U

Programming

A program is a detailed plan developed by teachers to manage teaching and learning activities for their students. The main purpose for programming in Science is to help teachers arrange the content of the course with a set of teaching and learning activities, organised on a yearly, term and weekly basis.

The whole school program

At the start of every year, each school has to decide on a number of systematic and organisational issues before delegating the task of programming to individuals or groups of teachers to develop specific subject programs.

Characteristics of a good program

An effective outcomes-based program:

- maintains a focus on learning outcomes, showing what students must know and do to achieve the outcomes,
- uses time flexibly, so that students with different needs can develop understandings and demonstrate specific outcomes over a period of time,
- uses a variety of teaching and learning strategies so that teachers act as facilitators of learning and cater for different learning styles and individual needs of students,
- emphasises the development of knowledge, skills and attitudes that promote life long learning,
- provides opportunities for students to become effective, self-directed learners,
- enables students to learn in a range of contexts,
- supports learning through the use of a variety of texts, media and real-life materials and resources,
- shows the links between the outcomes, teaching and learning activities and assessment tasks.

When programming, teachers should also take into consideration the following:

- providing a balance of activities including projects, practical work and assignments,
- students' needs and expectations,
- the community calendar and activities,
- unplanned events,
- holidays,
- major school activities.

A Science program

Teachers should use the whole school program to plan the units of work for the term so that a tentative program can be given to supervisors for information. A Science program should contain details of the following elements:

- Strands,
- Sub- strands,
- Outcomes,
- Units of work and topics,
- Timeframes,
- Teaching and learning activities,
- Assessment plans.

Syllabus considerations

The Syllabus is structured in a way that it allows for flexibility when planning the term or yearly program. The program you develop should cater for the needs of individual students, the school and community. It is essential that Science programs do the following:

- draw from all Strands in Science as well as other subjects in integrated units of work,
- build on knowledge, skills, attitudes, issues and general understanding of all Strands,
- promote Science processes and inquiry techniques to prepare students for becoming active participants in society.

Program samples

Yearly Program

The table below shows a sample format to organise a yearly program by terms. Insert Substrands into each column, showing how many weeks will be spent on each Substrand.

	Term 1	Term 2	Term 3	Term 4
Strand				
Living Things				
Science in the Home				
Earth and Beyond				

Time allocations

Some possible time allocations for lessons are given below to show how the 180 minutes per week can be programmed. Teachers will need to allocate lesson times according to the needs of the students and school. The Science weekly program could consist of:

- 2 x 60-minute and 2 x 30-minute lessons = 4 lessons per week
- 3 x 40-minute and 1 x 60-minute lesson = 4 lessons per week
- 4 x 30-minute and 1 x 60-minute lesson = 5 lessons per week
- 3 x 60-minute lessons = 3 lessons per week

Elaboration of outcomes

The elaborations of the outcomes are designed to help teachers understand the content of the outcomes so that they can develop teaching and learning activities that meet the needs of their students. The elaborations describe for each learning outcome:

- recommended knowledge,
- recommended processes and skills,
- suggested activities.

Recommended knowledge

Knowledge is what the students are expected to know and understand.

Science knowledge and concepts are identified from the outcomes and are given as short phrases or statements under 'Recommended knowledge'. The knowledge listed in the elaborations can be used by teachers to create units of work that are relevant to students' needs and local contexts.

Recommended processes,skills and suggested activities

The processes and skills section of the elaborations can be used by teachers to plan practical activities from the outcome statements where students apply the skills necessary for working scientifically. The list of skills for each outcome is not meant to be exhaustive, giving teachers the choice to incorporate other skills relevant to working scientifically.

For each of the outcomes there a list of teaching and learning activities that teachers can use to develop students' understanding of the outcome. These are best placed within the contexts of units of work. Again these lists are not exhaustive but simply provide a few suggestions for teachers.

Attitudes

The students should have a sense of identity and responsibility towards their environment and the resources that they have around them. They must conserve and value these resources and protect them as much as possible so that they are available for the future generation to use and enjoy.

The Science course should encourage students to:

- be responsible and self-reliant,
- think clearly and sensibly about the changes in the environment and then set their own goals and choose their own behaviours,
- demonstrate a willingness to work individually and as part of the group,
- show interest in the world around them and be curious to find out more about it,
- be able to cope with changes and make wise decisions about the things that are happening around them,

- take pride in their own culture and achievements, and show respect for themselves, their family and other individuals and groups,
- follow their individual interests,
- enjoy learning Science,
- see a variety of real purposes for their school work,
- appreciate their local environment and the traditional knowledge that relates to it,
- have confidence in their own problem-solving abilities,
- preserve and value their environment.

Processes and skills related to working scientifically

The table below lists recommended processes and skills associated with working scientifically, providing brief descriptions, examples and links to outcomes in the Science Syllabus. The outcome numbers are indicated. The skills and processes have been purposely grouped into *investigating, comprehending* and *communicating*.

The recommended processes and skills relate to the Strand Working Scientifically, described in outcomes 6.1.1, 7.1.1 and 8.1.1. The processes and skills have been organised under three main headings: investigation skills, comprehension skills, communication skills.

Skills	Descriptions	Examples of teaching and learning activities	Links to outcomes
1. Investigation skills			
Observing	The collecting of information using the senses: touch, smell, taste, sight and hearing.	Use the senses to make observations: • is the water warm?(touch), • is the lemon bitter?(taste), • describe the odour of a rotten egg (smell), • which leaf comes from the coconut palm? (sight), • identify these musical instruments from the sounds they produce (hearing).	**Grade 6:** 6.2.1, 6.4.2 **Grade 7:** 7.2.1, 7.4.1, 7.4.2 **Grade 8:** 8.2.1, 8.3.2, 8.4.2
Classifying	The information collected is categorised according to properties.	Classify: • objects according to size and weight, • substances according to solubility, • substances as solid, liquid or gas, • things as living or non-living.	**Grade 6:** 6.2.1, 6.3.1, 6.3.2 **Grade 7:** 7.2.1, 7.3.1, **Grade 8:** 8.3.1
Measuring	Measurements are taken to quantify size such as the *capacity* of a glass, *dimensions* of a box, *mass* of a brick, *energy* – temperature of water in a kettle.	Measuring: • height of a plant in its various stages of growth, • weight of an animal in different stages of growth, • temperature at different times of the day, • heat absorbed by different matter, • quantity of detergent or chemicals needed for washing.	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4.1, 6.4.2 **Grade 7:** 7.2.2, 7.3.1, 7.3.3, 7.3.4, 7.4.1, 7.4.2 **Grade 8:** 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.4.2

