areas. A lot more victims and survivors live with great regret and pain of losing loved ones, homes and properties.



1994 Rabaul volcanic eruption

Let us now study the timeline below. It shows the historical records of some natural hazardous events that occurred in PNG in the past decades.

Historical Timeline

- | | |
|-------|---|
| 1937: | Rabaul volcano erupted and caused huge destruction |
| 1970: | Earthquake occurred in Madang |
| 1972: | Cyclone Hannah hit Tufi which caused considerable damages |
| 1983: | Bumbu River in Lae, destroyed buildings and claimed several lives. |
| 1990: | Markham valley landslide, many lives lost |
| 1992: | Manam volcano killed few people and displaced many people |
| 1994: | Rabaul volcanic eruption destroyed Rabaul town |
| 1997: | Extreme drought experienced all over PNG |
| 1998: | Massive tsunami in Aitape, Sandaun Province claimed 3, 000 lives. |
| 2009: | Widespread flood in Oro province destroyed many homes, bridges and roads. |

2015 The El Nino effect caused widespread drought affecting many rural communities in Papua New Guinea

Here are few recent records of natural hazardous events that occurred around the world.

Kilauea Eruption

The Hawaiian Islands were formed by volcanoes that pushed up from the seafloor millions of years ago. This photo shows hot lava erupting from Kilauea, in Hawaii.



Hurricane Opal

Hurricane Opal hit Florida in 1995. It tossed boats ashore, destroyed homes, and produced heavy flooding. Here, residents inspect damage caused by the hurricane.



Summary

You have come to the end of lesson 25. In this lesson you have learnt that:

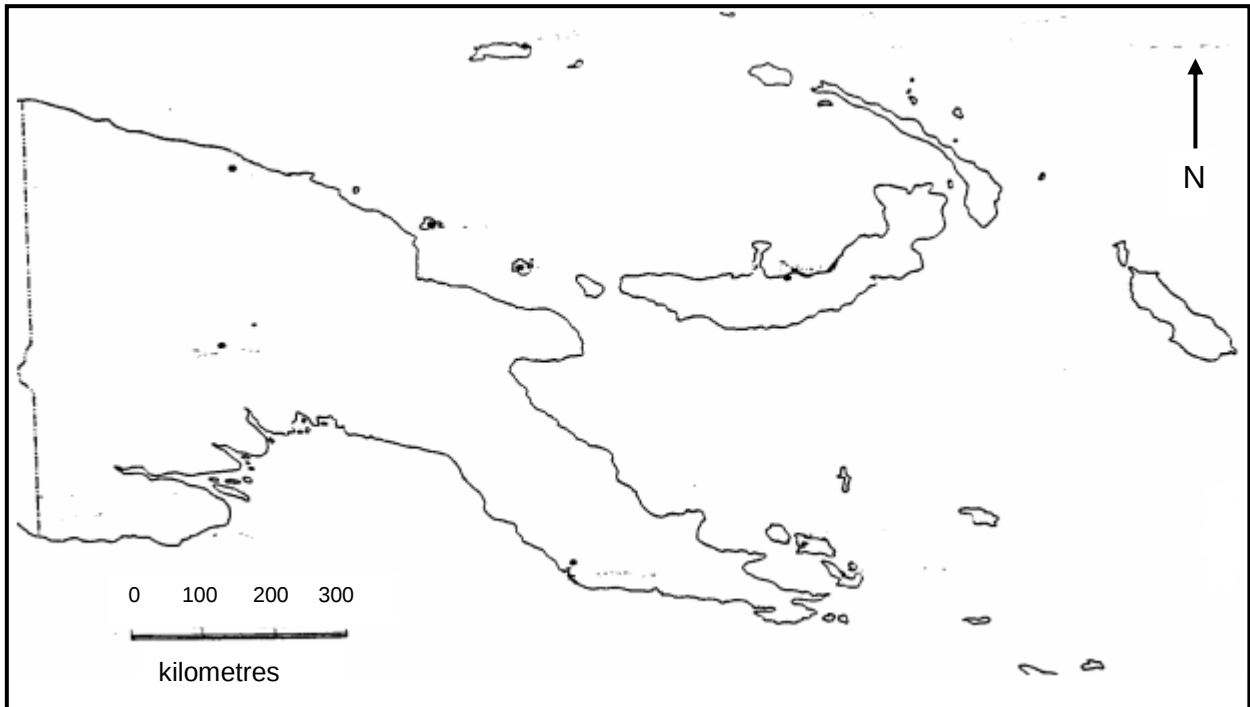
- Papua New Guinea experiences a lot natural disasters
- Tsunami, drought, frost, landslides, floods, earthquakes and volcanic eruptions are common in Papua New Guinea
- Historical records of past natural hazardous events are passed on orally by our ancestors in the form of legends, myths and songs.

NOW DO PRACTICE EXERCISE 25 ON THE NEXT PAGE



Practice Exercise 25

1. List some example of natural hazardous events in chronological order which is starting from the past to the present that you heard of or witnessed in Papua New Guinea or other Pacific regions.
2. In the blank map of Papua New Guinea indicate the historical sites of natural hazardous events.



NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 5

Lesson 26: Tectonic Hazards



Welcome to Lesson 26. In this lesson, you will learn about tectonic hazards. These are the dangers associated with plate movements and the internal forces in the earth's crust.

