Mathematics Science Strand

Resource Science

Resource Science

Lecturers' Guide

Lecturer Support Material

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Contents

Unit overview

The two modules, A4 *Marine Resources* and A5 *Earth Resources,* contain topics which reflect the draft Primary Syllabuses for Lower and Upper Primary Science. These Modules also contain topics to provide coverage of the topics in Program 2000. These Modules also contribute to the study of the Unit ***Agriculture and Resource Science***. Some Colleges may prefer to integrate these modules into the Unit *Environmental Science*.

Links to Primary Syllabuses

		Lower Primary			Upper Primary		
Code	**Module/topic**	**Yr3**	**Yr4**	**Yr5**	**Yr6**	**Yr7**	**Yr8**
A4	**Marine Resources**	Ö	Ö	Ö	Ö	Ö	Ö
	• Marine organisms - reefs and mangroves	Ö	Ö		Ö	Ö	Ö
	• Marine ecology			Ö	Ö		Ö
	• Utilisation of marine resources					Ö	Ö
	• Sustainability and management						Ö
A5	**Earth Resources**	Ö	Ö	Ö			Ö
	• Minerals and rocks	Ö	Ö	Ö			Ö
	• Weathering and erosion		Ö	Ö			Ö
	• Ores and mining			Ö			Ö
	• Oil and gas			Ö			Ö

Content and sequencing

Individual colleges may choose to teach these two modules as part of other related units such as Environmental Science to suit local conditions and needs. However due to the advanced nature of these modules it is essential that students study basic principles of ecology and earth science as prerequisites.

It is recommended that college teaching sequences provide students with the opportunity to study the Environmental Science Modules: ***E1 Ecology*** and ***E5 Earth Science*** before studying these two modules. A recommended sequence in the teaching and learning of the modules is provided with links to relevant Environmental Science modules (figure 1). College curriculum planning should take into account the complementary and support nature of these Resource Science modules with Environmental Science modules.

A4 Marine Resources

- Marine organisms - reefs and mangroves
- Marine ecology
- Utilisation of marine resources
- Sustainability and management

A5 Earth Resources

- Minerals and rocks
- Weathering and erosion
- Ores and mining
- Oil and gas

College programmes

One possible arrangement to ensure that the core modules of Marine and Earth Resources are taught is to establish TWO units for Environmental Science. These are shown in figure 1. The first is ***Environmental*** or ***Living Science*** and the second is ***Earth Science***.