Skills	Descriptions	Examples of teaching and learning activities	Links to outcomes
Predicting	Examine a given situation and make a forecast as to what might happen next, based on observations, prior knowledge and experience.	This is done through extending trends or verifying patterns to predict events such as: • when the wet season is likely to begin, • when it is time for planting and harvesting certain food crops, • tides and the best time for fishing, • the life cycle of a living thing.	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4.2 **Grade 7:** 7.2.1, 7.2.2, 7.3.2, 7.3.3, 7.3.4, 7.4.1, 7.4.2 **Grade 8:** 8.2.1, 8.2.2, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.4.1, 8.4.2
Problem-solving	Problem solving involves the students suggesting a range of options to solve a problem. They then select the most suitable option by analysing collected information, testing the solution by experiment and drawing conclusions.	Formulating a hypothesis and designing a fair test or experiment. Examples include finding solutions to problems such as: • lifting a heavy load onto the back of the truck, • using environmentally friendly methods of removing waste materials, • connecting an electrical circuit.	**Grade 6:** All outcomes **Grade 7:** All outcomes **Grade 8:** All outcomes
Investigating	Experiments are designed to explore the hypothesis through verification. Data is collected, organised, analysed and conclusions are drawn. Conclusions reflect on the accuracy of the hypothesis.	Designing an investigation or experiment: • that examines the effects of sunlight on plant growth, • that demonstrates how shape of the boat and sails affects the speed of a lagatoi, • that demonstrates how energy can change from one form to another, • to find what type of soil is best for growing kaukau, • to find out what material is best for making a saw dust stove.	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4.1, 6.4.2. **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.1, 7.4.2. **Grade 8:** 8.2.1, 8.2.2, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.4.1, 8.4.2.
Planning	Organising ideas, data and research materials into sequential or logical formats allowing for investigation, experimentation and research.	Appropriate processes for organising and presenting information when working scientifically include: • demonstrations, • research projects, • discussions, • designing and constructing models, • experiments that use the inquiry method, scientific methods, 5Es Model and open investigations.	**Grade 6:** All Outcomes **Grade 7**: All Outcomes **Grade 8:** All Outcomes **Also use Section 3 on Teaching and Learning Strategies*

Skills	Descriptions	Examples of teaching and learning activities	Links to Outcomes
2. Comprehension skills			
Thinking critically	Develop the ability to think with purpose.	Formulate scientific responses as to why and how things happen in the living and non-living world. Some examples of activities that require students to think critically: • develop an explanation as to why moulds grow on bread, • develop a convincing argument that supports the use of friction in transport systems such as cars, • suggest new ways of generating electricity.	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4.2 **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.1, 7.4.2. **Grade 8:** 8.2.1, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.4.1, 8.4.2.
Drawing conclusions	Drawing conclusions requires students to examine a given situation and formulate reasonable conclusions, based on prior knowledge, experience, collected information and experimentation.	Students could draw the following conclusions after using the processes described: • a green and hard banana is unripe, • aching joints, fever and headaches are signs of malaria, • the sounds certain insects and birds make suggest the coming of rain according to traditional beliefs.	**Grade 6:** All Outcomes **Grade 7:** All Outcomes **Grade 8:** All Outcomes
Working safely	When involved in experiments, excursions and field trips students should have knowledge of the hazards associated with these activities as well as the appropriate safety procedures and practices.	Hazardous activities need to be identified. If students are participating in activities that are potentially dangerous, their safety must be considered through a well thought out set of safety rules and procedures. Examples of activities that require safety rules: • all experiments involving potentially hazardous materials or substances, • role plays that involve extreme physical activity, • the use of tools, sharp instruments and simple machines, • bushwalking, • the use of electricity or flames to heat substances.	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.3.4, 6.4.1 **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.4, 7.4.1, 7.4.2. **Grade 8:** 8.2.2, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.4.1, 8.4.2.
Developing Questions	Being able to reason and formulate questions that can be investigated and or researched. Questions and questioning techniques become more complex as students progress to higher grades.	Asking why and how things happen. Deciding on a problem to investigate such as: • How does changing the wheel size on a wheelbarrow make it easier to push? • How does the position of a seed in soil affect the direction in which the roots grow? • Why would adding more batteries to an existing circuit make a torch bulb shine brighter? • Why would a tomato plant grow better if positioned on the sunny side of a fence?	**Grade 6:** 6.2.1, 6.2.2, 6.3.1, 6.3.2, 6.3.3, 6.4.1, 6.4.2. **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.5. **Grade 8:** 8.2.1, 8.2.2, 83.1, 8.3.2, 8.3.3, 8.3.5, 8.4.1, 8.4.2.

Skills	Descriptions	Examples of teaching and learning activities	Links to outcomes
Working Cooperatively	Having the capacity and skills to work in varied groups or as individuals in a classroom setting.	Students may be grouped in a range of ways in the classroom and will need to develop skills in working cooperatively such as: sharing equipment, listening to each other, making suggestions on what to do next, completing tasks allocated to them, providing feedback to other group members.	**Grade 6:** All **Grade 7:** All **Grade 8:** All
Initiating	Students need to be responsible for their own learning by putting self-confidence, commitment, knowledge and skills into best practice. They need to be proactive in their learning.	Students can initiate activities such as: • making and designing their own models of a volcano, racing cart or the solar system, • formulating traditional steps involved in herbal cures of diseases, • creating scientific games to illustrate a scientific concept, • formulating their individual portfolio, • planning and conducting an investigation.	**Grade 6:** All **Grade 7:** All **Grade 8:** All
3. Communication skills			
Oral skills	Communicate orally about a variety of scientific concepts using recognised scientific terminology.	Students may use oral communication skills to: • use vernacular and English to describe certain situations, • discuss ideas and findings with their peers, teachers and community members.	**Grade 6:** All **Grade 7:** All **Grade 8:** All
Auditory skills	Develop highly tuned listening skills.	Students may use auditory skills to: • respond to instructions, • accurately collect information from verbal sources such as discussions or listening to guest speakers.	**Grade 6:** All **Grade 7:** All **Grade 8:** All
Reading comprehension	Read and understand information from a wide variety of print materials.	Students read and understand concepts and ideas from books, newspapers, magazines, internet and other assorted print media and present these in different ways such as on posters, reports, reviews or debates.	**Grade 6:** 6.2.1, 6.2.2, 6.3.2, 6.3.3, 6.3.4, 6.3.5, 6.4.1, 6.4.2 **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.3.3, 7.3.4, 7.3.5, 7.4.1, 7.4.2 **Grade 8:** 8.2.2, 8.3.1, 8.3.2, 8.3.3, 8.3.4, 8.3.5, 8.4.1, 8.4.2
Writing	Communicate scientific data in a range of written formats. **Normal writing of notes is encouraged throughout*	Examples of written formats suitable for Science include: • scientific reports, • experiments, • projects, • reviews, • summaries, • diary entries, • student portfolios.	**Grade 6:** 6.3.1, 6.3.2 **Grade 7:** 7.3.1, 7.3.2, 7.3.3 **Grade 8:** 8.3.1, 8.3.2, 8.3.3

Skills	Descriptions	Examples of teaching and learning activities	Links to outcomes
Organising Data	Being able to organise information in a scientific manner.	Examples of ways to organise data include: • constructing graphs and tables, • presenting information as posters, projects and reports, labelled illustrations and diagrams, • identify and use appropriate computer software.	**Grade 6:** 6.2.1, 6.2.2, 6.3.4, 6.3.5, 6.4.1, 6.4.2. **Grade 7:** 7.2.1, 7.2.2, 7.3.4, 7.3.5, 7.4.1, 7.4.2. **Grade 8:** 8.2.1, 8.2.2, 8.3.4, 8.3.5, 8.4.1, 8.4.2.
Constructing Models	Design and construct models to communicate understanding of different Science concepts.	Examples of models include: • designing and constructing a model of a boat to investigate buoyancy, • constructing a model to clarify a research project such as a molecule, windmill, volcano.	**Grade 6:** 6.2.1, 6.2.2, 6.3.3, 6.3.4, 6.4.1. **Grade 7:** 7.2.1, 7.2.2, 7.3.1, 7.3.2, 7.4.1, 7.4.2. **Grade 8:** 8.2.1, 8.3.1, 8.3.3, 8.3.4, 8.4.1, 8.4.2.