Your Aims

- define tsunami, landslide and volcanic eruption.
- describe the causes and effect of tsunami, landslide and volcanic eruption

What is a Tectonic Hazard?

First of all, let us define tectonic. **Tectonic** refers to the forces that work beneath the earth surface to produce movement of the Earth's crust.

In Lessons 2 and 3, you learnt about tectonic plates. These are large land masses that move slowly on the molten mantle below it. They can bump, move away or slide past each other and produce *earthquakes*. **Earthquakes** as you have learnt earlier are sudden movements of the earth's crust caused by plate movements. These directions of plate movements are caused by energy from the hot air inside the earth's mantle. As a result, hazardous effects such as earthquakes, tsunamis, landslides and volcanic eruptions take place on the earth surface.

Earthquakes, as you can see in the photograph below can cause a lot of destructions to property and lives.



It could be scarier than feeling the ground shake under your feet. Maybe this has happened if you live in a place that has earthquakes.

Well, furniture shakes, pictures drop from walls and books fall off shelves. In really big quakes, roads can break up. Buildings and bridges can even collapse and people killed.



One of the most powerful earthquakes in United States history occurred in Alaska in 1964. More than 100 people died in the quake, which destroyed buildings and ripped up streets.



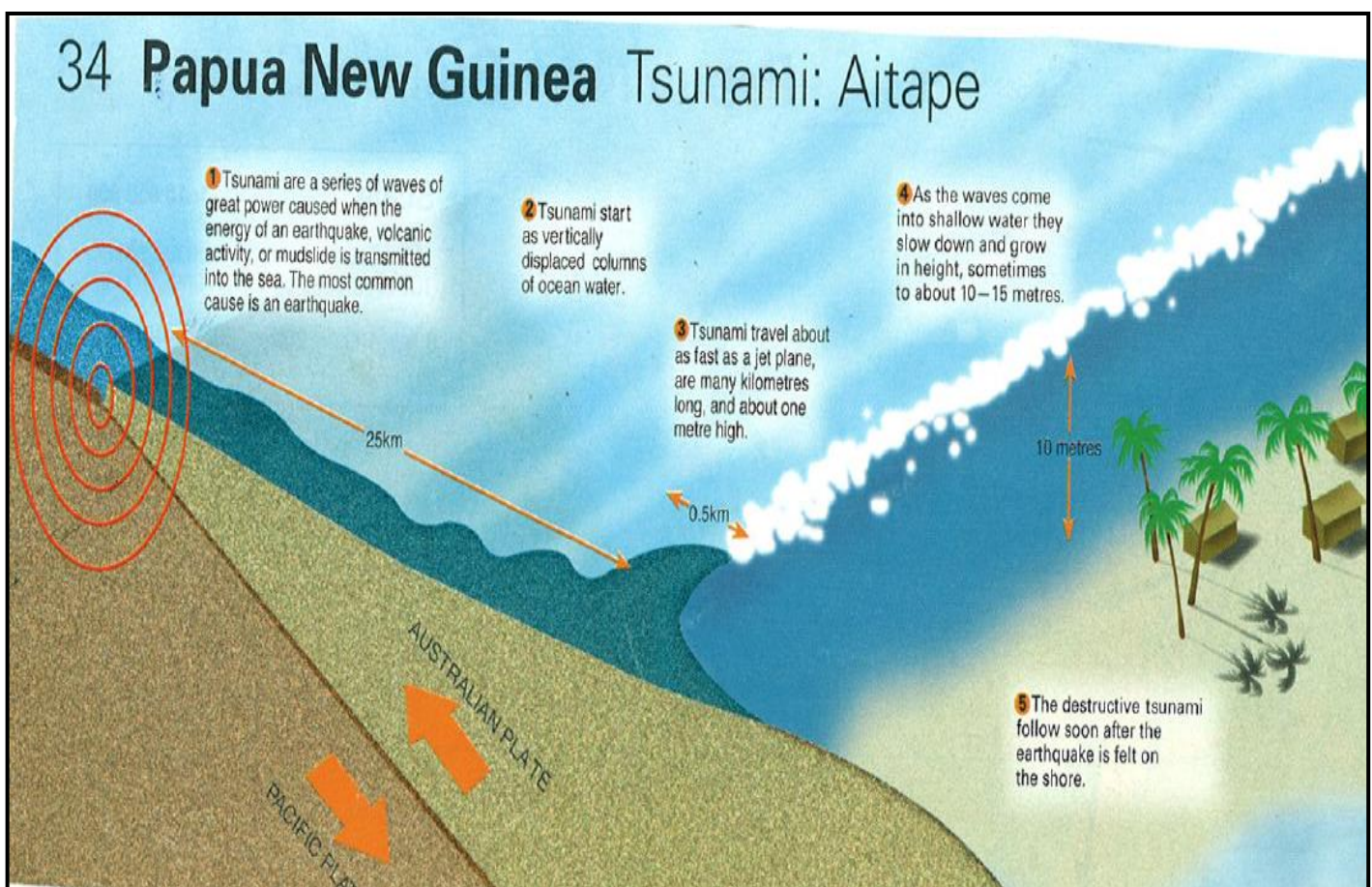
Alaskan Earthquake, 1964, USA

In Papua New Guinea as well as in other places, earthquakes occur near plate boundaries. Places like Rabaul and Manam in Madang are two areas where earthquakes are common.

