
Introduction

Purpose

The Teachers Guide is to be used in conjunction with the Science Syllabus and other Teachers Guides in Upper Primary. The main purpose of the Teachers Guide is to help you to implement the Science Syllabus in Upper Primary. It provides you with information and processes to:

- use the elaborations to identify relevant content and contexts,
- develop units of work or projects relevant to your students' needs, interests and social and economic opportunities,
- select appropriate teaching and learning strategies,
- plan a school based program suitable to your school,
- plan and conduct assessment to monitor students learning and achievement of learning outcomes.

How to use the Teachers Guide

When you receive this book, you need to do the following:

- read it carefully and grasp the flow of the content,
- read it carefully so that you become familiar with the Strands, the Substrands, the processes and skills, the Elaborations of learning outcomes and the teaching and learning strategies,
- identify specific projects based on the 10 learning outcomes for Grades 6, 7 & 8,
- consider how to use the information to develop your own programs and units of work.

Some options for developing programs include:

- teaching one of the sample units of work from a particular Strand,
- using the sample units of work as a guide to develop your own units of work relevant to local contexts,
- using the sample unit of work as a guide to develop integrated units of work with other subject outcomes.

Nature of science at Upper Primary

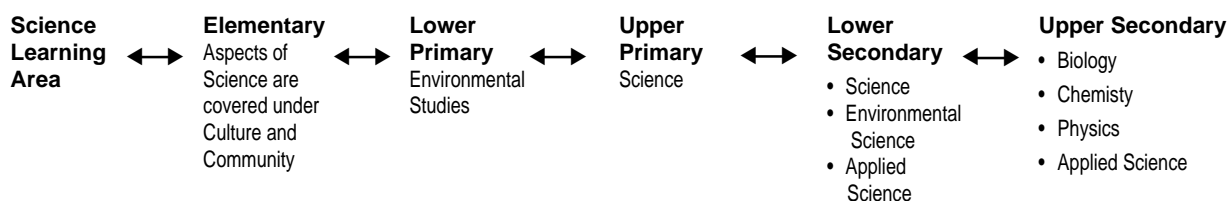
Science is best understood when it is related to real-life situations. It is important to present Science to students with an emphasis on Papua New Guinean contexts and issues. Teaching in local contexts allows students to be aware of how Science influences their everyday lives and how it can inform personal, community and government decisions.

The skills developed through a study of Science will prepare students for continuing studies, for entering the work force or for living in the community. Through learning Science in schools, students will become aware of some of the natural laws that explain the world around us. They will learn to gather evidence according to methods developed in Science such as hypothesising, experimenting, observing, recording, interpreting, analysing and drawing conclusions. The nature of Science provides students with many opportunities to solve problems using recognised scientific thinking skills and procedures.

Students at primary level are inquisitive and active by nature and enjoy participating in hands-on activities. They learn best by exploring the environment in which they live. It is recognised that at the Primary level of schooling, students like to work with concrete concepts and they learn best if they are encouraged to manipulate real objects in real-life situations. For them, learning is observing and doing rather than rote learning. A student-centred approach must provide the learner with multiple opportunities to work in a variety of contexts and to seek meaningful solutions to problems using the knowledge, skills and processes outlined in the Grades 6 to 8 Science Syllabus.

Links with different levels

The Science learning outlined in the Syllabus and supporting Teachers Guide builds on aspects of Science covered under Culture and Community at Elementary level, Environmental Studies in Lower Primary and makes links to the body of Science knowledge covered in Lower and Upper Secondary. Students leaving school at the end of Grade 8 should have basic scientific knowledge and skills as well as a foundation for studying Science at Secondary level. These links can be seen in the diagram below.



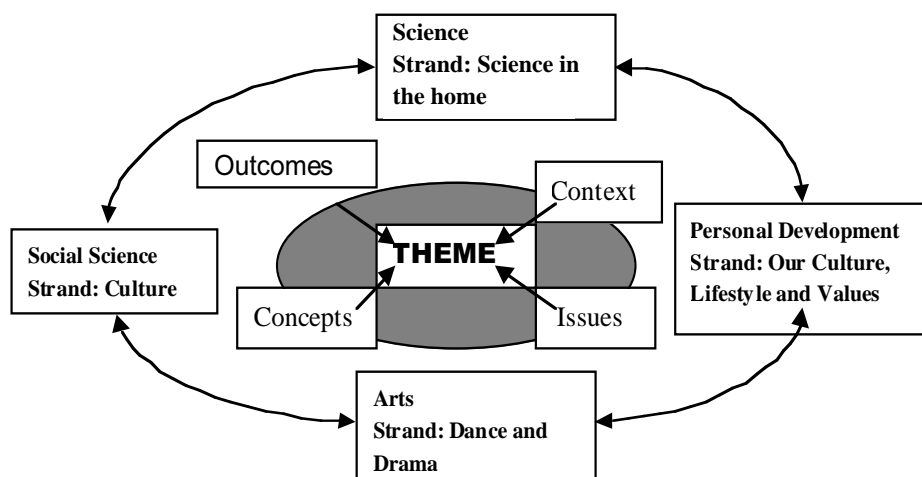
Links with other subjects

Teaching and learning can be organised in an integrated way as a whole school program or within a single subject. The Science outcomes in Upper Primary can be linked with:

- outcomes from other Upper Primary subjects to create themes for units of work,
- outcomes across Strands within a particular subject or Grade,
- outcomes within one Strand of one subject for one Grade.

Teachers can use the Science outcomes described as knowledge, skills and attitudes along with concepts, contexts, topics or issues based on the nature of the course to develop integrated units of work.

Below is a model that shows how related Strands in Arts, Personal Development, Science and Social Science may be linked to plan integrated units of work in Grade 6.



Links across the Science Strands

Use the same model above but replace the names of the subjects with Strands and Substrands from the Science Syllabus in order to create units of work for Science that include teaching and learning activities, assessment tasks and programs.

Units of work from one outcome

Not all outcomes will easily be integrated. Where the outcomes do not link naturally there should not be any integration taking place. Instead the outcome should be taught by itself and a unit of work created to teach that outcome to students.