Elaboration of outcomes

Strand: Living Things

Substrand	Grade 6	Grade 7	Grade 8
Nature of Living Things	**6.2.1** Identify the basic structure of living things that allow them to function in their environment	**7.2.1** Identify and compare the basic structure of living things and how they allow them to function in their environment	**8.2.1** Describe and explain the processes of reproduction in living things and how the environment influences these processes
	Recommended knowledge *Grouping of living things* Living things are mainly grouped into two kingdoms: Plants and Animals Animals form two major groups invertebrates (those with no backbones such as snails, crabs, insects) and vertebrates (those with a backbone such as dogs, cuscus, humans).Vertebrates are grouped into birds, mammals, fish, reptiles, amphibians≥. Plants form two major groups: Flowering plants (those that produce flowers such as orchids) and non-flowering plants (those that do not produce flowers such as algae, fungi, mosses, ferns. Some living things are neither plant nor animal and are placed in a kingdom of their own *Basic structure of living things* • all plants and animals are made up of cells • all cells have a nucleus that controls the cells and are made up of a complex substance called cytoplasm • animal cells are surrounded by a cell membrane • plant cells are surrounded by a cell membrane and a cell wall • some plant cells contain a green substance called chlorophyll **Recommended processes, skills and suggested activities** • to communicate ideas illustrate structures by drawing posters and use scientific terminology to label plant and animal cells • design and make models of plant and animal cells • conduct simple experiment about senses and make observations • identify basic sources and research animals with senses and write reports, such as highly developed animal like sharks, whales, bats, eagles • discuss and describe ideas and plan and carry out an excursion to investigate a local animal	**Recommended knowledge** *Basic structure of living things* Include: • sensory organs that detect changes in the environment such as skin (touch, temperature), eyes (sight), nose (smell), ears (hearing), tongue (taste). • vertebrates have internal skeletons (sometimes also external skeletons such as turtles) Some invertebrates have external skeletons such as crabs and beetles • animals' body coverings such as feathers, fur, shells and scaly skin to suit different surroundings. Some protect and keep animals warm; some detect changes in the environment. Plants are sometimes covered with hairs, some are sticky, some smooth and some are shiny. • specific adaptations include fish gills for oxygen, birds' wings and feathers for flight. Plants' leaves capture light energy. Roots collect water and minerals. Stems transport nutrients • fungi and bacteria help things decay and can be harmful to living things *Living things have special organs that help them function* Including: • digestion: physical and chemical break down of food Function of teeth, tongue, mouth, oesophagus, stomach, liver, small and large intestine, anus • respiration: function of nose, mouth, trachea, bronchi (air tubes), air sacs (alveoli) **Recommended processes, skills and suggested activities** • select living things, collect data and research how body coverings are designed and prepare report to present to the class • investigate digestive systems, draw and label different parts and their functions, and note similarities and differences	**Recommended knowledge** *Structure and function of male and female reproductive system* • female: labia, vagina, uterus, egg tubes (fallopian tubes) ovary, ovum, cervix • male: penis, urethra, scrotum, testis *Environment and reproduction* • sexual behaviours and patterns depend on the type of environment — the wet season is suitable for frogs to mate; plants produce flowers at particular times that attract insects or birds that pollinate flowers Seeds are produced at certain times and attract birds and insects that spread them **Recommended processes, skills and suggested activities** • draw reproductive structures and describe parts and functions • explain fertilisation • compare and contrast a variety of reproductive structures of animals • describe interactions and relationships between plants and animals such as flowers and insects • identify and observe patterns of reproduction in an animal or plant and compile a folio of how it reproduces and when, reasons why and competitions for mates • plan and design a folio of reproductive structures • observe a life cycle of a living thing in order to produce a folio with observations and results to establish a pattern for other purposes such as breeding season • analyse information and find out about human life cycle: birth, growth, death and other animals' life cycles such as a frog or butterfly and the life cycle of a flowering plant

Substrand	Grade 6	Grade 7	Grade 8
Ecology Relation-ships and Inter-actions	6.2.2 Using a diagram describe how energy moves through the living and non-living community	7.2.2 Interpret and discuss relationships that exist in a community, using a food web to show human activity in that community	8.2.2 Draw conclusions regarding the effects of excessive use of non-biodegradable materials on food webs

Recommended knowledge

Energy

Including:

- forms of energy: sound, light, heat, chemical, kinetic
- sources of energy: food, wind, sun, fire, lantern, candle, match, torch, electricity
- energy relationships: solar (sun), chemical (from food), heat or kinetic (animals including humans)

Relationships between plants and animals

- introduce the idea of a food chain. Emphasise all food chains start with a green plant because they make food, which contains energy for life
- track the passage of energy through a food chain starting with sunlight used by producers (green plants such as grass and corn) to consumers (animals such grasshopper then frog)
- relationship in a food chain: grass > grasshopper > frog > snake > hawk

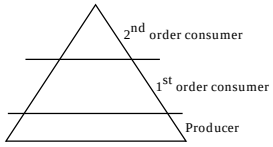
Recommended processes, skills and suggested activites

- draw a poster to illustrate the steps in a food chain from producer to top consumer
- observe plants and animals in the grounds or near surroundings and construct a food chain from your observations.

Recommended knowledge

Interactions between environment and organisms

- plant kingdom includes all organisms that can make food from carbon dioxide and water, using the energy of sunlight
- producers (green plants) and consumers (animals) and their relationship
- introduce idea of pyramid of biomass that shows producers at the base leads to top order consumer at the peak



- consider what would happen if the pyramid of biomass was reversed with the narrow peak at the bottom for producers, that is, not enough producers to feed all the consumers
- construct food webs – first combine simple food chains
- interactions within the environment such as competition for food, shelter, oxygen and space
- prey and predator relationships

Recommended processes, skills and suggested activites

- identify members of a simple food web including humans and discuss the feeding relationships in the food web
- collect data and make a chart of a food web including humans
- place members of a food web in order from producer to top order consumer
- research feeding relationships in an environment such as school garden, forest, lake, swamp, creek, mountain, valley, treetop
- identify predators and prey in the school garden, forest, lake, swamp, creek, mountain, valley, treetop

Recommended knowledge

Natural and processed materials

- identify materials that are biodegradable– plants, animals, organisms' wastes, chemicals, paper products, food and some plastics
- identify non-biodegradable materials – many plastics, glass, metals and chemicals: DDT, CFC
- identify non-biodegradable wastes from human activity such as insecticides and weedicides such as DDT that builds up in food chains and can harm organisms along the food chain

Man and environment

- consider how the use of dangerous chemicals and wastes affects food webs including those with humans: insecticides, pesticides, chemicals for mining and factories, sewage into seas and water ways, smog in the air

Recommended processes, skills and suggested activites

- plan and conduct a fair test on materials to find out if they are biodegradable or non-biodegradable, analyse the data, draw conclusions and then write a report about the findings
- plan and conduct a survey to collect data about the use of certain materials in the community Analyse these data and raise community awareness on the positive and negative impact of these materials
- invite a guest speaker to give a talk on the impact of biodegradable and non-biodegradable materials in the community
- invite a guest speaker to talk about what can be done to reduce the impact of human activities such as mining, fishing, logging, industrial activities, road building

Strand: Science in the home

Substrand	Grade 6	Grade 7	Grade 8
Learning about Substances	**6.3.1** Identify and organise common substances into groups according to physical properties	**7.3.1** Explain the structure and behaviour of matter in terms of the particles from which it is made	**8.3.1** Conduct investigations and use collected data to identify patterns in the physical interactions of substances

Recommended knowledge

Common Substances:

Including identifying:

- common substances used in factories or industries such as grease, lubricating oils
- common manufactured substances such as detergents, make ups, perfumes, soap
- common natural substances such as crude oil, palm oil, herbs, plant dyes, rubber

Use of Common Substances

- describe the properties of common substances such as cooking pots, detergents, cooking oil, perfumes, sprays, kerosene, petrol, wood, bush knives, plastic bags, newspaper, soap