Tsunami is a Japanese word which means 'giant' or 'tidal waves'. It is a series of waves of great magnitude (force) caused when plates move. When tectonic plates collide or move apart in the middle of the deep ocean, they can cause earthquakes. These giant waves start as vertically displaced ocean water. The waves travel very fast and cannot be seen or noticed as they are of very small **height**. The height of the waves increases and can be seen as it nears the shore. It comes like giant waves and can cover an entire village or an area, kills people and animals, uproots coconut trees and creates lakes by trapped ocean water.. The height of the waves can be a metre or more.

The coastal areas of Papua New Guinea are at risk of tsunamis. However, they occur much more frequently in earthquake zones.

Now look at the map below. It shows how a tsunami starts.



The next hazard you will learn about is **landslide**.

Landslide

We experience landslides in Papua New Guinea frequently. A **landslide** is a movement of soil and rocks that move downhill from mountains and hills. It is usually a huge mass of soil or rock that moves downhill from the mountains or hill sides under the force of gravity. It most often occurs after or during heavy rainfall when water soaks into the soil, making it quite heavy. If there are no tree roots to hold the soil, it slides away, downhill. It can move an entire landmass with plants, trees, gardens and houses. As such, it is very destructive and can kill people, bury houses and property. People who live near mountains and hills, plate boundaries or near flooding rivers are at risk of landslides. Landslides are most common up in the highland areas.

Most landslides happen as a result from heavy rains.

On 25th May, 2009 there was a large landslide in Sialum district of Morobe Province that reportedly killed 19 people.

The following is a passage of landslide from the National Newspaper.

A family is counting its luck after all its members survived a massive landslide that killed 19 of their relatives between the gorges of Firangka in the Sialum district of Morobe Province. The family of five survived by metres when the landslide swept down the mountainside and engulfed six houses, missing their hamlet in Zongefifi in the early hours of Monday...Locals retrieved three bodies, two male and one female while the other 16 bodies were still buried. The landslide started from the top of the mountain, slid down the gorge for about half a kilometre with debris strewn over 200 metres wide before dropping down the steep terrain.



Firangka landslide, Morobe Province



This image shows the track of the landslide

When landslides occur, they also affect infrastructures such as roads and bridges thus disrupting movement of people, and goods. This photograph shows a landslide along the Highlands Highway. Notice how the vehicles struggle to pass through the landslide.



This 1995 Landslide at La Conchita, a coastal town in California, swept away a hillside road and destroyed a number of houses.



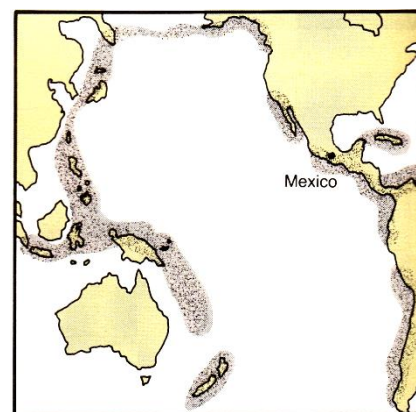
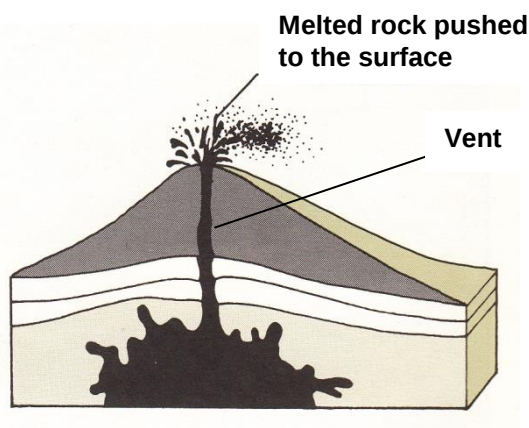
Next, we take a look at volcanoes. They are common natural hazards in some areas in Papua New Guinea.



Volcanic Eruption

There are many *active* and *dormant* volcanoes in Papua New Guinea. This is because, PNG is located along the zone called *Pacific Rim of Fire*. This Pacific Rim of Fire contains a chain of the most active volcanoes in the world. This is why places such as Japan, USA (Hawaii,) Philippines and Papua New Guinea experience volcanic eruptions frequently.