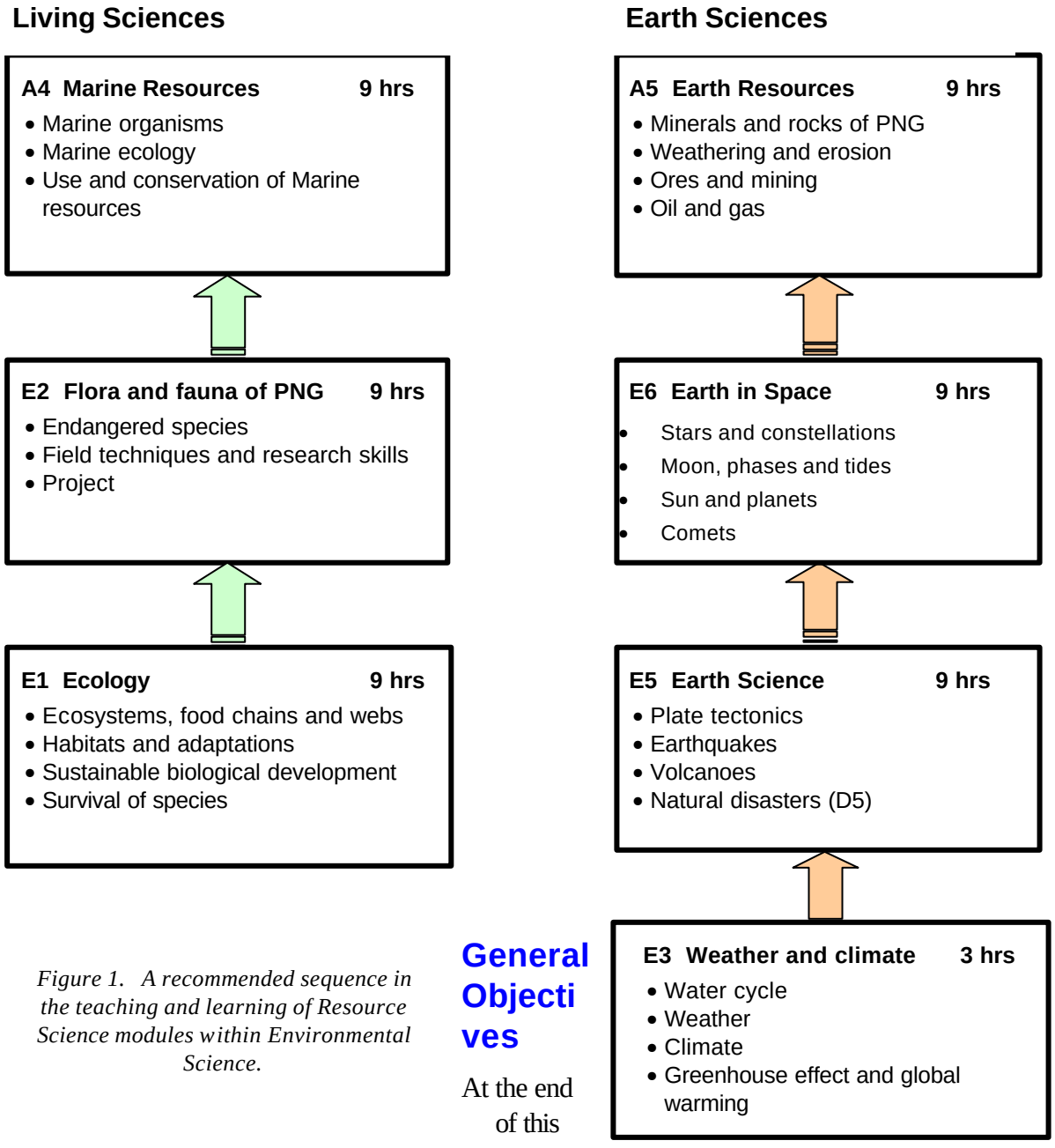

Figure 1. A recommended sequence in the teaching and learning of Resource Science modules within Environmental Science.

General Objectives

At the end of this module students should be able to:

(a) identify marine resources and the importance of their preservation;

(b) use, design, implement and report on a survey or field project;

(c) list and describe strategies for sustainable primary production and protection of the environment;

(d) identify and classify minerals, rocks and mineral resources of PNG;

(e) understand and apply the content and key principles of geology to everyday situations and observations;

(f) give examples of the relevance and impact of earth resources to everyday lives in PNG;

(g) access information to learn more about the geological history and resources of PNG;

(h) apply physical science principles to the understanding of and problem solving in earth science;

(i) appreciate the importance of earth science in their understanding, enjoyment, use, management and preservation of the environment in which they live;

(j) identify and describe the effects of human actions on environments;

(k) understand the importance of preservation of natural resources and the causes of specie depletion to becoming endangered;

(l) report on and provide educated opinions to the management of resources and habitat preservation in both local and regional settings of PNG;

(m) design, construct and use simple instruments to measure and record data;

(n) graphically represent and interpret data obtained first or second hand;

(o) communicate ideas and concepts of science using a variety of reporting formats applicable to teaching science in PNG Primary schools.

Approaches to teaching and learning

It is very important that the teaching of Resource Science is approached from the personal experience of students. These experiences will provide a real life connection to the important resource issues facing the citizens of PNG. Therefore students' prior knowledge and misconceptions about important issues must be established before planning the teaching program.

Student interaction and participation is essential to build on the fundamental understandings of resource knowledge. Practical experiences should be incorporated in the student learning experiences wherever possible. Activities that encourage group debate should form an integral part of the teaching strategies.

Local resources should also be utilised for student learning experiences. These resources include local rocks and minerals, mining and fishing operations, marine research centres, NGO groups, diving operations and government departments.

It also important to ascertain "tambus" in relation to different cultural origins and beliefs before the discussing sensitive issues. Alternative teaching and learning strategies may need to be provided to avoid potential conflict.

Assessment strategies

In keeping with a student-centred approach to teaching and learning it is important that assessment strategies provide opportunity for students to prepare for their professional roles as teachers. Therefore a range of assessment items should be utilised to reflect the teaching approaches and student application to their profession. A list of suggested items has been

included but is not exhaustive by any means. Some assessment items may include a number of strategies as a "package". For example, a student may conduct a survey, research his/her findings and assemble a teaching package tailored to local needs. Some examples are:

- Pen and paper examination e.g. multiple choice, short answer and extended answers
- Portfolio e.g., Collection and field notes
- Practical e.g., Preparation of report on field investigations
- Wall charts and posters for teaching Resource topics, e.g., display showing transect of reef with labels of zones and organisms found on a reef
- Models e.g., a model of an opencut mine
- Essay e.g., impact of over exploitation of resources
- Personal research e.g., Library or other research on aspects of environment and resources
- Library and media research e.g., Selected and directed topics from newspapers; CD – ROMS, library references
- Teaching resource e.g., prepare resource for teaching a Marine or Earth Resources topic
- Survey, e.g., Survey local fauna and flora in a field area
- Interview e.g., survey local conceptions about resource issues
- Case studies e.g., collect and collate latest information on a resource development near the college or near home
- Comparative studies e.g., Use and conservation of resources in PNG compared to other countries
- Stories about marine life and traditional uses of resources
- Seminar e.g., Present findings about resource investigation
- Group projects e.g., Team investigation of a marine lagoon/reef area or mining area.

Resources

This list provides colleges with recommended resources for the teaching of this unit. College lecturers should continue to keep abreast of changes and the publication of new books and new editions through the relevant booksellers. Those marked with ****** are highly recommended as essential lecturer reading. (Put them on your resource order!).

The following titles are essential and it is highly recommended that colleges add multiple copies of these to their libraries:

Deutrom, B. (1998). Science for the Pacific: A – Z of Essential Terms. Oxford:PNG. (ISBN: 0-19-554162-6. Price approx AUD13.00 available from the Co-operative Bookshop).