Recommended processes and skills and suggested activities

- identify common substances in the home and discuss their properties
- classify common substances into groups according to whether they are solids, liquids or gases
- classify common substances according to their properties

Recommended knowledge

Structure and behaviour of matter

Explain that matter:

- is any thing that has mass such as a book, water
- is made up minute particles called atoms that are always in motion
- exists as a solid, liquid or a gas and occupies space in different ways and these can be changed from one form into the other, for example, water can be solid (ice), liquid (water) or gas (water vapour)

Explain:

- solids are made up of particles called atoms packed very tightly together These particles are so close together they can only vibrate - wood, cement, iron, paper, chemicals
- liquids are made up of atoms with more space between them than solids and the particles have more space to move: water, cordial, kerosene, detergents, alcohol
- gases are made up of atoms that are much further apart than in most liquids at normal temperature and pressure and the particles move about quite rapidly : oxygen, nitrogen, water vapour, carbon dioxide
- what a solution is and types of solutions: saturated, unsaturated, strong and weak solutions

Recommended processes, skills and suggested activities

- construct simple models using local materials such as clay to illustrate the particle structure of solids, liquids and gases
- describe structure and behaviour of matter
- compare physical properties of matter

Recommended knowledge

Physical properties of:

Solids:

- properties of solids such as different metals, wood for hardness, weight, density, does it bend or is it brittle, colour, solubility (will it dissolve in water), floating and sinking
- most metals are lustrous (shiny), are good conductors of heat and electricity

Liquids:

- are fluid at normal temperature and pressure and other properties such as density, ability to dissolve solids,

Gases:

- vapour at normal temperature and pressure and other properties such as density,

Recommended processes, skills and suggested activities

- observe the properties of solids, liquids and gases
- test the properties of different materials

Substrand	Grade 6	Grade 7	Grade 8
Learning about substances	**6.3.2** Conduct practical investigations into the nature of mixtures and communicate their findings in a scientific way using available materials	**7.3.2** Compare the properties of materials before and after physical and chemical changes and identify patterns in the types of changes that take place in the materials used	**8.3.2** Identify and collect basic and acidic substances found in nature and use this data to elaborate on how these can be used to benefit the community
	Recommended knowledge *Mixtures* • identify types of mixtures and why they are called mixtures Mixtures are two or more substances that can be separated by physical means When substances combine they form compounds and these can only be separated by chemical means Mixtures can be formed by mixing solids with solids (sand and iron filings), solids with liquids (sand and water), liquids with liquids (water and cordial), liquids with gases (water and oxygen), gases with solids (soil), gases with gases (air) • distinguish between solutions and suspensions • conduct experiments to separate different mixtures using filtration, decantation, evaporation and magnetism *Important mixtures* Include: • herbal paints and how to mix them • traditional paints - lime, crushed rocks, clay, soil • traditional and modern paints and dyes • sago and water, tea and water **Recommended processes, skills and suggested activities** • identify, collect and analyse common mixtures from the community • conduct experiments on mixtures using various separation techniques • design and describe a test on common mixtures -- detergents, lipstick, traditional dyes and paints • research useful substances that can be mixed and used for certain purposes and occasions	**Recommended knowledge** *Properties of materials* • physical propeies of materials - hardness, weight, density, bend easily, stretch into wire (ductile), lustre (shiny or dull) • physical changes in matter: no new substance formed • chemical changes in matter: new substance formed • chemical changes require energy and may produce heat energy • demonstrate physical and chemical changes *Simple word equations*• • equations such as - carbon + oxygen = carbon dioxide • use correct signs and symbols in a word equation such as + reacts with, = produces, • use of correct terms: reactants and products **Recommended processes, skills and suggested activities** • collect materials and classify these according to their physical properties • find out how different substances are combined chemically to produce new materials • investigate substances that can be combined using heat	**Recommended knowledge** *Basic and acidic substances in nature* • test substance as basic: using litmus paper or home made plant dyes • test substances as acidic: using litmus paper or home made plant dyes *Uses of basic and acidic substances* • uses of acids and bases • simple chart of pH values and scales and how these are used eg soil testing • common laboratory acids and gases, HCl, H_2SO_4, NH_3, NaOH • demonstrate neutralisation process: Acid + Base = Salt + Water **Recommended processes, skills and suggested activities** • collect substances and use simple tests to determine whether they are acidic or basic • research the usefulness and dangers of acidic and basic substances in the community • conduct simple experiments and make observations about the reactions between diluted acids and bases

Substrand	Grade 6	Grade 7	Grade 8
Using Energy at Home	**6.3.3** Identify and describe the sources and the types of energy	**7.3.3** Investigate how energy changes from one form to another	**8.3.3** Apply their knowledge about energy to investigate electrical and heat energy in the home
	Recommended knowledge *Sources of Energy* • identify energy sources: sun, battery, fuel, chemical, electricity, fire, food *Types of Energy* • heat: fire, sun, fuel, chemicals, electricity • light: fire, sun, fuel, chemicals, electricity • sound • electricity • kinetic and potential energy, generation of hydro electric power *Energy transformations, change at home* • include burning wood, hydro-electricity, kerosene lanterns, candles, moving car, bow and arrow, man on bicycle, torch, various machines • investigate the energy changes in each of the following steps: burning wood: chemical changes: heat and light *Uses of energy in the home* • include light for reading, electricity for heating, light, communication, cooking, burning for cooking, warmth, making metals hot to shape them **Recommended processes and skills and suggested activities** • identify energy sources • collect information about effective machines for generating energy • construct a simple model of hydroelectric power and label sources of energy • identify and describe how simple machines can be used at home to assist with work • identify the five types of machines such as levers, pulleys, inclined, planes and axle • identify energy sources and explain how they can be used	**Recommended knowledge** *Using heat, light and sound energy* • investigate ways energy is used by humans such as light produced by the sun helps us to wake up in the morning; heat used in homes, factories, stores, gardens, workplace *Simple machines* • consider simple machines make work easier in homes such as levers, wedges, spanner, tin snips, scrapers, hammer, tongs • identify the energy changes that take place when using simple machines *Friction* • friction is a force that opposes motion Consider machines and friction and the advantages and disadvantages of friction **Recommended processes, skills and suggested activities** • observe and identify energy changes from one form to another in local community such as light in cooking • research the beneficial and harmful effects of heat and light on things around them • design and make simple machines to do work • write a report to communicate about the impact of simple machines on others	**Recommended knowledge** *Force, work and energy* • qualities that can be measured using force meter, spring balance, scales • taking measurements: 100g = 1 N (100 grams = 1 Newton) • friction can be useful but costly: useful when striking a match or when applying a brake in a vehicle, costly because friction slows things down and energy use has to be increased to keep things moving against frictional force • energy is measured in joules (J) *Methods of applying and controlling heat* • heat in real life situations: cooking, burning, drying, smoking, solar heater • methods of controlling heat • measuring temperature using a thermometer (degrees Celsius) *Electrical circuits* • electrical energy is generated from other sources of energy such as solar, hydro and used to produce light and heat • sources of electricity: battery, solar, hydro, fuel • make a simple circuit using wire, battery and light bulb • simple electrical circuit: a circuit is a path through which electricity can flow. Not all matter conducts electricity. Most conductors of electricity are metals. The flow can be a direct current (DC) from a battery or alternating current (AC) from a generator like a motor **Recommended processes skills and suggested activities** • research how simple machines work • make a simple motor to generate an AC current • describe how electricity is generated in a car, at a hydroelectric power station, by a windmill