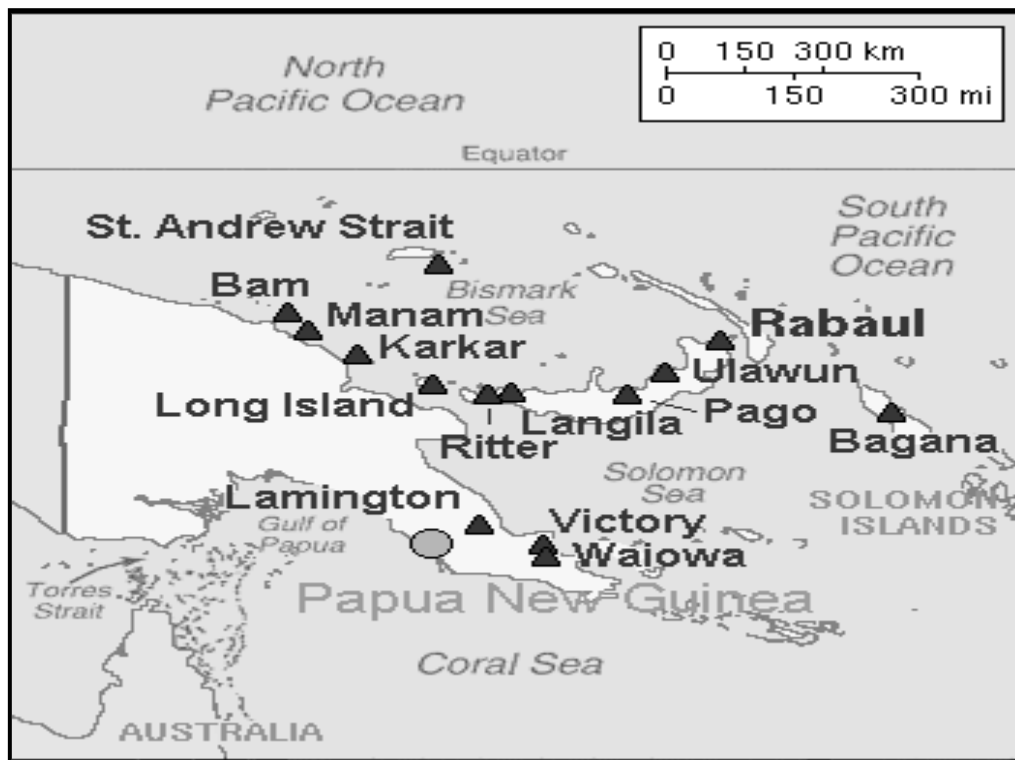
The huge pressure beneath the crust then flushes the hot, molten liquid called *magma* up through the long passage in the volcano called *vent*. The opening of the volcano on the earth surface is its *mouth*. This is the opening that allows the hot air with ashes, hot stones gases out. Violent volcanic eruptions throw the ashes and lava into the air. These can travel several kilometers as lava before solidifying. Volcano is a very dangerous natural hazard that can kill people and destroy property.



The Pacific Ring of Fire

The map below shows a good summary of the major volcanoes of PNG. If you live near a volcanic area you would better understand the dangers of volcanoes because of the experiences you had.

MAJOR VOLCANOES OF PAPUA NEW GUINEA



Here are some safety measures you or your community can take to avoid disasters brought about by **volcanic hazards**.

VOLCANO MITIGATION

Before the Disaster	During the Disaster	After the Disaster
• Learn about community warning systems and of disasters that can come from volcanoes (earthquakes, flooding, landslides, mudflows, thunderstorms, tsunamis) • Make evacuation plans to higher ground with a backup route • Get a pair of goggles and a throw-away breathing mask for each member of the household • Have disaster supplies on hand (flashlight, extra batteries, portable	• Follow evacuation order issued by authorities • Avoid areas downwind of the volcano If indoors: • Close all windows, doors, and dampers • Put all machinery inside a garage or barn • Bring animals and livestock into closed shelters If outdoors: • Seek shelter immediately • If caught in a rockfall, roll into a ball to	• Listen to radio for emergency information • Stay away from ashfall When outside: • Cover mouth and nose to protect from inhaling ash and wear goggles to protect eyes • Keep skin covered to avoid irritation or

battery-operated radio, first aid kit, emergency food and water, non-electric can opener, cash and extra shoes) • Develop an emergency communications plan in case of separation during the earthquake	protect head • Avoid low-lying areas where poisonous gases can collect and floods can be dangerous • If caught near a stream beware of mudflows. • Wear long sleeved shirts and pants • Use goggles to protect eyes and a dust-mask or damp cloth over face to help breathing • Keep car engines turned off • Stay out of the area. • Mudflows can occur when rain falls through ash- carrying clouds or when rivers are dammed during an eruption and are most dangerous close to stream channels; if on a bridge and notice a mudflow upstream, DO NOT cross the bridge - the mudflow can destroy a bridge quickly.	burns • Avoid contact with any amount of ash if you have a respiratory ailment • Avoid driving in heavy ashfall (it may clog engines and stall vehicles) • Clear roofs of ashfall (could cause buildings to collapse) • Help neighbors who may require special assistance.
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Summary

You have come to the end of lesson 26. In this lesson you have learnt that:

- Tsunami is a very powerful giant wave that is caused by the disturbance of an earthquake, volcano or mud flow under the ocean
- Tsunami move very fast and grows as high as it approaches the shores
- Landslides are the movement of huge mass of land caused by heavy rain and flooding
- Volcanic eruptions are caused by tectonic movement which creates holes for the magma to explode into the air with high pressure
- Volcanoes are very dangerous natural hazard
- Coastal villages are vulnerable to tsunamis
- Landslides are most common in the highlands regions

NOW DO PRACTICE EXERCISE 26 ON THE NEXT PAGE



Practice Exercise 26

1. Explain how;

Tsunami takes place.

Landslide takes place

2. How are volcanoes formed?

3. Complete the table by summarising the causes and effects of landslide and volcanoes.

Natural Hazardous Event	Causes	Effect
E.g. Tsunami	Undersea Submarine earthquake	Lives lost, buildings damaged
Landslide		
Volcano		

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 5
--

Lesson 27: Climatic Hazards



Welcome to Lesson 27. In the last lesson, you learnt about the three main geological hazards that are caused by plate movements. In this lesson, you study climatic hazards and their causes.