Cross, R. (1996). Teaching Primary Science: Empowering children for their world. Addison Wesley Longman: Melbourne. (ISBN: 0-582-80364-0. Price approx. AUD30.00).

Anderton, J. (Ed). (1999). Fundamental Science for Melanesia: Books 1, 2, 3 and 4. Longman. (ISBN: 0 582 72123 7; Approx price each AUD20.00**). This series of books are textbooks used throughout PNG in secondary schools.**

The following CD ROM set is also very useful for both students and lecturers:

Oxford University Press. (2001). Encyclopaedia Britannica 2001 Deluxe Edn. (CD ROM). Oxford University Press: London. (CDDLX01/01: Cost approx. AUD99.00. Available from any good computer software store such as Harvey Norman or Office Works (Price: Approx. AUD90.00).

Other references

Allan, M., Edwards, J., O'Brien, J., Ritchie, S., Hopley, D., Wilson, L., Brodie, G., Zann, L., Collins, J. C. (1996). *Oceanography and plankton and caring for the sea: Teachers Guide 3*. UNESCO. JCU: Townsville.

Allen, G.R. and Steene, R. (1996). Indo-Pacific Coral Reef Guide. Tropical Reef Research: Singapore. (ISBN: 981-00-5687-7; Approx. AUD49.00.). *****

Allen, G.R. and Swainston, R. (1993). Reef Fishes of Papua New Guinea. Christensen Research Institute: Madang, PNG. (ISBN: 9980-9999-0-X. Available from most dive shops and booksellers in PNG – about Kina 10.00). *****

Beckett, B, S. (1993) *Illustrated Human and Social Biology* Oxford university Press

Calder, P. (1988). *Living Organisms Plants and Animals* ADT University of Goroka, PNG.

Clark, I.F. and Cook, B.J. (1986). *Geological Science: Perspectives of the Earth.* Australian Academy of Science: Canberra.

Energy Publications. PNG Resources: Reporting on PNG's petroleum, Mineral and Forestry Resources. Published Quarterly. Energy publications: WA. Annual Subscription: AUD70. Energy Publications, Energy House, PO Box 127, Mt Hawthorn, WA, 6016.

Minerals (chart). Atlantic Europe. (ISBN: 1862140332; Approx. price: AUD30.00

Moffat, R. (1992). *The Barrier Reef World.* Wet Paper Publications: Gold Coast.

Musso, B. &Hutchison, E. (1996). *Corals and coral reefs.* UNESCO. JCU: Townville.

Rosen, S. (1998). *Teachers Manual for Earth Science*. Macmillan. ISBN: 155675 713 1; Approx. price: AUD15.00).

Tarbuck E.J. and Lutgens, F.K. (1994). *Earth Science*. (7th edn). Macmillan College Publishing: New York.

Tarbuck, E. J., Lutgens, F.K. (2000). *Earth Science* 9th Edn (With CD-ROM). Prentice Hall: NY. Price: Approx. $140.00. Excellent resource for the lecturer. *****

Videotapes

Film Makers Cairns. (1999). *Coral Kingdom: Australia's Great Barrier Reef.* Film Makers Cairns (Available from the Cairns Underwater World or Great Barrier Reef Marine Park Authority; Price: AUD39.00).

BBC Series. Blue Planet (series). Available from ABC Shop, Australia. About AUD90.00

BBC Series. Planet Earth. Available from ABC Shop, Australia. About AUD90.00

The Planets (Double Video). Available from ABC Shop, Australia. About AUD50.00

Equipment and consumables

Excursions are an essential part of the teaching process and will require basic equipment for field studies. This list recommends some essential items.

Marine resources

- Masks and snorkel sets (about 12 per class) - more important than fins
- Fins, heeled in medium and large sizes (Sizes 7 –9, 9 – 11, 11 – 13) (12 sets)
- Aquarium Net, 100mm, 250mm Handle (need 12 per class)
- Aquarium, Glass Tank With Cover, 600mm x 300mm x 300mm (for keeping live specimens for study from reef or river) - more than one might be needed if keeping specimens that need to be separated
- Aquarium accessory set, full kit, air pump, corner filter, charcoal, tubing, two way multi-flow gang valve, wool, 1" air stones

- Reagent or specimen jar, glass, wide mouth, plastic screw cap, 250ml (for collecting specimens)
- Chart of fishes of PNG (from Fisheries Dept)

Earth Resources

Mineral Kits (4 sets)

- Rock kits (at least 4 sets)
- Ore Kit, 12 Specimens (Galena, Bauxite, Hematite, etc)
- Geological hammers (about 4)
- Safety Spectacles, Chemical & Impact Resistant, Clear Lens, Basic Style
- Geological maps of PNG
- Mining company reports are useful as well

A4 Marine Resources

Pre-requisites

The Module E1, *Ecology*, is a prerequisite to the study of this module.