Substrand	Grade 6	Grade 7	Grade 8
Using Energy at Home	**6.3.4** Identify and describe the nature of force as being a push or a pull	**7.3.4** Investigate how we use force in everyday life	**8.3.4** Apply their knowledge about force to investigate simple machines
	Recommended knowledge *Force* • a force is a pull or a push • types of forces • a force can make objects move • push, pull *Forces in action* • applying forces: model car, tug of war, holding a flag, pulling up an anchor, flying a kite • pushing forces (what is doing the pushing?) • pulling forces (what is doing the pulling?) • balance and unbalanced forces (tug of war) **Recommended processes, skills and suggested activities** • demonstrate that force is needed to move something • demonstrate that force can make things change direction • draw pictures and explain how and why applying force can have effects on an object • investigate force and ways of reducing force • differentiate between forces • design and perform experiments to distinguish between forces • play with objects to discover forces • research the nature of forces	**Recommended knowledge** *Forces in everyday life* • gravitational force • atmospheric pressure • forces that slow things down • forces that speed things up • forces that change direction of a moving object **Recommended processes, skills and suggested activities** • discuss different types of forces • design a series of experiments to test forces • research different types of forces and the positive and negative effects on the lives of people in the community • investigate nearby places to find out where forces are applied such as in factories, stores, workshops, roadwork sites, wharves, local communities, local river or sea	**Recommended knowledge** *Simple machines* • mechanical advantages: energy not lost or gained but only changed to another form • calculating mechanical advantages • measuring forces: forces and formula (W = F x D) • pulleys and forces **Recommended processes, skills and suggested activities** • problem solving • calculate mechanical advantages • describe how forces are applied • use formula correctly • design experiment and test how lever is applied to move a heavy object: label and give distances in order to calculate moving formula • design and test experiments to test how objects can move and change directions: with values or measurements given for calculation • excursions to such places as wharves or garages to see how pulleys are applied

Substrand	Grade 6	Grade 7	Grade 8
Using Energy at Home	**6.3.5** Identify and explain how simple machines can be used in homes and the community to do work	**7.3.5** Identify and make recommendations on how simple machines can make life easier through community field study	**8.3.5** Conduct investigations on simple machines and use problem-solving skills to establish the efficiency of the machine as a tool to do work
	Recommended knowledge *Types of Simple Machines* how the following simple machines are used in the home and community • levers: how used, what is it • pulleys: how used and function • axle: how used and function • gears: how used and function **Recommended processes, skills and suggested activities** • draw posters or make models of types of simple machines and explain how they are used	**Recommended knowledge** *Application of simple machines* • conduct a survey of the local community and list all the simple machines that are being used such as gardening tools, lights, different motors. Identify how these machines make life easier for the community **Recommended processes and skills and suggested activities** • carry out a survey on the way simple machines are used to do work at home	**Recommended knowledge** **Machines and efficiency** • identify the parts of machines and their functions • explain how the efficiency of machines can be calculated **Recommended processes skills and suggested activities** • calculate the mechanical advantage of simple machines using equations and formulae

Strand: Earth and Beyond

Substrand	Grade 6	Grade 7	Grade 8
Our Earth and its Origin	**6.4.1** Investigate the Earth's structure and describe the formation, composition and the cycling of rocks	**7.4.1** Collect data of the sedimentation process and observe the presence of fossils to explain the living past, using a variety of sources, including first hand experiences	**8.4.1** Demonstrate the formation of igneous and metamorphic rocks and relate findings about the properties of rocks to the ways they are used
	Recommended knowledge *Formation of the Earth* • how the Earth was formed – legends, myths, stories, scientific facts *Structure and composition of the Earth* • crust: soil, rocks, plants, oceans, mountains, continents • mantle: molten rocks (magma) • outer core: solid rocks • inner core: liquid rocks *Soil formation* • how are soil formed? Sand, silt, mud, remains of plants and animals *Rock formation* • how different rocks are made shape, colour, size, hardness, weight (rock cycle): obsidian, clay, limestone, stone axe **Recommended processes, skills and suggested activities** • draw structure of the Earth and label • design and make a model of the Earth • collect rock samples • describe rock and soil samples • define scientific terminology • interview and compile stories, legends and myths related to the formation of the Earth • design and make model of the Earth and identify layers by labelling • investigate how soil is made using models of road cuttings, hill sides or along rivers • collect and make rock profiles of their physical characteristics • carry out an excursion to a mountain side, road side or volcanic site to observe different types of rocks and how they are formed	**Recommended knowledge** *Sedimentation process* • weathering • erosion • transportation • deposition *Past evidence in rocks* • sedimentary, metamorphic rocks • fossils **Recommended processes, skills and suggested activities** • draw and design models of the sedimentation process • carry out experiments to test models • identify types of rocks • describe how fossils are formed • design and make models of the fossilisation process • research, design, make models to explain the process of sedimentation • investigate how fossils are made over a long period of time • research for evidence to explain the living past	**Recommended knowledge** *Formation of rocks* • igneous, metamorphic, sedimentary *Rock classification* • basic groupings of rocks: minerals, tools, others **Recommended processes, skills and suggested activities** • explain rock components • examine structures of rocks • classify rocks • identify uses of rocks • research on Papua New Guinea's precious minerals • design a model to explain how rocks are formed and label steps • investigate how rocks change from one form to another • research the usefulness of rocks and relate their uses to everyday lives including roads, buildings, soil • research Papua New Guinea's mineral wealth

Substrand	Grade 6	Grade 7	Grade 8
Space Exploration	**6.4.2** Identify and describe familiar events such as star patterns and moon phases	**7.4.2** Investigate the interactions between the Earth, Moon and Sun	**8.4.2** Collect information about human exploration into space
	Recommended knowledge *Stars in the sky* • traditional beliefs of creation, myths, stories • star patterns: traditional names, patterns, movements • observing the night sky: movement of groups of stars, shooting stars *Phases of the Moon* • moon phases: gibbous, new, crescent, full • tides and gravity: low, high • effects of moon phases on daily lives • traditional calendar: navigation, fishing, hunting, feastings, harvesting, planting **Recommended processes, skills and suggested activities** • tell and write traditional stories about the stars and night sky • research traditional beliefs about how the Earth and stars were formed • write a report about the effects of the moon on the Earth • plan and draw traditional calendar that includes seasonal changes and the phases of the moon • groups discuss and report on the shared results of a traditional beliefs and stories about sky and stars • investigate the moon phases and how this affects the livelihood of the community, hunting, fishing • design a traditional, school or community calendar to monitor seasonal activities and events and relate this to the way of life	**Recommended knowledge** *The planet Earth* • origin of the Earth - traditional beliefs, scientific explanation (Big Bang Theory and Condensation Theory) *The Solar System* • compositions of our solar system: sun, moons, comets, meteors and planets • interactions between heavenly bodies and their appearance - Milky Way Galaxy, Earth, Sun and Moon and other heavenly bodies: distance, size, shape, weather, rotation, orbiting, life span **Recommended processes, skills and suggested activities** • draw posters to show the nine planets and their distance from Earth • discuss and interpret traditional beliefs about the formation of the stars and Earth • design scaled models of our Earth, Sun and Moon • identify and compare distances in our Solar system • research, draw posters and write descriptions to explain the Earth's origin • design scaled diagram and make models to explain the composition of the solar system	**Recommended knowledge** *Models and inventions* • into space: telescopes, rockets, spaceships, satellites • communications: radio, telephone, televisions, computers, internet *Communication and information* • sound and vibration: sending and receiving information through: speech (voice, ear), guitar (strings vibration), radio (voice, ear), telephone (mouth piece, ear piece) TV (voice, vision), internet (satellite, computer) **Recommended processes, skills and suggested activities** • research for information • draw diagrams of some of the instruments used to study space • select an instrument or machine listed above and conduct research to explain how this instrument or machine works • research and write report on how human beings communicate using voices and ear • investigate space travel and write a report on how humans travel into space: space suits, food, oxygen, water, tools, information equipment

U

Units of Work

What is a unit of work?