Key Features

The key features outlined in this section are identified as unique to Science and important in the planning, development, and implementation of whole school programs. The key features of the Grades 6 to 8 Science curriculum emphasise recommended knowledge, skills and processes and provide ideas on how to teach Science without a laboratory and practical Science.

Science without a laboratory

Science without a laboratory is a reality for many Papua New Guinean schools. With this understanding, the Grades 6 – 8 Science Syllabus together with the Teachers Guide have been specifically designed to assist teachers in planning and developing worthwhile learning opportunities for all students irrespective of the school's resources. Science processes and procedures can be taught and learned without a conventional Science laboratory. Students and teachers are encouraged to use the resources that are readily available to them in their own surroundings. Local knowledge and situations become very important in this approach.

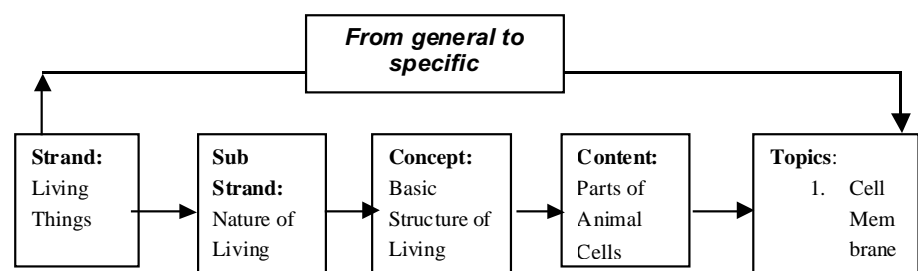
Content, skills and processes

Each of the four Strands in the Science Syllabus identify a particular aspect of Science and each outcome statement within each Strand has content, skills and process components. The principal tool for planning learning experiences and assessment activities are the learning outcomes.

Recommended content

To assist teachers in planning, the Science Syllabus organises the recommended content into Strands, Substrands, and Grades. Students will be given many learning opportunities to develop an understanding of the recommended content and opportunities to demonstrate their achievement of the outcomes.

The diagram below explains how teachers can work from the Strands and Substrands, through to teaching and learning programs, when using the Science Syllabus.

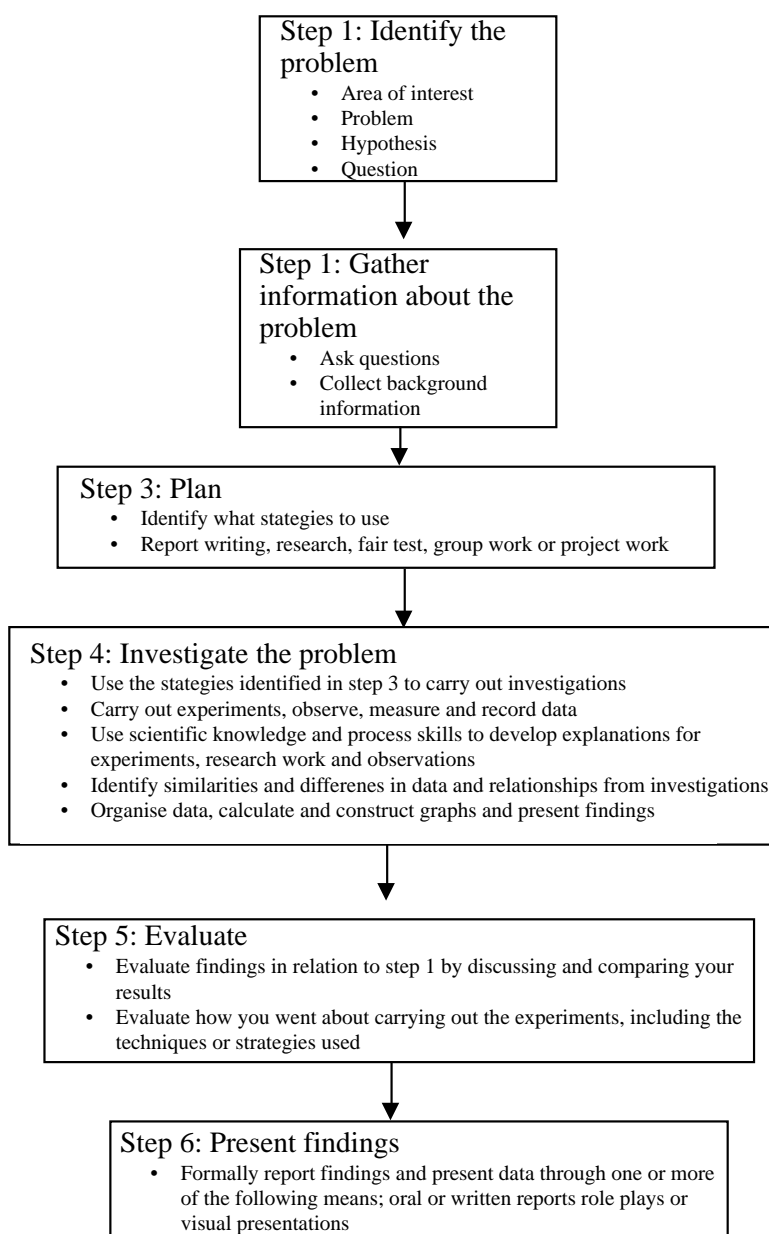


Recommended processes and skills

Primary school students learn best when given opportunities to experience many and varied hands-on activities. Early exposure to practical Science, at a level that is appropriate to the age of the learner, is seen as advantageous in building future capacity for working scientifically.

Science processes

Science teachers, students and others who are involved in teaching and learning Science use these processes when carrying out investigations. These processes can be simplified to suit the learning needs of the students.



Science skills

Working Scientifically which is a skills-oriented Strand for Upper Primary Science, helps empower students to implement problem-solving strategies to help them understand the world around them. There are three aspects of working scientifically:

- investigating students use different ways of collecting information and give reasons for collecting it in a particular way,
- comprehending students use different ways of making sense of information and check the validity and reliability of information,
- communicating students use a variety of situations and means of communications to present findings.

When selecting contexts and planning units of work, it is important that the skills and processes listed in the table below be developed using the outcome statements, indicators and elaborations found in the Grades 6 to 8 Science Syllabus and Teachers Guide. The skills and processes in this table are to complement those listed in the 'Elaborations of Outcomes' section of the Teachers Guide.