Rationale

The Module Marine Resources is a core module of the unit Agricultural and Resource Science. This module should be associated with studies of Ecology as an extension to the Unit, *Environmental Science*. The content of this module may need to be adjusted to suit the needs of individual colleges. Marine resources are an important part of the Primary syllabus, e.g., the Grade 7 Unit *Life in the Sea*. In the lower primary school marine topics may be integrated into studies on the types of environments. However more emphasis should be placed on marine science in schools that are close to the sea and use the sea for resources.

Rules and regulations need to be developed through high level discussions and decision-making. It is therefore important that students are exposed to marine biology so that the marine environment is better understood and maintained for the future. Students should study the sea and the resources first hand (excursions) in terms of what the sea means to many coastal villages. Discussions, lectures, research and hands-on activities should help students appreciate and control what is removed from or put into the sea.

It is expected that this module will develop preservice teachers whom:

- are able to confidently teach the marine topics of environmental science in the upper primary syllabus;
- are flexible and creative in their teaching approaches;
- appreciate and understand the elements associated with marine environments;
- have an appreciation of the cultural significance of the sea and the naming of marine organisms in vernacular language
- respect for the sea and the inherent dangers.

Objectives

At the end of this module students should be able to:

Knowledge and processes

- describe the significance and the characteristics of living things;
- explain the diversity of marine organisms in relation to the types of interactions;
- make decisions about what to extract from the sea so as to conserve and sustain the marine environment;
- demonstrate how marine organisms adapt to their environment and fend for themselves;
- recognise dangerous animals and describe the effects on humans;
- identify traditional and modern first aid for bites and stings from marine organisms;
- identify marine resources and the importance of their preservation
- identify and describe effects of human actions on environments;

- list and describe strategies for sustainable fisheries production and protection of the environment;

Skills

- select and use appropriate equipment to carry out field investigation of a marine environment, e.g., mask and snorkels;
- Observe, sketch and care for marine organisms during field work;
- draw and label a transect of a coral reef shoreline using an appropriate scale;
- observe, sketch and investigate the characteristics and behaviour of marine organisms and their interactions with the environment;
- use keys to describe and identify marine organisms;
- design, implement and report on a field project.

Values/Attitudes

- appreciate and respect marine environments;
- appreciate and respect traditional values and uses of marine resources;
- work with perseverance in field investigations;
- value marine totems.

Main ideas developed

Traditional classification of marine organisms was important for collecting food, for ceremonial and other occasions.

The binomial scientific classification system provides a mechanism for the interchange of information between specialists from around the world.

As with other sources of food, creatures of the sea exist within complex food webs and delicate habitats.

The complex relationships that exist in the marine environment must be researched and understood if we are to protect that environment.
Marine organisms live in a fragile environment and their habitats must be protected.
The marine environment is important for food and recreation for many people in PNG.

Some fishing practices are detrimental to the marine environment.

Foreign companies exploit the oceans of PNG for marine products.

The marine habitat must be studied to understand the effects of exploitation.

The marine resources must be controlled and protected to ensure that over-exploitation does not occur.

Local peoples need to understand that the marine environment needs to be nurtured and protected to provide sustainable resources.

Content and sequencing

Coral reef development

- location of reefs
- composition of reefs
- formation of reefs

Marine organisms

- marine plants
- animals on the reef

Marine ecology

- abiotic and biotic factors
- food chains and food webs
- ecological niche
- dangerous sea organisms
- field studies

Utilisation of marine resources

- traditional uses of marine resources
- traditional fishing techniques
- modern fishing methods
- Endangered marine species

Sustainability and management

- coral reef sustainability
- fisheries management
- managing marine environments
- mangroves

Suggested teaching strategies

It is essential that the Module E1, *Ecology*, is studied before this one. Students need to understand the basic principles of ecology to be able to apply them to the issues of marine conservation and preservation.

Coral reef development

An excellent way to introduce this topic is through the use of suitable videotapes, e.g., *Coral Kingdom: Australia's Great Barrier Reef.* Film Makers Cairns (Available from the Cairns Underwater World or Great Barrier Reef Marine Park Authority).

The coral reefs of Australia are very similar to those of PNG; therefore the Australian materials are very relevant and useful for teaching this module in PNG colleges.

Examples of types of coral reefs in PNG should be discussed. Many students would have first-hand experience at some of the uses of the marine environment traditionally and commercially.

Marine organisms and marine ecology

This topic could be taught with E2, Flora and Fauna of PNG. An excursion is an excellent way to introduce students to the organisms of the sea. If students are in the Highlands then a

videotape such as the one above are a satisfactory way to introduce students to the interactions of marine organisms.

An example of an excursion has been included in the appendices in this guide. It is important that, whenever excursions are included, the lecturer/s are familiar and conduct a prior reconnaissance of the study area.

The lecturer should try to identify as many of the organisms as possible before taking students to the field study area. Assistance may be needed from a marine research centre or even a local scuba diving group.

Charts of marine organisms would be very useful as a teaching aid. These could be compiled by student research or by the lecturer.

Students may need to review the construction of food chains and webs.

Compare and contrast freshwater habitats with marine. This might be useful if students are unable to see a marine environment first hand.

Utilisation of marine resources

At issue here is the delicate nature of some of the interactions and dependencies between organisms of the sea.

It should be made clear to students, with reference to the principles of ecology and conservation, that areas cannot be over-fished without affecting the whole ecosystem.