A unit of work is a set of sequenced teaching and learning activities with assessment tasks designed to help students achieve selected learning outcomes within a specific time frame.

Components of a unit of work

Each unit of work that you develop should contain these components:

1. Title
2. Grade
3. Time frame
4. Strands and Substrands
5. Learning outcomes
6. Teaching and learning activities
7. Assessment methods and tasks
8. Links to other subjects where necessary
9. Resources and equipment required

Considerations when planning a unit of work

When planning a unit of work, the following should be considered:

- limit the number of outcomes selected as the focus for the unit of work to three or four outcomes to keep it manageable,
- decide if it is appropriate to integrate the Science learning with other subjects,
- clearly identify the content of the unit of work in terms of knowledge, skills and attitudes that are derived from the learning outcomes,
- plan the assessment tasks while you are planning the unit of work,
- where possible use up to date references and resources,
- take account of the learning needs of your students,
- address gender issues and cultural norms by making sure that the unit of work is inclusive and fair for all your students.

Developing a unit of work

Planning from outcomes

Because primary teachers have to manage all of the outcomes for all seven subjects, you will need to work out ways of making teaching and learning manageable. One way of doing this is to cluster outcomes that link naturally together and then plan a unit of work that allows you to teach several outcomes within a set period of time. You can cluster the outcomes in a number of ways:

- within one Strand of Science,
- across several Strands in Science,
- across several subjects within one grade,
- across several grades if you are teaching a multigrade class.

Process for developing a unit of work

This is a general process which can be modified to develop integrated or subject based units of work, or units of work for a single outcome. For example in the event where an outcome cannot be linked or clustered with other outcomes and you decide to teach it separately, step 2 will have to be ignored.

Steps for developing a unit of work

Step 1: Study the content overview from the Syllabus that shows the Strands and Substrands.

Step 2: Identify 2 to 4 outcomes that link naturally together. Brainstorm possible themes, issues or topics that link the outcomes and identify a relevant theme or issue from this list to use in this unit of work.

Step 3: State the purpose for the unit of work.

Step 4: Identify the unit content, the knowledge, skills and attitudes that you want students to demonstrate. Use the outcomes and indicators in the Science Syllabus and elaborations of the outcomes in the Teachers Guide to help you.

Step 5: Develop and sequence teaching and learning activities and identify the teaching and learning strategies and resources to be used.

Step 6: Develop an assessment plan with assessment methods, assessment tasks and criteria and methods of recording.

Step 7: Estimate the time frame required to complete the unit of work.

Step 8: Develop a weekly program for the unit of work.

Sample format for developing a unit of work from outcomes

You should use the process described above and the sample format given below as a guide when developing units of work. You can adapt the process and sample format to suit your needs or the needs of the school.

A Unit of Work

For each unit of work use the following headings:

- Title of the unit of work
- Strands
- Substrands
- Science learning outcomes
- Learning outcomes from other subjects
- Theme, topic or issue that links the outcomes
- Purpose of the unit of work
- Knowledge and skills (Use the indicators and elaborations as a guide.)

  What knowledge do you want students to know at the end of this unit of work?

  What skills do you want the students to be able to do during this unit of work?
- Working Scientifically

  Which skills do you want the students to apply during the unit of work from the *Working Scientifically* Strand?

  A. Process Skills

  B. Comprehension Skills

  C. Communication Skills

  D. Attitudes
- Teaching and learning activities
- Assessment tasks and assessment criteria for the unit of work
- Resources

Using the Format

This format is applicable for developing a unit of work using one or more of the following methods:

Method A: a unit of work focusing on one outcome for a particular grade,

Method B: a multi grade unit of work in one subject across two or more grades.

Samples of each of these types of units of work appear below.

Method A: A sample unit of work for one outcome and one grade

This sample unit of work is project-based. Some steps have been modified to suit a project-based approach.

Step 1: It is not necessary to read the overview of Strands from the Syllabus because only one outcome is used in this unit of work. This unit of work is for a Grade 6 class.

Step 2: Identify the learning outcomes from the Strand.

***S*trand:** Earth and Beyond

Substrand: Our Earth and its Origin

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

Step 3: Select a title and develop the purpose of the unit of work.

Title: Earth formation and structure

Purpose: Students describe and make a model of the earth's structure, collect rock and soil samples and make a model showing how soil erosion occurs.

Step 4: Identify knowledge, skills and attitudes for this unit of work.

Check the Syllabus for relevant indicators for the selected outcome and the Teachers Guide for Elaborations of outcomes that show recommended knowledge, processes and sk and attitudes for the selected outcome.

The following identifies possible knowledge, processes, skills and attitudes foutcome.

Knowledge	Skills	Attitudes
Formation of the Earth How the Earth was formed - *legends, myths, stories* **Structure and composition of the Earth** Crust: *soil, rocks, plants, oceans, continents* Mantle: *molten rocks (magma)* Outer Core: *solid rock* Inner Core: *liquid rock* **Soil Formation** How is soil formed? *Sand, silt, mud, remains of plants and animals,* **Rock Formation** How different rocks are made *shape, colour, size, hardness, weight* (rock cycle), *obsidian, clay, limestone, stone axe*	**Investigating** investigate describe research draw label design collect information **Comprehending** tell stories listen **Communicating** write compare define make models	Check the general list of attitudes in the key features section of this Teachers Guide

Step 5: Develop and sequence teaching and learning activities.

1. Invite guest speakers to tell stories and legends on how the world was made from their cultural point of view or beliefs.
2. Research and present evidence to show that Papua New Guinea was once attached to other continents such as Australia and Asia.
3. Research and describe the internal structure of the Earth. Make a model of the Earth's structure.
4. Describe the effects of wind, rain, sun and ocean waves on the landscape.
5. Identify variations between soils from different locations and investigate how they were formed.

Step 6: Develop assessment tasks and criteria.

There will be one assessment task for this unit of work:

- make a model of the Earth's structure and label it.

Use the following table to develop the assessment tasks and criteria.

Assessment task	Assessment criteria	Recording method

Step 7: Identify and list the resources and equipment required for the unit of work.

The resources for this unit of work include:

- local elders,
- world map,
- samples of different types of soil such as clay, sand and loam.

Step 8: Estimate timeframe for the unit of work.

This unit should take 1 week of Science teaching time and will require 4 lessons: 1 x 60minute lesson or 3 x 40 minute lessons. You can structure the lesson durations in other ways to suit the teaching and learning activities and needs of the school.

Step 9: Develop a weekly program and lesson plans for the unit of work.

Method B: A sample unit of work for a multigrade class

This method is applicable for the teacher who is teaching more than one Grade. For example a teacher may be teaching Science to a Grade 6 and 7 class. Although the teacher is using one unit of work to teach, aspects of the lessons should be planned specifically for each of the Grades taken. This includes teaching and learning activities, language level, resources used and types of assessment methods and tasks.

When planning a unit of work for a multi-grade class, a teacher should do the following:

- use different outcomes for students from different Grades within the class,
- select outcomes that address common concepts.

Planning a multigrade unit of work

Suggested steps to develop a multigrade unit of work.