Your Aims

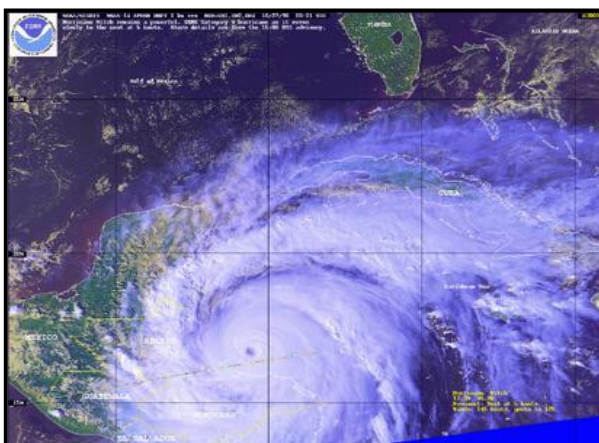
- define cyclone, tornadoes, floods, frost, droughts and bushfires
 - describe the causes and the effect of cyclones, tornadoes, floods, frost, droughts and bushfires
-

What is Cyclone?

A **cyclone** is a large and powerful storm with heavy rain and strong winds. It consists of huge clouds swirling around a calm centre known as the eye. They develop in areas of low pressure in equatorial regions of the Atlantic and the Caribbean seas. Sometimes hurricanes reach land and cause a lot of damage. Tropical cyclone depends on wind and warm water to heat the air to start the storm system. The warmer the water becomes, the stronger the storm will be. The warm water can act like a fuel

Cyclones have different names such as *Typhoons* and *hurricanes*.

Cyclone Destruction



Hurricane Mitch travels across the Caribbean Sea in 1998.



Cyclones and Hurricanes can bring flood, destroy property and people

Cyclones cause a lot of damage to buildings and the human environment. It brings flooding that can destroy building farms and can kill people. The very strong wind that blows can uproot weak trees, houses and blow away cars away.

Tornados

A **tornado** is a violent destructive storm with circular winds. It causes flooding, high tide, large amount of erosion and destruction to properties. A tornado can tear roofs off houses, smash brick buildings and can even pick up cars and trucks, and toss them. People can be badly hurt or killed by flying objects in a tornado.

Tornadoes look like big, dark funnels coming from the bottom of a storm cloud. In Photograph 2, a person tracks a tornado to learn more about it.



Photograph 1



Photograph 2

Where Do Tornadoes Come From?

Tornadoes come from big thunderstorms and can drop down from the bottom of a storm cloud. Tornadoes blow in a circle and you can easily tell the wind, by its “funnel” shape created by the dust it picks up in its part.

Some tornadoes look like a swinging elephant’s trunk. They sound like a freight train going by and can cause damage when the bottom of the funnel touches the ground. They can form anywhere, but they are more common in the United States of America.



Did you know? Tornado Alley is a place in the Midwestern United States where many tornadoes form?

Flood



Now, let us take a look at **flood**. Have you ever seen a flooding river?



You may have seen or read about floods in the newspaper or on television. A flood happens when a river overflows its banks. Too much rain or melted snow can also cause flooding.

A flood occurs when rivers flood their banks. When rivers overflow, they deposit sediments on the flat land alongside the riverbanks. The flat land can be in a valley or on a plain. It is called the *floodplain*. All rivers have floodplains. These plains can spread out hundreds of kilometres from a river. People build farms and towns on floodplains because the sediments deposited on the plains are fertile and make great farmland. If the river overflows its banks, however, the farms and towns get flooded.

There are two types of flooding. They can be distinguished as (1) river flooding, caused by too much water from heavy rain and (2) coastal flooding caused by rising sea level (an unusual rise in sea level associated with hurricanes and other storms at sea). Floods can cover lowland areas and cause destructive landslides to occur.



Can the effects of flood be controlled?

Yes, in many countries, governments build dams to control the effects of flooding on the people and the environment.



You can see the photographs of dams in the photographs below.



• Hoover Dam

Dams are built to control the flow of water in a river or stream, especially during big floods.



Grand Coulee Dam

The Grand Coulee Dam uses water to produce electricity but importantly control flooding. It is located in Washington State.

Frost

Frost usually occurs in the highlands region. It happens when the temperature drops below zero degrees Celsius. The thin layer of ice is formed on the ground especially during the very cold or frozen night as a result of a long period of dry season. Frost can destroy food crops, freezes animals and people to death, and disturbs human activities.

Drought

A long dry period of weather especially without rain or water is known as **drought**. The effect depends on the period of drought. The longer the period, the more destructive the effect it has on humans and animals. It causes damage to crops, stream flow reduction, and reduces groundwater and soil moisture. Drought can also cause cancerous skin diseases and frost in the night. Drought combined with human and animal pressure can lead to desertification.

The cycle of wet and dry period pose serious problem for farmers who depend on these cycles. During the wet period, the size of the herds increase and cultivation is extended into drier areas. It occurs when evaporation and transpiration (the movement of water in the soil through plants into the air) exceed rainfall for a long period. Drought is the most serious physical hazard to agriculture in nearly every part of the world.

Let us now take a look at the four main kinds of drought.

- (i) **Permanent Drought** : places that have hot and dry climates with very little rainfall
- (ii) **Seasonal Drought** occurs in climates that have rainy and dry seasons; for successful agriculture, planting must be adjusted so that the crops develop during the rainy season.
- (iii) **Unpredictable Drought** : A brief and abnormal rainfall failure; it may occur almost anywhere. It often affects only a small area.
- (iv) **Invisible Drought** can only be known by using certain instruments to collect the amount of rainfall. Rain may fall without supplying the normal amount of water in an area.