Through discussion groups and student experiences, list marine resources that are commercially or privately used.

Discuss traditional uses of marine resources. A series of questions could start the discussion: *Why are some areas depleted? What has caused this? Is over-population a concern in some areas? Do modern fishing aids deplete an area faster? Should small fish be taken? Should some fish be left? Do they have an important role to play?*

Groups could discuss and present their findings about selected issues.

Sustainability and management

Define the meaning of sustainable to students. List practices which are not sustainable, e.g., methods of harvesting.

Arrange a debate about whether commercial fishing by overseas companies should be allowed.

List ways to promote sound and sustainable management of PNG marine resources.

Suggested student activities

The following activities may be used to supplement the student materials or to develop alternative activities to teach the module

Diversity of marine organisms

1. Research the **traditional** ways in which marine flora and fauna have been classified. List some of the traditional names and their scientific equivalent.

2. Research and produce a chart, suitable for use with a Grade 5 class, of the main groups of marine animals and plants. Use your chart to explain to the class the main characteristics of each group.
3. Participate in a field trip/excursion to a beach, reef and mangrove area. Before you go, make a list of all the equipment you would need to study the organisms you might find and the methods of recording your observations.
4. Make a collection of shells, coral, starfish, seaweed, etc. Study living things by capturing them and placing them in a container to examine them, then draw, describe, photograph them before returning them to the location you found them. Do not take living creatures away. Organise a class display of the labeled collections.
5. Write a story or poem, suitable for Grade 3 students, which describes people interacting with sea creatures.
6. Research fish and their characteristics. Draw up a chart showing the parts of a fish. Explain to your partner how a fish obtains oxygen from water.
7. Research corals and reef building. Explain to your partner where and how corals grow and how they reproduce, and why corals are good indicators of the health of the environment.
8. Choose one group of marine animals or plants to research. Write a one-page summary of the group characteristics. Draw a representative of the group on card, cut it out and hang it with the page description from the ceiling of your classroom.
9. Research the different habitats in the ocean and describe the characteristics of each habitat. Write a report on what you have found.
10. Make a list of the adaptations different groups of animals have made to living in the sea, e.g., mammals such as dolphins need to breathe air so they have had to develop good lung capacity.
11. Research the effects of land-based pollution on coral reef. Prepare a report to the group on what you have discovered about the effects of litter, chemicals and sediments.
12. Make a “What am 1" picture book. Each class member could write out five clues for a chosen sea creature. The answer could be a picture hidden by a folded part of the page.
13. Organise a class debate on a topic such as "A traditional, local classification system for marine organisms is much more useful than a complex scientific classification".
14. Make up a card game suitable for Grade 6 students, using drawings of common sea creatures and names of the groups to which they belong.
15. Construct a simple food web for some of the main groups of sea creatures in the local area.

Use and conservation of marine resources

1 Describe the traditional role of marine animals and plants in the village community.

2 Research some traditional songs, dances and stories relating to marine organisms.

3 Classify some of the common marine organisms in terms of their usefulness, e.g., for food and ceremonies.

4 Research one type of marine organism caught or harvested commercially in PNG.

5 Research the use of shell money in PNG. Make a chart suitable for Grade 7 students and use it to explain to your partner the significance of shells to trade in PNG in pre-colonial times.

6 Draw a map of PNG and on it draw the boundaries of the sea area which PNG controls. Estimate the proportion of sea to land in this total area. Find out what PNG obtains from the large sea area it controls and what international obligations there are in controlling such areas.

7 Investigate commercial fishing in PNG. Explain to your partner the importance of this industry to the country. Find who owns the companies, boats, factories, what infrastructure exists and what returns go to the people of PNG.

8 Research the devastation caused by using explosives and cyanide as fishing methods on some reefs. Explain to your partner what is involved with these methods and why they are so devastating.

9 Investigate "fish farming". Explain to your partner how it works, where it is done and some of the advantages and disadvantages of fish farming.

10 Organise a class debate on topics such as: "Foreign fishing vessels ought not be allowed to fish in PNG waters"; “Size and catch limits should be introduced for all persons in PNG to protect vulnerable species.”

A5 Earth Resources

Rationale

The physical and living environments have complex interactions. Human utilisation of resources has an impact on these environments. A study of ecology is a prerequisite to understanding the interactions between the living and physical environments. Studies in rocks, minerals, weathering and erosion provide an understanding of the formation of important mineral resources such as ores, oil and gas. Many earth resources have cultural as well as economical significance to the peoples of PNG. Students need informed knowledge to understand the importance of resource development in PNG and the need for controlled development and conservation. Assignments should include the development of resource materials that can be used to educate children in primary schools.

Objectives

Objectives

At the end of this module students should be able to

- understand the processes at work in the formation of minerals and rocks of PNG;
- classify a range of typical minerals and rocks of PNG;
- observe and record properties of minerals and rocks;
- apply earth science principles to the understanding of the formation of mineral resources in PNG;
- access information to learn more about the mineral resources of PNG;
- graphically represent and interpret data obtained first or second hand;
- communicate ideas and concepts of earth resources using a variety of reporting formats applicable to teaching;
- critically and rationally review examples of resource development and impact on lives and lifestyles in PNG;
- propose effective plans for resource development and management and
- appreciate the importance of earth resource development to the economics of PNG.