1. Identify the grade levels you will program for and study the content overview from the Syllabus.
2. Identify and select relevant Substrands and outcomes that will be suitable for your multigrade class.
3. Identify and write suitable themes or topic that link the outcomes.
4. Identify the purpose for the unit of work.
5. Develop and sequence teaching and learning activities.
6. Develop a variety of assessment tasks with specific assessment criteria.
7. List resources.

Sample unit of work for a multigrade class

Step 1: Identify the grade levels you will program for and study the content overview from the Syllabus.

For the purpose of this sample unit of work, the grades selected are Grades 6, 7 and 8. For the content overview, refer to Science Syllabus.

Step 2: Identify and select relevant Substrands and outcomes that will be suitable for a Multi-grade class that link well.

Strand: Living things

Substrand: Nature of living things

Outcomes

6.2.1 Identify the basic structure of living things that allow them to function in their environment.

7.2.1 Identify and compare the basic structure of living things and how they allow them to function in their environment.

8.2.1 Describe and explain the processes of reproduction in living things and how the environment influences these processes.

Step 3: Identify suitable themes or issues or topics that link the outcomes.

The theme selected for this multigrade unit of work should be relevant to each of the three outcomes stated above. Here are some possible themes for this unit of work:

- living things,
- basic structure of living things,
- plants and animals.

Step 4: Identify the purpose for the unit of work.

Examples:

- identify patterns, groupings, classifications, and the main characteristics of living things,
- research how living things function and reproduce in their environment.

Step 5: Identify the knowledge, skills and attitudes that you want the students to demonstrate.

Refer to the relevant outcomes and indicators in the Science Syllabus and Elaboration of outcomes in the Teachers Guide.

Step 6: Develop and sequence teaching and learning activities.

The knowledge, skills and attitudes will be used to decide which activity belongs to which grade:

- identify common features of living things that can be used to classify them into groups and give names to the groups identified,
- identify, describe and list similarities and differences of cells from certain plants and animals,
- explain how some living things interact in relation to each other as well as their immediate environment, addressing topics such as animal behaviour, courtship, aggression and caring for young,
- describe responses to the environment that help livings things to survive,
- select a living thing, explain the group it belongs to, its structure, function, how it reproduces and state how you protect that species for future generation.

Step 7: Develop assessment methods and tasks you will use for assessing each grade.

Example

Below are some examples of the activities that teachers could use as a guide in developing assessment tasks in this unit of work.

Select a living thing in the school area and keep a record of the following:

- the group to which it belongs,
- its structure,
- its function,
- method of reproduction,
- how you can protect that species for future generations.

The table below may help you in planning your assessment tasks.

Grade	Assessment method	Specific tasks	Recording method
1.	Focused analysis	Comparing planning and report sheets	Checklist
		Making models	
2.	Observation	Teachers can use the information on assessment section to complete this.	
3.	Observation		

Step 8: List resources

Examples include samples of living things from around the school area and community.

Step 9: Programming

You will need to work out how many lessons needed to teach your unit of work and how much of your time will be involved in working with students from each grade.

These suggested activities above have been organised as follows using the 5 Es approach.

The 5E approach

Engage	Plan and conduct an excursion to a site to observe the environment. List all the necessary resources needed for the excursion and state the purpose of the excursion. For example: to observe and list as many living things as possible from the selected site. Before the excursion, brainstorm what they are likely to find in an environment.
Explore	Investigate the environment, collect or list as many living things seen or observe from the given time. Identify and list some similarities and differences from their observations.
Explain	Identify features of living things that can be used to classify them into groups. Draw a chart to show the different groups of living things, for example show how animals and plants are classified. Explain how some living things behave such as animals, courtship, aggression and caring for the young.
Elaborate	Describe responses to the environment that help livings things to survive. Select a living thing, explain the group it belongs to, its structure, function, how it reproduces and state how you protect that species for future generations. Identify and list similarities and differences of cells from various parts of plants and animals.
Evaluate	Give a brief two-minute talk on a selected topic related to living things. Suggested topics could include 'characteristics of an animal, animals and their needs,' 'plants and their needs,'animals and their young'. During the talk, students express their ideas, beliefs and understandings to support the evidence gathered from their discoveries on the topic. State how they want to either promote the use or protection of that particular living thing. List things they know and have learned and ask more questions or carry out further research on the different topics their peers have talked about in their presentations.

Resources

You are encouraged to be resourceful when selecting teaching materials and try working with other teachers to share the load. Most importantly you should select materials relevant to the Science Syllabus and learning outcomes. You are also encouraged to identify, improvise and use materials readily available in their own school area and communities.

Recommended resource materials

The following resource materials in the table below have been produced by the Department of Education and are relevant to the Science Syllabus for Upper Primary. All Secondary schools and some Primary schools have these. You are encouraged to locate these resources in your own or nearby schools.

The resources have also been listed under each Strand from the Syllabus. Materials listed in the other materials list are expected to be easy to find within the school area or nearby community. These are not listed under each Strand because they are general materials and can be used in any of the three Strands and Substrands.

The following resources may be useful sources of information. Care should be taken to make sure the content of these resources is relevant to the Science Syllabus.

Department of Education publications

Strand: Living Things	Strand: Science in the Home	Strand: Earth and Beyond
Grade 8 Science Syllabus and Teacher Guide	Geology	Fundamental Science, Book 4 Answer Book
Growth and Reproduction, Unit 5	Electricity Item Bank	Earth and Beyond, Book 3
Living Things, Grade 7	Matter: Student Resource Book	Science Item Bank, Grade 7
Life in the Sea, Grade 7, Unit 4B	Matter: Teacher Guide	Sun and the Earth Teacher Guide, Grade 7
Reproductive and Sexual Health: Supplementary Text	Science Skills	Sun and the Earth Resource Book, Grade 7
Video – Kisim Save Series 1 – 2	Electricity: Teacher Guide	
Into Space Supplementary Text	Radio Science, Grade 5	
Lower Primary Environment Studies Syllabus, Grades 3-5	Radio Science, Grade 4	
Lower Primary Environment Studies Resource Book, Grades 3-5	Radio Science Teacher Guide	
	Science Teacher Guide, Grade 6	
	Fundamental Science for Melanesia Book 3	
	Science in Process, Part 1	
	Science in the Classroom, Books 1 and 2	
	Earth and Beyond for Thinking Scientists Books, 1 – 4	
	Science in the Classroom, Books 1 – 2	
	Science Work Books 1- 2	

Other materials for the three Strands that may be available in the community

Utensils and containers such as spoons, knives, strainer, funnel, cups, jars, jugs, empty plastic containers and plastic bags, empty tins, matchboxes, empty cartons and boxes

Household items such as stoves-kerosene, gas or electric, cushions, old wire, torch, batteries, string, cotton, gauze, rubber hose, hollow tubes, tyres and tubes, old light bulbs and tubes, radio cassette players, video players, toys, marbles, clothing materials, hammer, paint, scale, tape measure, nail, saw, pliers, spanner, screwdriver, hair comb and brush, hair cream, grass knife, spade, telephone, watch or clock

Substances such as steel wool, scraps of food, milk, salt, sugar, vinegar, ice, water, oil, chalk dust, cordial, petrol, detergents. bleach, disinfectants, metals, betelnut, lime, mustard, yeast, flour, dyes, grease

Stationery items such as rulers, pens, ink, white and coloured paper, chalk, rubber bands, old newspapers, magazines

Human resources such as a traditional healer, musician, local navigator, tradesperson, craftsperson, weather person, electrician, mechanic

Community resources such as canoes, boats, sails, water tanks, hydroelectric power stations, guitar, ukulele, organ, keyboard or computer

Teaching aids such as advertisements, posters,charts

Items from the environment such as wood, twigs, insects, flowers, fruit, nuts, food types, bones and herbal plants

Other textbooks for Upper Primary Science

These resources are produced in other countries but are still useful in this course. Teachers and schools can use the addresses given below and other information given in the table to order these books.