Bush fires

Prolonged drought can start the natural fires to the environment. Bushfires are caused naturally by lightning, accidental drop of cigarette or match by someone or by the blowing wind on a nearby fire place. Sometimes the fire is started by the extreme heat of the sun. Bushfire can easily spread during longer period of dry season. It burns down properties and can kill people.



A Bushfire in Australia

We may not experience a lot of destructive bushfires but places like Australia and the United States of America do experience very destructive effects during the hot, dry summers.



Summary

You have come to the end of lesson 27. In this lesson you have learnt that:

- Cyclone is natural hazardous event that occurs as a result of uneven heating and cooling of the air.
- Tornado is a violent destructive storm with circular winds: that is caused by depression of winds that move in spiral.
- Floods are covering of the dry land by huge amount of water in the river. This is caused by continuous heavy down fall of rain.
- Drought is a long period of dry season or without rainfall.
- Bushfire are naturally or deliberately ignite fires that can spread and burn down entire surrounding environment.
- Frosts are caused by very cold climatic condition with temperatures below zero degrees celsius.
- A hazard may be natural but humans may also contribute to its occurrence

NOW ANSWER PRACTICE EXERCISE 27 ON THE NEXT PAGE



Practice Exercise 27

1. Summarize the causes and effects of these hazardous events in the table below with appropriate headings.

Natural Hazardous Events	Causes	Effects
Cyclone		
Tornado		
Flood		
Frost		
Drought		
Bushfires		

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 5

Lesson 28: Response to Hazardous Events



Welcome to Lesson 28. This is the last lesson of Strand 1. In the last few lessons of this sub-strand, you learnt about the different types of natural hazardous events and their causes and effects. In this lesson you will study the different ways of responding to some of these natural hazardous events.



Your Aims

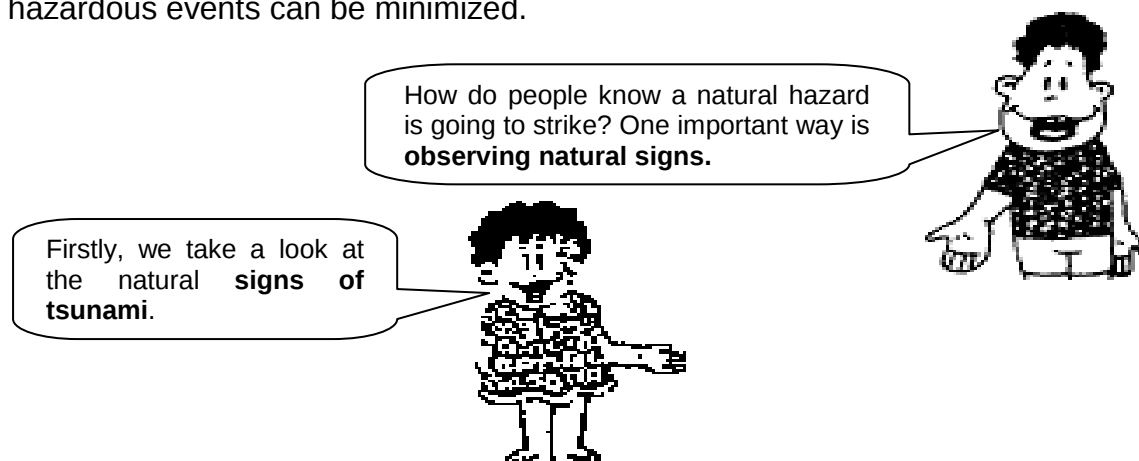
- identify the signs and explain ways of responding to any natural hazardous events
 - examine specific signs for each event from oral and historical records that would help predict future occurrences
-

Responding to Natural Hazards

What do we mean by responding to natural hazards? This refers to the different methods of action to cope with the hazards and ways of moving to safer environments.

The biggest difference in responses to natural hazardous events is between wealthy countries and poorer countries (or countries where money is not allocated for disaster prevention and relief). Wealthy countries can afford disaster warning systems but this does not mean that citizens will always pay attention or that the system will always work. People in all countries are often slow to recognize hazardous events. Papua New Guinea is one of the few developing Pacific island countries to have a National Disaster and Emergency Services Department to direct and co-ordinate hazard related activities.

Many people still do not believe that there are risks. There are also economic reasons why people are at risk. People may not be able to afford to live in safer areas, or there may be very little land available. When people buy land, they may not be told about the risks they face. In Queensland, Australia, the government had to make a law against developers building and selling houses on the plains. Laws are a means in which the risks posed by natural hazardous events can be minimized.



Natural Signs to Tsunami

Before tsunami strikes, the following natural signs may be seen:

- a sudden violent earthquake along the coastal areas
- rapid drop of sea level
- coconuts falling and
- animals fleeing

If you live on the coast, you need to be mindful of these signs and be alert so you respond quickly by:

- moving quickly to higher ground
- or if you know that a tsunami will strike, move away from that area to higher ground.

Here are some common signs that will help you predict for landslides.

Natural Signs for Landslides

- cracks along or around the nearby hills.
- downward movement of soils
- continuous rain, etc.

If you live in the highlands or landslide prone areas, you need to respond quickly by:

- moving away from the landslide area.
- move people from the area.
- in the long term, avoid building houses/homes near these areas.