You can work with other teachers to determine the Grade at which these skills are most appropriate, based on the learning needs of students. Remember that some of the specific Science skills and processes are to be taught in all Grades but using different contexts and varied activities. For example, measuring is a fundamental Science skill that is common in all Grades but varies in level of difficulty and the resources used for measuring.

Investigating	Comprehending	Communicating
<ul style="list-style-type: none"> • collecting information • exploring phenomena • seeking reasons • hypothesising • looking for patterns and meanings • making observations • measuring • playing with toys • accessing resources • designing experiments • engaging with problems • identifying and controlling variables • making plans • handling materials • performing investigations • representing data • using written and oral texts as references • cooperating • clarifying and challenging values • expressing a point of view • actively listening • formulating questions • experimenting 	<ul style="list-style-type: none"> • making decisions • solving problems • predicting • taking action • classifying • reporting in both oral and written forms • logical thinking • talking and listening • analysing • interpreting data • making suggestions • using ideas, theories and principles • assessing • constructing meanings • formulating and elaborating ideas • making generalisations • looking for alternatives • making comparisons • making links • applying ideas and concepts • making judgments • reflecting • drawing conclusions • examining and evaluating • gathering data 	<ul style="list-style-type: none"> • interpreting data • observing • creating • comparing • recording • working safely • making models • developing a point of view • clarifying ideas and concepts • discussing • exploring and elaborating ideas • listening and questioning • responding and debating • using scientific terminology • negotiating • supporting ideas • arguing a position • constructing models • creating presentations • creating tables and graphs • summarising and reporting • using scientific report genres

Practical science

Students need to be confident in using basic Science equipment such as a ruler or reading an instrument correctly. The Grades 6 to 8 Science curriculum encourages learners to be active participants in developing and monitoring growth in the skills linked to working scientifically.

The ongoing assessment of students' ability to demonstrate outcomes is a fundamental component of an outcomes approach to learning. Not all practical work needs to be assessed. The intent of collecting information from ongoing assessment is to determine students' growth within the boundaries of the learning outcomes.

Students are encouraged to be active participants in the assessment process by knowing the types of assessment methods and the criteria to be used for assessment prior to the start of a learning unit.

Teaching and learning strategies

Teaching and learning

A student-centred approach to teaching and learning encourages students to actively acquire knowledge, skills and attitudes. The teacher takes on the role of guide and facilitator of students' learning. The following three teaching and learning approaches and related teaching and learning strategies use a student-centred approach.

Teaching and learning approaches and strategies

A teaching and learning approach is usually a model, consisting of phases, that organises teaching and learning over a period of time. A teaching and learning strategy is a way of developing teaching and learning within each phase of the approach. For example, the 5Es approach consists of 5 phases: engage, explore, explain, elaborate and evaluate. Several teaching and learning strategies such as group work, experiments, discussions and surveys could be used to develop students' learning in each phase of the approach.

Student-centred approaches

The three teaching and learning approaches described in this section are student-centred and can be used by teachers to develop students' achievement of the outcomes.

Approach 1: the 5Es

This '5Es' is a constructivist approach based on the idea that students learn best when they participate in activities that give them opportunities to work things out for themselves. As the names suggests, there are five phases; engage, explore, explain, elaborate and evaluate.

Engage

In this phase:

- teachers engage students in activities that capture their interests and stimulate curiosity,
- students raise questions,
- teachers verify students' prior understandings of the topic,
- students compare ideas.

Explore

In this phase students undertake hands-on activities where they:

- experience the phenomenon or concept,
- explore the questions they have raised, test their ideas and solve problems.

Explain

Only after students have had opportunities to explore, do they have opportunities to:

- compare their ideas with scientific explanations,
- use scientific terminology,
- construct explanations that can be justified using information collected.

Elaborate

In this phase students have opportunities to:

- apply what they have learnt to new contexts,
- develop a deeper understanding of the problem or phenomenon as they discuss and compare ideas.

Evaluate

In this phase students and the teacher:

- look for evidence of changes in students' ideas, beliefs and skills,
- evaluate what students know and can do.

Example of the 5Es teaching and learning approach

Phase of the teaching and learning approach	Examples of teaching and learning activities	Sample Questions
Engage Create interest Reveal personal ideas and beliefs	Brainstorming, concept mapping, developing questions, demonstrations, asking open-ended questions.	What do you mean by . . . ? Tell me more about . . . ? I find that hard to understand: tell me . . . ? What makes you think . . . ? How do you know . . . ? How did you find out about that idea . . . ?
Explore Explore questions and test student ideas	Prioritise class questions, group tasks, investigations, test ideas, research.	How are you going to . . . ? How will you be able to tell . . . ? Is that the question you really want to ask . . . ? What will you do when . . . ? It might be a good idea to think about . . . How will you know it . . . ? What do you need to find out more about . . . ? Why are you doing it that way . . . ? How will you be sure it is a fair test . . . ? How did you arrive at that idea . . . ?
Explain Compare ideas Construct explanations and justify them in terms of observations and data	Reporting, group discussion, gathering information.	What do you think others might think about this . . . ? How is that idea different to . . . ? Some people say . . . Does that fit with your idea . . . ? How did you arrive at that idea . . . ? How will you be able to tell . . . ?
Elaborate Apply concepts and explanations in new contexts	Further practical work, videos, debates, research.	Same as the <i>explore</i> phase. How could you verify that . . . ? What will happen if . . . ?
Evaluate Gather evidence of changes in students' ideas, beliefs and skills	Refining concept maps, responding to open-ended questions, reflection.	How have your ideas changed . . . ? How is that different to . . . ? It seems you are not sure about . . . Do you have any questions about . . . ? What have you found out? What else do we need to know . . . ? What else might you do to be really sure of that . . . ?

Approach 2: the interactive approach

The interactive approach involves a teacher-student partnership in which the student and teacher discuss and cooperate in selecting the topic. The students are active participants and this helps improve their understanding about familiar and unfamiliar concepts as well as their learning processes. There are five phases in this approach; preparation, exploration, students' questions, investigations and reflection.