Main ideas developed

Minerals and rocks are formed by a number of dynamic processes on the earth's surface and are important in understanding the formation of important resources.

Some minerals and rocks have cultural significance or uses and have been used by indigenous persons for thousands of years.

Weathering and erosion are important mechanisms in the shaping of PNG landforms.

Due to the nature of the climate and the terrain all development, both at a community level and corporate level, which affects the environment must take into account the weathering and erosion potential in PNG.

Geologists use mapping, satellite imagery, sampling and drilling techniques to explore for possible resource deposits.

Metals are found in ores occurring in a variety of rock types formed through a number of different processes.

Oil and gas are hydrocarbons formed in sedimentary rocks from the breakdown of plant and animal remains trapped as sediments accumulate on the sea floor.

Hydrocarbons move through permeable sedimentary rocks until they escape or are trapped by an impervious barrier.

Complex infrastructure is needed to extract, process, transport and refine mineral resources before they are exported.

Mineral resource developments are important for producing resources for our lifestyles, sources of jobs and export income for PNG.

Mineral resource development is a national responsibility but must be carried out with full consultation with the local community.

Mineral resource development has environmental implications in terms of the air, water and land surface.

Content and sequencing

Identification of minerals

- Useful properties of minerals

Igneous rocks

- Identifying igneous rocks

Sedimentary rocks

- Environments of sediment accumulation
- Lithification
- Textures of sedimentary rocks
- Sedimentary structures
- Classification of sedimentary rocks
- Identification key for common sedimentary rocks

Metamorphic rocks

- Basic classification and examples from PNG

Weathering and erosion

- Mechanical weathering
- Chemical weathering and soils
- Erosion and mass wasting

Mineral and energy resources

- What is a resource?

- Social, cultural and political pressures
- Mineral resources
- Energy resources

Suggested teaching strategies

Mineral and energy resources have formed as a result of favourable geological conditions. These conditions include the rocks and minerals, structures and tectonic setting. In module E5, Earth Science, students should have studied the processes that contribute to formation of mountains and volcanoes. It is a logical progression to now look at the types of rocks, the mineral content of rocks and the occurrence of mineral resources.

Identification of minerals

There is no need to undertake a detailed study of minerals in this topic. The main purpose is to acquaint students with the major rock0forming minerals and ores that important to the mining industry in PNG.

The student materials are self-explanatory and use a discovery approach in which students investigate the properties that are used to identify minerals.

When looking at rocks it is important to recognise the minerals that are used to classify a rock. We do not need to know every mineral in a rock.

Try to collect rocks and minerals from the local area of the college. You may need the help of a geologist to identify your local rock collection.

Discuss traditional uses of well-known minerals and ores, e.g., ochre, gold, quartz.

It is a good idea to label the mineral and rock specimens so that the labelling agrees with the list provided. Page 29 of the student materials gives the identity of the minerals in the activities.

When testing the hardness of a mineral, the test mineral should be scratched with the tester and vice versa to ensure one is not the same hardness as the other.

When testing density, use the method of heft. Just toss the mineral up and down in the palm of your hand. It is easy to develop a sense of density by doing this. Shutting your eyes will also help.

Activity 1.3 Answers

1. The structure and arrangement of atoms and ions does not always exhibit an external shape (crystal).
2. Many minerals may have the same colour.
3. Hardness testing will determine if the mineral is other than diamond.
4. Corundum is used in the abrasives industry for making grinding wheels and sandpaper. Coloured corundum is known as sapphire and ruby and these are gemstones.
5. Silicon is the name of the element while silicates contain silicon and oxygen in varying proportions.

Igneous rocks

Activity 2.2 Answers

1. The light coloured rocks contain the silica – aluminium rich minerals, quartz, feldspar, etc.
2. The dark coloured rocks contain the ferro-magnesium minerals, e.g., hornblende, pyroxene, olivine, plagioclase, magnetite, etc.
3. The bigger the grains the more time the rock had to cool from the molten state.
4. The rocks are (a) acid; (b) intermediate and (c) basic.
5. The rocks would contain the ferro-magnesium minerals.

Review answers

1. All kinds of rocks may be subducted and melted through the tectonic cycle.
2. The rock would most likely be basalt, a basic volcanic rock.
3. The porphyritic texture indicates that the rock has been cooling deep below the surface and then suddenly expelled as lava. The bigger crystals are visible, hence the term porphyritic.
4. They have a similar chemical composition. Granite has cooled slowly while rhyolite has cooled quickly.

Sedimentary rocks

Introduce this topic by bringing some river gravel into the classroom. Discuss with students the different shapes and reasons for the shapes. Make it clear that rounding and sphericity are different terms and are related to the composition, hardness and origin of the rock. The rocks that travel further are generally more rounded. Rocks which have a uniform hardness become more spherical.

In looking at sedimentary structures it is good to see what is around the vicinity of the college and use that as a starting point for discussion.