Floods are usually caused by continuous or heavy rain. The signs of the floods to occur are: rivers current increases and become rough, bursting small creeks and streams. The quickest way to respond is to avoid living or building houses on the lowland areas near the rivers or lakes.



How can you tell, there is going to be a flood?

Natural Signs for Frost, Drought and Bushfire

The natural sign before the occurrence of frost is a drought. The sign of bushfire to start depends on the last period of the drought. The following are some of the suggested responses that we could under take:

- Avoid planting crops during drought
- Stay indoor to keep warm in the night during the drought
- Store up extra water in tanks to use during a drought
- Avoid making fires close to a dry bush area during drought to avoid bushfire

- Stop or remove any ignited fires before it spreads

Natural signs for cyclones, tornados and volcanoes are quite unnoticeable. People living on the areas where these natural hazards occur should be more alert, as they strike without warnings.



Summary

You have come to the end of lesson 28. In this lesson you have learnt that:

- Responses to natural hazards are actions that we take to avoid facing the natural disasters cause by natural hazards
 - The signs of tsunami are; earthquake, sudden drop of sea level strange sea uproar and animals fleeing to higher ground
 - The signs of volcano eruption are not easily noticed. The only two signs seen are the steams rising from the volcanic mountain and the sudden earthquake
 - Signs of other natural hazards are not noticeable while some are slightly noticeable if people are more careful
 - People have different ways of reading or interpreting the signs and they respond in different ways
 - Sometimes people are careless and not aware of the natural hazards
-

NOW DO PRACTICE EXERCISE 28 ON THE NEXT PAGE



Practice Exercise 28

1. List the signs of tsunami?

2. List two responses for the tsunami.

3. What are the signs of landslide?

4. List two responses to landslide.

NOW CHECK YOUR ANSWERS AT THE END OF SUB-STRAND 5
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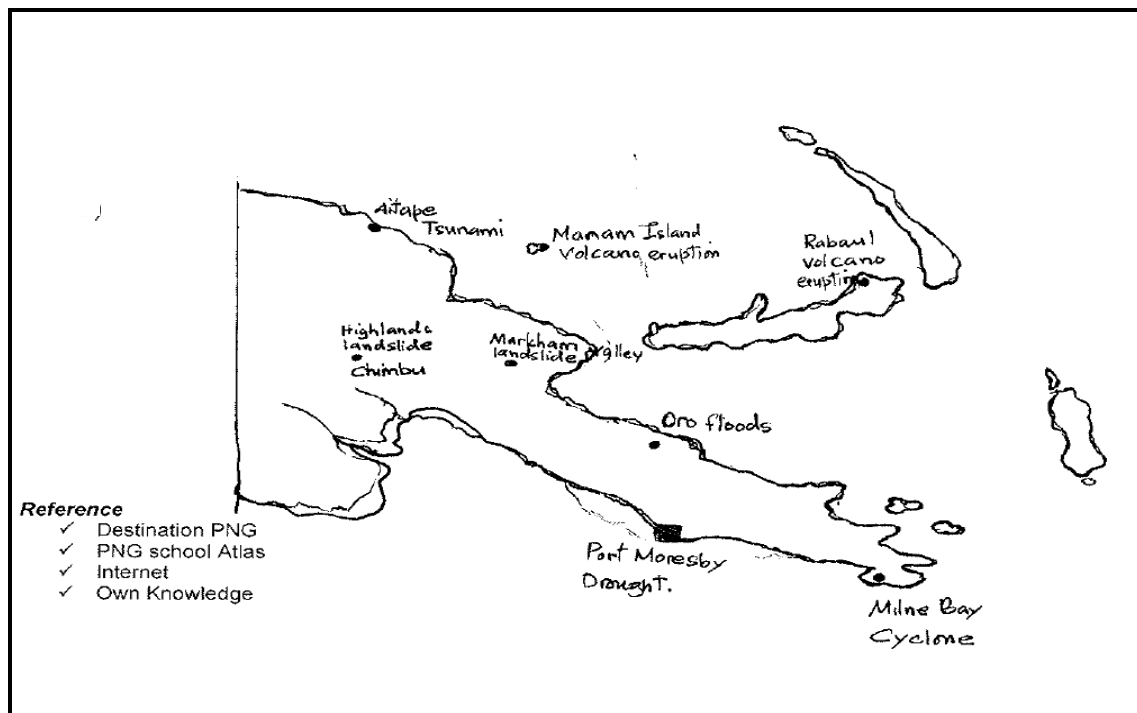
SUB-STRAND 5

ANSWERS TO PRACTICE EXERCISES 24-28

PRACTICE EXERCISE 24

1. **Natural hazardous events** are something that can harm us naturally and unexpectedly.
 2. Some examples of natural hazards are: Tsunami, volcano eruption, earthquake and frost.
 3. Flooding and frosts
-

PRACTICE EXERCISE 25



PRACTICE EXERCISE 26

1. **Tsunami** is a Japanese name given to huge disastrous tidal waves. It is caused by underground disturbances in the deep ocean by the mudslide, submarine volcano or an earth quake. Most caused by an earthquake. These huge waves can travel very fast and can grow up to more than 10 meters high as the wave approaches the shore. It washes everything back to the sea. The effect is fatal. Tsunami is common in the coastal areas.