Preparation

In this initial phase, teachers:

- select the topics jointly with students,
- verify students' prior understandings of the topic,
- assemble background information.

Exploration

In this phase students:

- clarify the topic and focus their thinking on particular aspects of the topic,
- participate in an activity, preferably hands-on, that enables them to become more familiar with the topic.

Students' Questions

In this phase students:

- explore the topic and pose further questions for investigation.

Investigations

In this phase students and the teacher:

- select questions to investigate,
- plan and carry out investigations to finalise their answers to the selected questions.

Reflection

In this phase students have opportunities to:

- compare their views on the topic before and after exploration, questioning and investigation,
- reflect on what has been determined and what needs further exploration.

Example of the interactive teaching and learning approach

At every step of this approach, there must be constant interaction and consultation between the teacher and the student.

Name:

Class

Outcomes

Preparation Phase

Topic:

What do I know about this topic?

What background information do I need?

Exploration Phase

What are some of the things that I am expected to do in this topic?

What are some of the problems I am expected to come across when trying to understand this topic?

How will I explain these to my teacher: as a report, demonstration, role play or oral report?

Students' Questions Phase

Are there other questions that I should ask my teacher about?

Are there any other questions I will need to explore?

Investigations Phase

The following are my findings during and after the investigations

Reflection Phase

The following are my views before and after the exploration.

Approach 3: Predict, observe, explain

This approach is based on students drawing on their own experiences to make predictions. There are three phases in this approach: predict, observe and explain.

Predict

In this phase:

- teachers pose the question and allow time for students to think about and clarify the question,
- students make a prediction and give reasons for their prediction,
- teachers and students accept all predictions without judgement,
- students may change their minds as they share their predictions and reasons.

Observe

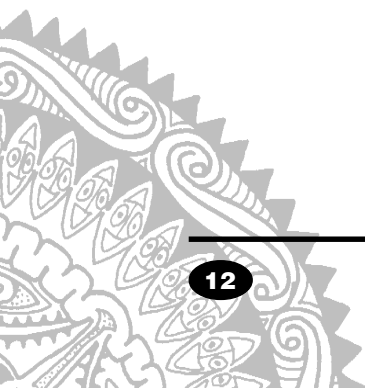
In this phase teachers or students perform relevant activities, either as a class demonstration, in a group or individually, and students record their observations.

Explain

In this phase students attempt to explain their observations which may conflict with their original prediction. Teachers encourage students to reflect on their predictions and modify them to better fit the observations.

Example of the predict, observe, explain teaching and learning approach

Demonstration	Sample Format
<ul style="list-style-type: none"> • You have been provided with: <ul style="list-style-type: none"> – Balloons – Plastic Cups (2) • Blow up a balloon a little way and then have your partner firmly hold two plastic cups against opposite sides of the balloon (the open end of the cups come in contact with the balloon) <p>Now WAIT!</p> <ul style="list-style-type: none"> • Predict what will happen when you fully inflate the balloon and your partner lets go of the cups. Record your predictions and write your reasons for this prediction before you carry out the investigation. <p>Now PROCEED!</p> <ul style="list-style-type: none"> • Fully inflate the balloon and let go of the cups, Observe what happens. • Explain what was observed and your predictions and try to find a solution to any difference between your prediction and observation. 	<p>Prediction</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Reasons for prediction</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>Observation</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>A solution to your prediction and observation , if necessary.</p>



Teaching and learning strategies

This table outlines some student-centred teaching and learning strategies that are appropriate for Science.

Teaching and Learning Strategies	Descriptions and Examples of Strategies
Survey	<p>A survey is usually used to find out what other people think about an issue. It involves interviewing people or giving out questionnaires. Results may be presented as reports, tables or graphs.</p> <p>Examples of survey topics Drinking water supply, household wastes, explaining natural phenomena, uses of plants, traditional Science and effects of drought</p>
Testing predictions	<p>This involves making a prediction and testing it. Choose a problem you want to investigate, carry out background research on the problem and predict what might happen.</p> <p>Examples of issues Energy content of different fuels, effects of soap detergents on the environment, water quality, effectiveness of insecticides, strength of a sling-shot, effects of salt water on plants, what makes a healthy soil.</p>
Collecting and observation	<p>Observing is an open ended activity. Observations may be carried out over a short or long period. Specific or general observations may be made and data collected to be later classified and analysed.</p> <p>Examples of observations Position of sun at sunset, position of Southern Cross, bird study, changes in tides, growth of seedlings, pollution on coral reefs or other areas.</p>
Making models	<p>Models can be used to show a Science concept. Models can be working models or built to scale if they are demonstration models.</p> <p>Examples of models Worm farm, butterfly farm, waste disposal, food drier, making a telescope, weather station and operation, model house circuit.</p>
Excursions and field trips	<p>Excursions and field trips are a valuable and positive addition to any Science program. Science teachers should take every opportunity to study and increase their knowledge of local resources and places suitable for excursions. On any excursion, identify safety measures required to ensure students' safety.</p> <p>Examples of excursions Use the local environment outside the school, both natural and built, and obtain the support of local community agencies, local government departments, conservation groups and local industries and consider local resources and landscapes such as geological formations, rivers, mining sites, fisheries and hydro-electric plants.</p>
Demonstrations	<p>Science demonstration lessons are usually practical lessons where demonstration steps or procedures are outlined and then followed, while others are observing and taking notes. Demonstrations can be conducted by the teacher, students or an expert from a Science related background. Students can then repeat the same demonstration lesson. In any student demonstration, supervision is required at all times.</p>
Projects	<p>Upper Primary Science Projects should focus on practical work carried out by one or more students over a number of lessons. The students can demonstrate physically their understanding of the outcomes in various activities they have chosen to investigate.</p> <p>Examples of projects Studying marine life, pollution or erosion, food sources, weather and climate change, monitoring rainfall, growth of particular plants, animals of the neighbourhood, making an aquarium with fish, snails, water plants, sand and rocks.</p>