The most important sedimentary rocks are those of use and those in which oil and gas might be found. There is no need to have students study every type of sedimentary rock. Make sure they are familiar with:

Sandstone, conglomerate, limestone, shale, mudstone, breccia and chert.

Review Answers

1. Minerals that resist weathering (e.g., quartz) or are the products of weathering, (e.g., clay).
2. The grain size.
3. Sandstone, breccia, conglomerate, chert and shale are common.
4. Compaction forces grains together (almost like welding).
5. Bedding layers are the most common structures seen in sedimentary rocks.

Metamorphic rocks

Once again see what can be found locally to teach this topic. Look near known intrusions of igneous rocks (granites, etc) for contact metamorphic rocks. PNG is also full of regional metamorphic rocks due to the tectonic history and folding.

Exercise 4.1 Answers

1. The main agents are heat and pressure.
2. Regional metamorphism occurs when rocks are folded and buried by tectonic movement while contact metamorphic are formed by being next too molten igneous rocks.
3. Schist has layers with visible mica minerals while quartzite looks like "cooked" quartz.
4. Metamorphic rocks usually show a texture such as layering or granulated appearance (contact).

You should try to obtain information about mines in PNG from the mining companies. This will greatly assist your own understanding as well as students.

Weathering and erosion

Field excursions are an excellent way for students to see the processes of weathering and erosion at work.

Mineral and energy resources

It is important that students understand the need for development of mineral and energy resource in PNG. You should try to obtain information about mines in PNG from the mining companies. These materials may form the basis of a case study for students.

There are also a number of videotapes produced by companies and as documentaries, which would support the teaching of this topic.

Suggested student activities

Further in-class and extension activities for students during study of this module are listed below under general areas.

Minerals and rocks of PNG

1. Research and explain to your partner the term sedimentary rock. Draw up a list of the names of some sedimentary rocks. Collect and make a labelled display of sedimentary rocks.
2. Make a collection of or examine some ore minerals. Label each specimen with its name and the metal it contains.

Weathering and erosion

1. Investigate examples of weathering and erosion in your local area.
2. Compere the differences in weathering on local rocks.
3. Investigate local erosion problems and suggest how these problems could be rectified.

Ores and mining

1. Make a list of the metals and their uses that you use in one day or that are present in your classroom, workshop or local industry. (For example, a motor vehicle contains iron, copper, zinc, nickel, chrome, lead and plastic.)
2. Use a newspaper to find out the present world prices for various metals. Find out how much of each of these metals is exported from PNG in a year and calculate their value as export earners.
3. The main metals mined, or about to be mined, in PNG are copper, gold, molybdenum, nickel and cobalt. For each metal, give its chemical symbol, main uses, and the name of the ore from which it is extracted.
4. Research and explain to your partner how ore minerals are formed. Draw a map of PNG and on it show the location of the major ore deposits. Explain why PNG and Irian Jaya have a number of large 'porphyry-copper-gold' deposits.
5. Research and explain to your partner the main methods by which metallic ores are mined, giving the advantages and disadvantages of each. Use diagrams to help in your explanation.
6. Make a list of the major possible sources of pollution from a large-scale mining operation in the highlands of PNG.
7. Research and write a report about a major ore body being mined in PNG. You should include the metals mined, the rocks in which the ore occurs, mining method, reserves, expected mine life, production figures and methods of benification.
8. Organise a debate in your class entitled “Land rights should apply to resources of national importance such as major mining sites.”

Oil and gas

1. Make a list of all the uses of oil and gas in the world around you. Oil and gas are also the source of many chemicals including medicines and plastics. Explain to your partner how these chemicals are manufactured.
2. Research and explain to your partner the terms pore, porous, permeable and impervious. Find a piece of porous rock such as limestone and slowly pour water over it to see how much water can be held in the pores. Draw what a porous rock would look like if viewed under a microscope.
3. Research and explain to your partner how oil and gas are held in, and migrate through, sedimentary rocks until they are trapped in reservoirs. Explain how geologists search for possible accumulations of oil or gas. Draw up a chart suitable for Grade 7 students that would help you explain this process to them.
4. Research and explain to your partner the meaning of the terms carbohydrate and hydrocarbon. List the name and chemical formulae of some of the simple hydrocarbons found in oil and gas, such as methane, ethane, propane and octane, and relate these to the terms LNG, LPG, diesel, petrol and kerosene.
5. Draw a map of PNG and on it show the location of the major oil and gas discoveries. Show also the main infrastructure, such as pipelines, terminals and refineries, associated with extraction and utilisation of these resources.

6. Half fill a screw top jar with water, pour in a small amount of oil, and then screw the lid on tightly. Shake the contents vigorously and then let the jar stand for a while and observe what happens. Explain to your partner how this demonstration relates to the positions of water, oil and gas in a hydrocarbon reservoir.
7. Draw a cross-section through one of the important oil or gas reservoirs discovered in PNG and use it to explain to your group how that accumulation was formed.