Landslide is the movement of huge landmass caused by heavy rainfall and flooding. The water seeps into the soil and trapped inside, this causes it to be a water area. Landslide commonly occurs in the out logged areas.

Volcanic eruption is caused by *tectonic plates* movement .When two plates collide or move apart, the hole is grated in the Earth's crust where the hot and molten liquid, *magma*, is ejected through the crack and flushed into the sky by the huge pressure. Poisonous and hot ashes, gas and rocks are blasted into the air. They rain back into surface and the magma flows as lava for several kilometers before it solidifies. Volcano is a very disastrous event.

2.

Natural Hazardous Event	Causes	Effect
e.g. Tsunami	Undersea earthquake	Lives lost, buildings damage
Landslide	Heavy rainfall, earthquakes etc	Buries lives, damage buildings and properties
Volcano	Earthquakes, plate movements	Buries lives, damage buildings and properties, destruction of land etc

PRACTICE EXERCISE 27

1.

Natural Hazardous Events	Causes	Effects
Cyclone	Strong violent storms and winds	Destruction of lives and property, damage buildings
Tornado	Destructive violent storms and strong circular winds caused by depressions	Destruction of lives and property, damage buildings as it picks things up
Flood	A flood happens when a river overflows its banks.	Carries villages and people away who live downstream, destroys food gardens and lives etc.
Frost	Frosts are caused by very cold climatic condition with temperatures below zero degrees celsius	Destroys food crops
Drought	Drought is a long period of dry season or without rainfall	People go hungry as crops dry up
Bushfires	Bushfire are naturally or deliberately ignited fires	These fires can spread and burn down entire surrounding environments and kill people and buildings, domestic animals

PRACTICE EXERCISE 28

1. Earthquake, sudden sea level drop, sea uproar and animals fleeing to higher ground.
(Any two of the above)
 2. Run immediately to the high land areas; avoid residing along the coastal areas where tsunami is predicted to occur.
 3. Frequent heavy rains, cracks along or around the hills, soil movement, flow of flooded creeks and streams, etc.
 4. Stop building houses near the hills and move away quickly to other places that are safe.
-

THIS IS THE END OF GRADE 7 STRAND 1 COURSE

NOW TURN TO YOUR ASSIGNMENT BOOK 1 AND COMPLETE ALL THE QUESTIONS IN TOPIC TESTS 1,2,3,4 AND 5. CHECK YOUR ANSWERS AGAIN AND WHEN YOU ARE SATISFIED, SEND YOUR ASSIGNMENT BOOK TO YOUR PROVINCIAL COORDINATOR FOR MARKING.

References

1. Grade 7 Social Science Text Book, *Papua New Guinea Its Land and People*
2. Grade 8 Social Science Text Book, *The Resources of Papua New Guinea*
3. Grade 9 Social Science Text Book, *People and Places in the Pacific*
4. Ranch, S 2007, *Outcomes Edition for Papua New Guinea, Social Science, Grade 7 Student Book*, Oxford University Press, South Melbourne.
5. Rannells,J, Matatier,E, 2005, *PNG Fact Book*, 3rd edn, Oxford University Press, South Melbourne.
6. Codrington, S, Chittenden,C, *The Geography Skills Book*, Oxford University Press, South Melbourne.

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18	MANUS	P. O. Box 41, Lorengau	9709251	72228128	The Coordinator	Senior Clerk	72229080
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21	HELA	P. O. Box 63, Tari	73197115	72228141	The Coordinator	Senior Clerk	72229083
22	JIWAKA	c/- FODE Hagen		72228143	The Coordinator	Senior Clerk	72229085

SUBJECT AND GRADE TO STUDY

GRADE LEVELS	SUBJECTS/COURSES
Grades 7 and 8	1. English
	2. Mathematics
	3. Personal Development
	4. Social Science
	5. Science
	6. Making a Living
Grades 9 and 10	1. English
	2. Mathematics
	3. Personal Development
	4. Science
	5. Social Science
	6. Business Studies
	7. Design and Technology- Computing
Grades 11 and 12	1. English – Applied English/Language & Literature
	2. Mathematics - Mathematics A / Mathematics B
	3. Science – Biology/Chemistry/Physics
	4. Social Science – History/Geography/Economics
	5. Personal Development
	6. Business Studies
	7. Information & Communication Technology

GRADES 11 & 12 COURSE PROGRAMMES

No	Science	Humanities	Business
1	Applied English	Language & Literature	Language & Literature/Applied English
2	Mathematics A/B	Mathematics A/B	Mathematics A/B
3	Personal Development	Personal Development	Personal Development
4	Biology	Biology/Physics/Chemistry	Biology/Physics/Chemistry
5	Chemistry/ Physics	Geography	Economics/Geography/History
6	Geography/History/Economics	History / Economics	Business Studies
7	ICT	ICT	ICT

REMEMBER:

- For Grades 7 and 8, you are required to do all six (6) courses.
- For Grades 9 and 10, you must study English, Mathematics, Science, Personal Development, Social Science and Commerce. Design and Technology-Computing is optional.
- For Grades 11 and 12, you are required to complete seven (7) out of thirteen (13) courses to be certified.

Notes: You must seek advice from your Provincial Coordinator regarding the recommended courses in each stream. Options should be discussed carefully before choosing the stream when enrolling into Grade 11. FODE will certify for the successful completion of seven subjects in Grade 12.