Teaching and learning strategies	Descriptions and examples of strategies
<p>Role play</p>	<p>In role play students imitate the behaviour or characteristics of something. For example, they can perform how energy is passed on from one form to another by giving themselves names that represent each type of energy and then upon the word 'go', the student representing the source of energy taps the next student and so on till the last.</p> <p>Examples of role play How energy is passed from one form to another, electrical circuits, behaviour of particles in matter, food chains and food webs, digestive system in action, force and friction.</p>
<p>Peer teaching and learning</p>	<p>This is organised as a partnership activity. One student performs while the other observes and assists in making corrections and suggesting new ideas and changes. The teacher's role in this strategy is to observe as well encourage positive interaction and effective communication through which the intended outcome is achieved.</p> <p>Examples of peer teaching and learning This strategy can be applied in most Science topics.</p>
<p>Group Work</p>	<p>The purpose of group work is to give students opportunities to share ideas and at the same time learn from group members. Every group should have a group leader to supervise the group's activities such as delegating tasks and consulting the teacher. Group work activities can take place anywhere: in the classroom, under a tree, on a riverside, at the beach, in a forest or school garden.</p> <p>Examples of group work This strategy can be applied in most Science topics.</p>
<p>Research</p>	<p>Research involves collection of data and analysing them in order to gain new information or knowledge about a particular subject. Any form of research must be well planned and those who will be involved must be notified well in advance.</p> <p>Examples of research Topics for research could include: common diseases in their local community, certain species of animals that are becoming rare in the local area, erosion of river banks or seashores, food that is unsafe for human consumption, rubbish dumps being a health hazard to the community.</p>
<p>Discussions</p>	<p>Discussions are a way of exploring issues. Discussions can occur between teacher and students and students and students.</p> <p>Examples of discussion topics This strategy can be applied in most Science topics.</p>
<p>Debates</p>	<p>A debate is a fair and formal way of discussing a topic or issue. It normally takes place after preparations from two groups – one for the topic and one against the topic.</p> <p>Examples of debate topics Traditional drugs and medicines are more effective for curing certain diseases. Manufactured food is better than local food. Chemical fertilizers should be used to treat agricultural and commercial crops.</p>
<p>Science clubs</p>	<p>Students with the help from their teachers can form Science clubs within each class, Grade or one for the whole school. The members are responsible for organising Science activities that they wish to explore further. The club does not necessarily need funds to carry out these activities. Students should make use of local resources available in the school or community.</p> <p>Examples of Science Club activities Activities could include organising meetings as well as take part in extra curricular activities that are associated with Science, such as inviting guest speakers to talk to club members, forming a daily bulletin team that places notices on a bulletin board for the whole student body to read for information and producing daily or weekly Science quizzes for interested students.</p>

Teaching and learning strategies	Descriptions and examples of strategies
Science day or night	The Science Club or teachers organise a day or night for the students to show their products and models from Science lessons and to conduct demonstrations for other students, parents and community members. Students are given the opportunity to talk to other students as well as the members of the public to share their learning.
A fair test	A 'fair test' means controlling the variables and changing one variable at a time in order to find out which change causes a particular result. Students observe and record what they see and compare it to what they thought would happen. They ask questions such as why, how and what if? Students then test their models and write up their findings. This strategy is appropriate for introducing students to the nature of a controlled investigation. It requires them to recognise the various kinds of variables. That is, they identify what is to be changed, what is to be measured and what is to be kept the same.
Open investigations	<p>In open investigations students actively engage in all aspects of scientific investigation. Students and teachers are encouraged to identify a problem and ask questions, design and plan relevant activities with clear steps to follow, carry out activities using scientific knowledge, skills and processes to solve the problem, collect results and data and draw conclusions and make decisions for actions and follow-up.</p> <p>Examples of open investigations</p> <p>Experiments, demonstrations, excursions and research.</p>

Sample student worksheets

Planning and reporting worksheet for an short-term open investigation

This sample is useful for activities that require students to work as small groups or individuals during a lesson.

Open Investigation

Name: _____ Class: _____

Other members of the group:

Outcomes:

Step 1: Identify a problem and ask questions

I am going to investigate . . .

What I think will happen . . .

Why I think this will happen . . .

Step 2: Design and plan activities with clear steps to follow

What I am going to do?

What I will need?

Step 3: Carry out activities using scientific knowledge, skills and processes to solve the problem using identified steps outlined in Step 2 above.

How I will make it happen?

Step 4: Collect results and data and draw conclusions

What happened?

Was this what I predicted?

Why did it happen this way?

What was difficult?

How could I improve this investigation?

Step 5: Make decisions for actions and follow up

What will I do next because of my action and decision?

Planning and reporting worksheet for a long-term open investigation

This sample is useful to use in project work and other practical tasks that require a lot more work over a long period.

Open Investigation

Name: _____ Class: _____

Class or Group members:

Stage 1: Getting started: Topic, aim, title

Which method or methods will I use to gather information? Examples could be survey, observations or experiments.

What notes and background knowledge do I need?

Use the points above to develop an aim for your project.

Use the aim to develop a title.

Stage 2: Planning materials, personnel, organisation of activities, safety

How will I carry out the project?

Where will I do most of my work?

Who will I need to contact or work with?

What safety measures are there? These might be measures for approval such as letters

How often will I check with my teacher?

Stage 3: Carrying out task

Carrying out the tasks, asking questions, collecting data, consultations with teacher, checking progress.

Conduct any tests, observations or experiments needed to gather information.

Stage 4: Results and products

Results and products, consultation with teacher, changes made

Show completed task to teacher for further assistance.

Collect and compile test results. This will be completed by . . .

Stage 5: Reporting

Explain processes, products or results through notes, demonstrations, written or oral reports or models.

How do I present my final product?

Planning and reporting worksheet for a fair test

This is useful when students want to see what happens when certain conditions are changed within a test and others are kept as they are.

Open Investigation

Name : _____ Class: _____

Other members of the group:

Outcomes:

What are you going to investigate?

Example: To see how fast a nail will rust if placed in water, saltwater and exposed to the air.

What equipment will you need?

Example: 3 nails, fresh water, saltwater, empty glass

What do you think is going to happen? Explain why?

Example: I think the nail in the saltwater will rust faster than in water and air. This is because saltwater contains chemicals that will make the nail rust faster.

What will I keep the same?

The nail placed in a glass exposed only to the air.

What will I change?

Place one nail in fresh water and the other in saltwater

Draw your set up here.