Issues in exploitation of resources (extension)

1. Set up a "students' learning centre" in part of the classroom. Use a notice board dedicated to resource exploitation on which to post newspaper clippings, magazine articles, etc. Make containers such as boxes available for reports, booklets, company brochures, etc. related to the topic.
2. Describe and explain to your partner the possible effects on each of the air, water and land surface near each of the following (a) a copper-gold open cut mine, (b) an oil well field, and (c) a logging operation in a forested area.
3. Research the share ownership structure of a mining, logging or oil company. Find out how many shares are owned by PNG citizens or companies, how much in royalty payments is paid each year and the number of jobs created. Calculate the amount of money that flows into the community as a result of the company's activities.
4. Organise a class debate about the advantages and disadvantages for PNG of the establishment of a large copper-gold or nickel mine in the country.
5. Conduct a survey in the local community to determine community attitudes to the exploitation of resources such as copper, gold, nickel or oil. Make sure you have a useful set of questions to ask before you start the survey. Present a report of the survey findings to the class.
6. Invite a guest speaker from a mine, oil field or logging operation to address your class about the benefits the operation brings to the local community and the national economy.
7. Organise a class debate on the topic " A resource should belong totally to the community on whose land it occurs".

Appendix 1. Marine Resources Excursion

Excursion to Kabanga Bay

This excursion forms part of the assessment for the elective. As such participation and submission of a report is compulsory.

Objectives

You should be able to:

- describe and sketch the physical characteristics of a shoreline and coral reef
- draw a transect and label the zonations clearly
- record observations of living things in the environment
- classify living things found on the shore and the coral reef
- describe adaptations and feeding behaviour of living things
- illustrate food webs and relate to energy and nutrient flows
- identify marine resources and the importance of their preservation

Some guidelines to preserve the reef and yourself

1. Do not walk on coral. It is living!
2. Only walk on the sandy bottom.
3. Wear suitable footwear to protect feet from cuts and jabs.
4. Specimens must be kept in seawater while being examined.
5. Return specimens to the place you found them.
6. Remember that some things sting, bite or stab (Anemones and coral; cone shells and crabs; sea urchins)

There are four tasks to complete:

Task 1 Transect

Task 2 Survey of shore area

Task 3 Survey of reef area

Task 4 Report

Task 1 Transect

1. Select a section of the coastline where there is some original undisturbed vegetation.

2. Imagine a straight line from the reef edge to the trees beyond the beach.

3. Draw a crossection and estimate the distances from one zone edge to the next. Mark these on your sketch.

4. label your sketch to describe the living and non-living components of each zone.

5. Collect samples of plant materials for identification.

6. Make notes about the size and composition of the beach materials.

7. Describe any physical changes taking place in this environment.

8. Classify these changes in terms of natural or human-made.

9. Your sketches and data must be included in your report (Task 4).

Task 2 Survey of shore area

1. Locate an area (habitat) of the shore which contains diverse physical and biological characteristics

2. Mark out a one square meter area.

3. Carefully observe and sketch all features **before disturbing the area.**

4. Now lift rocks, twigs, logs and drift material to see what lives under or on these things. Observe behaviour and any relationships to other living things. Sketch and label the organisms seen.

5. Your sketches and data must be included in your report (Task 4).

Task 3 Survey of reef area

This task will be completed in two parts and will necessitate sharing of equipment.

Part A: Reef Walk

1. Make sure you have covered footwear.

2. Carefully walk out from the shore (near the house) avoiding standing on coral or sea urchins. Stop periodically.

3. Look through the masks to observe living organisms.

4. Note features (morphology), behaviour, specialised adaptations and feeding habits of each organism. You might need a partner to keep notes (out of the water).

5. Use the scoop net to collect larger specimens for further examination on shore.

6. Place these organisms in a container with seawater and keep in a shady place. **Do not let the organisms become stressed!**

Part B: Reef Organisms

1. Examine and sketch each of the organisms that you have collected.

2. Label the prominent features.

3. Use suitable references or advice form lecturers to identify the Phyla and Class of each organism.

4. Further classify the organisms by Genus.

5. Your sketches and data must be included in your report (Task 4).

Task 4 Report

Back at College you are to collate your report under the three headings:

Transect

Survey of shore area

Survey of reef area

Detailed descriptions of organisms

Your report must reflect the objectives and these objectives will be the basis of assessment for a grade.

Appendix 2. Assessment criteria for Marine Excursion

This is an example of how student reports may be assessed. This criteria sheet must be given to students as a guide so that they are aware of the criteria.

3 = Very well documented

2 = Satisfactory

1 = Could be improved

0 = Not documented at all

Transect	**3**	**2**	**1**	**0**
° Scale shown				
° Total length shown on the cross-section distance				
° Distance from one zone edge to the next				
° Depth from one zone to the next				
° Living and non living components of each zone				
Survey of seashore				
° Area drawn to a scale of a 1 m^2				
° Sketch of organisms in a disturbed area				
Reef walk				
° Clear sketches of organisms				
° Common name, Scientific name and phyla of these organisms				
° Prominent features of organisms labelled				
° Description of organisms in terms of behaviours, specialized adaptations, feeding habits and etc				
Report				
° Introduction (reflection of the objectives of the excursion)				
° Presentation				
1. Description of any physical changes in the environment				
2. Description of any physical change that is man made or non man made				
3. Description of behaviours, adaptations and any relationships seen in organisms				
° Conclusion (importance of marine preservation)				
Total				