What will I measure?

Observe each day and record what you see happening to each of the nails.

What happened?

Describe your observations and record your results.

Example: The nail in the saltwater rusted very quickly. This was because saltwater contains substances that helped the nail to rust much faster than in freshwater and when exposed to the air.

Can your results be presented on a graph or a table?

Example: Use graph paper or draw a table from information given above to complete this.

What do your results tell you?

Try to use scientific terms to explain the relationships in this experiment.

Were your findings different from your prediction at the start?

Explain

How can you improve this experiment if you had some difficulties carrying it out?

Assessment

General information on assessment

In an outcomes based approach to education, a student's performance is assessed according to demonstrations of what he or she knows and can do. This approach uses criterion-referenced assessment. Teachers work with students to develop specific assessment criteria for each assessment task that are derived from the learning outcomes. These criteria are used to judge the performance of individual students. Criterion-referenced assessment does not compare the performance of one student to another.

What is assessment?

Assessment is the ongoing process of identifying, gathering and interpreting information about students' achievement of the learning outcomes (*National Assessment and Reporting Policy, 2003*).

Assessment requires that students are able to show what they have learned, they can demonstrate what they know and can do. There is an integral relationship between the experiences that promote learning and the assessment methods that facilitate students' demonstrations of learning outcomes. The assessment process is based on the learning outcomes and assessment methods and instruments are selected by teachers to enable students to demonstrate the knowledge and skills outlined in the outcomes. The experiences provided for students will determine the specific assessment task to be used. To ensure fairness in assessment and reporting, specific assessment criteria are developed by the teacher to suit the assessment task and to describe characteristics of ideal responses.

Purpose of assessment

The purpose of assessment is to improve students' learning and is focused on students' demonstration of learning outcomes. The information obtained from assessment will be used to:

- provide feedback on students' progress,
- inform decision making about student learning,
- improve teaching and learning strategies and the effectiveness of teaching, learning and assessment programs.

The *National Assessment and Reporting Policy* outlines the following purposes for assessment and reporting:

- feedback is provided to the individual learner and the teacher on students' progress towards the achievement of the learning outcomes,
- students improve their standards of achievement by knowing what they do well and where they need to improve,
- evidence gathered from assessments is monitored and used by teachers to improve their teaching and help students raise their standards of achievement,

- assessment information is reported to parents, guardians and other stakeholders to enhance their understanding of students' standards of achievement,
- reports are used to inform students' choices of suitable careers and selection for educational progression and employment.

National Assessment and Reporting Policy, 2003, p. 5

Principles of assessment

Assessment and reporting must be culturally appropriate for Papua New Guinea. For assessment and reporting to be effective, it should:

- focus on students' demonstrations of learning outcomes,
- be comprehensive,
- be valid and reliable,
- take account of the needs of individual students,
- reflect equity principles,
- be an integral part of the teaching and learning process,
- provide opportunities for students to take responsibility for their own learning and to monitor their own progress,
- be based on a criterion-referenced approach.

Upper Primary statement about assessment

The *National Assessment and Reporting Policy* states that assessment at Upper Primary should:

- be flexible and use a range of assessment methods,
- be continuous and show the development of knowledge, skills and understanding in all school subjects,
- use local cultural approaches to assess and report students' achievement where appropriate,
- be mainly internal but may include external assessment at the end of Grade 8,
- use criterion referencing and learning outcomes as the basis of external assessment at the end of Grade 8,
- result in the issue of National Certificates of Basic Education approved by the Board of Studies reporting academic achievement, attitudes, values and other relevant achievements.

Roles and responsibilities

Role of teachers

The *National Assessment and Reporting Policy* (2003) describes teachers' roles in assessment to:

- develop and implement effective school assessment and reporting practices within school assessment and reporting programs,
- discuss with students the assessment, recording and reporting procedures that meet the learning needs of individuals and groups of students,

- develop students' knowledge, skills and understanding of effective assessment and reporting methods,
- maintain and share relevant records of students' progress whilst maintaining confidentiality where appropriate,
- plan tasks and activities which provide sufficient evidence to show that particular learning outcomes have been achieved,
- report students' progress and achievements to students, parents, guardians, teachers and others,
- use assessment information to inform and enhance their teaching and learning practices,
- use assessment information to guide students to career paths,
- make valid reports on students' achievement of outcomes, attitudes and values using the appropriate reporting or certification systems.

Role of students

Students at Upper Primary have the responsibility to:

- use assessment information to improve their learning,
- ensure that they reach their highest potential.

Factors to consider when developing assessment methods and tasks

Below are three factors that may influence teachers' choices of assessment methods and tasks.

1. The experience students have with different assessment methods, tasks and criteria

It is important that students learn how to use different assessment methods and tasks effectively. For example, they need:

- practice in peer assessment and self assessment,
- an understanding of certain features used in written and oral tasks,
- skills in making the best use of time in tests or other assessment tasks.

Familiarity with these methods may give students a degree of ownership of a particular task and a greater willingness to participate actively.

2. Selecting appropriate assessment tasks

Teachers need to select assessment methods and tasks that align with teaching and learning activities. For example, a unit of work that emphasises discussions and presentations will not lend itself well to a pen and paper test.

3. A variety of assessment methods

A variety of assessment methods should be used to take account of students' different levels of understanding, learning styles and backgrounds.

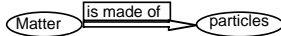
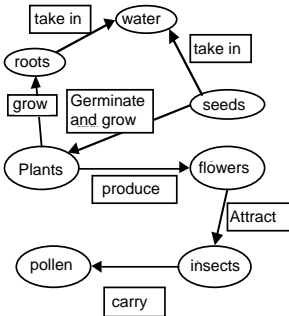

Assessment methods

Assessment methods should be selected according to the context in which the learning outcome is being demonstrated and the type of evidence required. Teachers are encouraged to familiarise students with the methods through modelling and practice.

This table contains various ways of gathering information about students' demonstrations of outcomes. Four main assessment methods are listed with descriptions and examples of appropriate recording methods.

Assessment methods	Description	Recording methods
Observation	Observation is an effective way for gathering information about students' demonstration of outcomes. Teachers monitor students' progress on a given task as they work. Sometimes observation is incidental and takes place as learners participate in activities, or observations are structured to gather particular information.	Anecdotal records Audio tapes and videotapes Checklists (class or individual) Running records Photographs
Consultation	This method involves teachers interacting with students, colleagues, parents, guardians or other relevant people associated with the student. Consultation enriches the teacher's understanding of students' demonstration of outcomes. The information gathered through consultations may confirm or conflict with the teacher's impression when observing students. If it conflicts, then further assessment is needed.	Anecdotal records Checklists (class or individual) Student-teacher discussion or interview notes
Focused analysis	<p>Focused analysis involves teachers in examining specific details and features of students' demonstration of outcomes. Teachers can analyse samples of students' work, either written, oral, products or process skills. Focused analysis can assist teachers to identify and examine the strengths and specific needs of individual students. Examples of learning activities that could be analysed by the teacher appear below.</p> <p>Oral tasks such as <i>group discussion, debates, role play or interviews</i>. Written tasks such as <i>plans, descriptions, information reports, note taking, explanations, reviews or scientific reports, completed worksheets, annotated drawings or journals</i></p> <p>Other products such as <i>concept maps, constructed models, posters, journals</i>. Tests such as <i>multiple-choice tests, diagnostic, tests, short answer tests</i>. Portfolios that include <i>diagrams, maps, drawings, sketches, graphs, photographs, assignments, journal entries, other items of written work</i>.</p>	<p>Student work samples with teacher comments on what they have done well and areas for improvement.</p> <p>Checklists that show how well students met the assessment criteria.</p> <p>Portfolios of students' work showing the progression in their learning.</p>
Peer assessment and self assessment	Peer assessment involves students applying criteria to assess the work of their classmates or peers. They reflect on their own learning by focusing on others' learning. Students should understand the roles they play in peer assessment in order to negotiate, collaborate and be fair to support their peers' achievement of the outcomes. Self assessment provides opportunities for students to monitor their own work progress and to control their own learning. Teachers should communicate with students about their work progress and their views on their own learning. Students are able to reflect on what they have learnt, see their strengths as learners and the areas where they need to improve. They make judgements and decide on ways to improve their learning.	<p>Learning logs</p> <p>Individual checklists</p> <p>Worksheets designed to help students reflect on their learning</p>

Samples of assessment methods, instruments and examples

Assessment method	Recording methods	Sample of the listed recording method																																		
Observation	<p>Class checklist</p> <p>A class checklist can be used to record how well students meet the assessment criteria when working on an assessment task. For example the following code could be used to complete the columns for assessment criteria.</p> <p>H – met the criteria to a high standard S – met the criteria to a satisfactory standard NP - needs further practice</p>	<p>A class checklist with assessment criteria</p> <table border="1"> <thead> <tr> <th rowspan="2">Name</th> <th colspan="4">Assessment criteria</th> <th rowspan="2">Comments</th> </tr> <tr> <th>1</th> <th>2</th> <th>3</th> <th>4</th> </tr> </thead> <tbody> <tr> <td>Anitta</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Moa</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Jay</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Andrea</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	Name	Assessment criteria				Comments	1	2	3	4	Anitta						Moa						Jay						Andrea					
		Name		Assessment criteria					Comments																											
1	2		3	4																																
Anitta																																				
Moa																																				
Jay																																				
Andrea																																				
Consultation	<p>Interview</p>	<p>Interview</p> <p>Interviews can be conducted with students on Science practical work that may assess:</p> <ul style="list-style-type: none"> • understanding of Science facts, • the steps involved in the experiment, • discoveries made, • comparison of the predictions against discoveries, • ability to draw conclusions from the results. 																																		
Focused analysis	<p>Concept maps</p> <p>Concept maps can be used to assess students' understanding of concepts and the relationships that exist within that concept.</p>	<p>Concept maps</p> <p>A simple concept map</p>  <p>A complex concept map</p> 																																		
Peer assessment and self assessment	<p>Learning logs</p> <p>Checklists (class or individual)</p> <p>Journals</p>	<p>Peer assessment.</p> <p>Students can assess each other's Science practical work, by giving informal feedback to each other. They focus on positive comments and areas that might need improvements. Students make these assessments using assessment criteria that have been developed by the teacher or by the teacher and students together.</p> <p>Self assessment</p> <p>Students can keep journals on the Science skills they are good at and those that they need to improve. One example is measuring accurately —</p>  <div style="border: 1px solid black; padding: 5px; display: inline-block;"> <p>I need to improve how I read scales in centimetres</p> </div>																																		

Process for developing specific assessment tasks

Assessment methods are identified during the process of planning a unit of work. The process involves:

- providing students with opportunities to demonstrate what they know, and can do based on the teaching and learning activities and the required learning outcomes,
- gathering and recording evidence of students' demonstrations of the learning outcomes,
- making judgements about students' demonstrations of the learning outcomes.

How to plan and develop assessment tasks

Assessment tasks are an integral part of the students' activities. You will need to select the assessment method that best gives you evidence of students' achievement of the outcomes. Learning outcomes should be used as the starting point in the process of planning assessment tasks. Experienced and creative teachers are encouraged to work with other teachers in improving these steps in terms of identifying suitable assessment methods and developing assessment criteria to meet the needs of the students. When developing or writing an assessment task, the following are some steps that you may find useful to follow.

1. Select students' learning experiences and activities that you will use as assessment tasks while planning the unit of work.
2. Choose which assessment method is most suitable for the assessment task.
3. Develop assessment criteria by breaking down the learning outcomes into knowledge, skills or attitudes students will do in order to complete the activity successfully.
4. Develop a manageable way of recording your assessment information:
 - class checklist or individual checklist, class grid to record observations,
 - comments on students' work showing what they have done well and what they need to improve on,
 - work samples being added to a portfolio,
 - test marks,
 - students' assessment of their own performance using the assessment criteria,
 - student's assessment of their peers using the assessment criteria.

Teachers can also adapt samples from other subjects to develop other assessment tasks.

Demonstration of the steps to develop assessment tasks

Each of the four main steps in the process above are given below, each with sample activities to clarify this.

Step 1: Select students' learning experiences and activities that you will use as assessment tasks while planning of the unit of work.

The sample teaching and learning activities below are from a unit of work for the Strand Earth and Beyond, and address Outcomes 6.4.1, 7.4.1 and 8.4.1. This unit would be suited to a multigrade class of Grades 6, 7 and 8 students.

Teaching and learning activities

- Invite guest speakers such as elders to tell stories and legends on how the earth was made from their cultural point of view.
- Research and present evidence to show that Papua New Guinea was once attached to other continents such as Australia and Asia.
- Research and describe the formation of layers or the internal structure of the Earth. Make a model of the Earth's structure.
- Describe and name rocks according to their physical properties.
- Collect rock samples and compare their properties in order to organise them under some common features, such as hardness, size, colour and weight.
- Research the three main types of rocks: sedimentary, igneous and metamorphic and write a report on how they are formed.
- Identify and discuss differences and similarities between soils from different locations and investigate the formation of soils.
- Describe the effects of wind, rain, sun and ocean waves on the landscape.
- Explain how rocks from the earth's core come up to the surface.
- Explain the effects of the atmosphere such as temperature, weather and rainfall on the earth's surface.

Assessment tasks

The following activities selected from the learning activities above could be developed as assessment tasks for this unit of work.

- Grade 6: make a model of the earth's structure and label it.
- Grade 7: make a model of a local soil profile.
- Grade 8: make a chart showing the formation of the three kinds of rock: sedimentary, igneous and metamorphic. Label the charts correctly.

Step 2: Choose which assessment method is most suitable for the assessment task.

You need to select the assessment method that will best give you the evidence you need to show that students have achieved or partly achieved the selected outcomes in the unit of work. In this unit of work the assessment method to be used is focused analysis and the assessment task is a project that involves making models.

Step 3: Develop assessment criteria by breaking down the learning outcomes into knowledge, skills or attitudes students will do in order to complete the activity successfully.

Sample of Assessment Task

Assessment method: focused analysis

Assessment task: project

The type of investigation selected here is making models, with an assessment task for students in Grades 6, 7 and 8. The processes involved are similar to those used in other investigations and practical work.

Outcome 6.4.1: Investigate the Earth's structure and describe the formation, composition and the cycling of rocks.

Assessment Task for Grade 6

Make a model of the earth's structure and label it.

Assessment Criteria

For a student to successfully demonstrate achievement of this outcome, they must meet the following criteria

- Label in correct order the layers of the Earth
- Draw a rock cycle correctly naming each step of the cycle in the right sequence.
- Identify three ways rock is formed: sedimentary, metamorphic and igneous.
- Describe using appropriate terminology the formation of sedimentary, metamorphic and igneous rocks.
- Identify the mineral composition of three local rock samples.

Step 4: Develop a manageable way of recording your assessment information.

You will need to work out how best to record students' achievement of the outcome. In this case you could use a class checklist with comments to record how well each student met the assessment criteria.

Recording

Recording is what teachers do to collect evidence of students' achievement of the learning outcomes. The *National Assessment and Reporting Policy* (2003) states the purposes of recording are:

- to check students' progress,
- to plan and program future learning,
- to report students' progress or achievement to parents, guardians and others,
- to inform students about their progress (p. 8).

The principles of assessment outlined earlier in this document also apply to reporting.

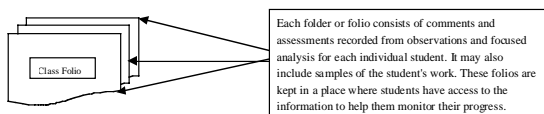
Recording can be done a variety of ways.

Some recording methods include:

- checklists: either whole class or individual,
- anecdotal records,
- journals,
- work samples with teacher comments,
- portfolios.

Samples of recording methods

Student's Folio



Class Checklist

Make up a sheet like this to keep an ongoing record of your students' performance. You enter comments for each stage from observations of students at work. Your comments should address the assessment criteria. List the assessment criteria and develop a code to show how well the students met the criteria. An example of a code appears below:

- A: met the criteria all of the time
- B: met the criteria some of the time
- C: rarely met the criteria.

	Name of student	Assessment criteria 1	Assessment criteria 2	Assessment criteria 3	Assessment criteria 4	Comments
Group 1	Edith	A	B	B	A	
	Theresa					
	Gabby					
	Johel					

A summary sheet for students for a unit of work

A classroom setting that allows the teacher to be the facilitator of learning must allow for students to achieve individual outcomes at their own pace with a range of learning and assessment methods to choose from. The following recording method focuses on students taking some ownership of their own learning.

The record sheet could be given to students at the start of every unit of work. Students like to control what they do. This allows individual learners to manage their own learning. Give students the chance to choose from the range of activities. The order of learning activities should also be flexible where appropriate.

Individual students keep this sheet so that they can keep updated records of completed tasks and both the teacher and student are consistently monitoring information. Students can use the comments column to assess their achievements

Record sheet

Name _____ Class _____ Unit of work _____

Assessment Tasks	Tick each box as you complete activities, along with date finished.						Comments
Investigation							
Worksheets							
Practical work							
Textbook set							
Peer tutoring							
Assignment							
Poster							
Presentation							
Project (Making Model)							

Students may negotiate any of the following:

- timeframe for completing set tasks,
- number of set tasks to be completed,
- how assessment tasks will be presented.

Reporting

Reporting is communicating clearly to students, parents, guardians, teachers and others, the information gained from assessing students' learning

National Assessment and Reporting Policy (2003) .

Teachers can make judgements about students' demonstrations of learning outcomes when they are satisfied that they have sufficient evidence of such demonstrations.

When reporting on a student's demonstration of learning outcomes:

- there should be no reference made to the performance of other students,
- the teacher should only report that the outcomes have been achieved, when students have demonstrated the outcomes consistently, to a high standard and in a range of contexts,
- the teacher needs to base the report on evidence gathered from a variety of assessment methods.

Students, parents and guardians are entitled to receive feedback about students' progress towards achieving the learning outcomes. The information given to the students must be clear, accurate and fair so that all concerned can help students to improve their standard of achievements.

Some forms of reporting include:

- written report cards,
- record cards,
- certificates from both internal and external assessment,
- parent, student, teacher interviews.