ISBN	Publication Title	Publisher	Type
	Earth and Beyond-Activities for thinking scientists, Book1	Macmillan	Student Resource Book
073294779 0	Earth and Beyond, Activities for thinking scientists, Book 2	Macmillan	Student Resource Book
073294780 4	Earth and Beyond,Activities for thinking scientists, Book 3	Macmillan	Student Resource Book
058272113 x	Fundamental Science for Melanesia, Book 1	Longman	Teacher text, Student Resource Book
058272122 9	Fundamental Science for Melanesia, Book 2	Longman	Teacher text, Student Resource Book
0 86901 059 x	Basic Science Series, Books 1 – 16 New Ed.	Great Western Press	Student Resource Book
01955 4162 6	Oxford Science for the Pacific, A- Z of Essential Terms	Oxford	Student Resource Book
01955 0824 6	Science in the classroom, Book 1	Oxford	Student Resource Book
01955 0825 4	Science in the classroom Book 2	Oxford	Student Resource Book
01955 3681 9	Science Works, Book 2	Oxford	Student Resource Book

Excursions and field trips

Science activities can be carried out to places outside the usual classroom. Excursions and field trips are a valuable and positive addition to any Science program. It is important for Science teachers to take every opportunity to study and increase their knowledge of local resources and issues.

Use the local environment, both natural and built, outside the school as an inspiration, focus or setting for learning experiences where appropriate. Contact, and where possible, obtain the support of local community agencies, local government departments, conservation groups and local industries.

Consider local resources and landscape such as geological formations, rivers, mining sites, fisheries, hydroelectric plants and wildlife as a part of the extended Science classroom.

Discuss and find out from students what issues concern their communties. Examine the recommended knowledge, processes and skills and suggested activities in the Teachers Guide to establish opportunities where students and teachers can get out of the classroom and explore their local environment.

Getting organised

A good excursion or field trip is a well-planned trip where aims and objectives are identified and the activities conducted are intended to achieve the learning outcome. Consider these key points when planning an excursion.

- What is the aim of the excursion?
- What work do you expect the students to complete at the site? Is it to be submitted before the end of the visit or is it part of an ongoing project or will it be completed for homework?
- Are the students clear about what is expected of them?
- What are some of the risks involved in the excursion and what steps are you going to take to minimise or stop these from happening?
- Do you know the site well yourself or have you organised management at the site to provide security and assistance when required?
- Have you obtained approval from relevant authorities and parents or guardians?
- How long will it take: a lesson, a day or longer and will you require necessities such as food, shelter and sleeping materials?
- How are you travelling to the site and have you arranged this?
- Do your students have everything they need such as pencils, books, questionnaires and worksheets?
- How are your students carrying out the tasks; in groups, pairs or individually?
- Will you need support from other staff members as well?

Being safety conscious

It is the responsibility of the teacher to ensure that the classroom is a safe working environment for students. An untidy, littered classroom encourages attitudes that may themselves result in accidents. Science teachers have a duty to:

- research the chemicals associated with any class experiments or demonstrations,
- demonstrate experiments using safe procedures and chemicals before allowing the students to try it themselves,
- warn students about the potential dangers associated with an experiment and demonstrate proper techniques in dealing with these,
- supervise students at all times and ensure that safe techniques are followed throughout.

The basic first aid kit

Every school should have a first aid kit readily available during demonstrations or experiments. All Science teachers are expected to be familiar with simple first aid procedures. Prompt action is essential in first aid situations. The kit should contain cotton wool, a mild antiseptic solution, eye wash bottle, scissors, tweezers, gauze, small plastic or metal bowl, burn cream, bandages of various sizes, sticking plasters, band aids, safety pins.

Addresses for materials, equipment or chemicals

The addresses listed are for the schools that are able to secure funds to purchase resources and equipment for their respective schools. The Education Department does not supply these resources.

PNG Suppliers: Chemicals

Belltek Chemicals
PO Box 2358, Boroko
Fax 3250949, Phone 3257079

Spring International Holdings
PO Box 6880, Boroko
Fax 3253411, Phone 3255734

Pacific Scientific Instrumentation
PO Box 384, Madang
Phone/Fax 9822693

Methods and Measurements
PO Box 974, Boroko
Fax 3258886

Zampolle Pacific PNG Ltd
Fax 3201128

Silkwood Business International
PO Box 1455, Lae
Phone/Fax 472 6329

PNG Suppliers - Books

Gordon & Gotch (PNG) Ltd
PO Box 107, Boroko, NCD
Phone 3254855, Fax 3250950
Email ggpng@online.net.pg

La Galamo Office and Schools Supplies Pty Ltd
PO Box 1405, Lae
Phone 4722588

Web Books
PO Box 1385, Port Moresby
Phone 3252508 Fax 3230737

Oxford PNG
PO Box 7979 Boroko,
Phone 3235611 Fax 3235615

Overseas Suppliers: Chemicals

Serrata Pty Ltd
PO Box 73, Galstone, NSW 2159 AUS
Fax 0561 2651 2031 Phone 0561 2 651 3033

Biolab Scientific,
Private Bag 36900, Northcote Auckland, NZ,
Phone 0564 9 418 3039 Fax 0564 9 480 3430

Philip Harris International Ltd, Lynn Lane, Shenstone, WS14 OEE, Staffordshire, UK

Q Stores (Chemicals),
4-6 Huntley St
PO Box 77, Alexandria,
NSW 2015, AUS,
Phone 0561 2 3187 888
Fax 0561 2 3187 886

Overseas Suppliers: Books

Macmillan, Macmillan Education Australia
627 Chapel Street, South Yarra, Victoria, Australia 3141
Phone (03) 9825 1095Fax (03) 9825 1010

Ofarrel & White, Book Publishing Services, Oxford University Press,
34 Godfrey Avenue, East St Kilda, Victoria, Australia 3183,
Phone/Fax (03) 613 9534 4401

Longman Cheshire Pty Limited
Longman HouseKings Gardens,
95 Coventry Street, Melbourne,
Australia 3205

Heinemann Australia Pty Ltd, 22 Salmon Street, Port Melbourne, Victoria, Australia 3207

Glossary

Adaptation	changing based on the changes taking place in the environment
Atom	the smallest part of an element
Anecdotal notes	notes taken about individual students during lessons that record significant or interesting observations
Assessment Criteria	statements that are used to judge the quality of student performance or achievement
Categorise	put into groups
Characteristics	common features of living or non-living things
Classification	a process of grouping things in a systematic way
Contrast	to describe the differences between two things
Criterion-referenced assessment	criterion-referenced assessment uses specific assessment criteria derived from the learning outcomes to judge a student's individual performance. It does not compare the performance of one student to another
Conventional	the accepted view about something
Concepts	these are ideas, thoughts or understandings about something
Conclusion	a definite outcome derived from evidence gathered from experiments or an accumulation of research evidence
Context	the surrounding conditions or situations where something is likely to take place
Decanting	separating mixtures by carefully pouring off the liquid from the solids such as separating a mixture of water and sand by pouring off the water leaving the sand behind
Diversity	a range of different things such as diversity of living things
Explicit	clear, accurate, specific
Food chain	the simple links between a producer and consumers that show the transfer of energy from one to the other
Food Web	the many links between producers and consumers that involves more than one food chain within an ecosystem and that shows the transfer of energy within an ecosystem
Hypothesis	a statement that proposes an explanation that can be investigated and proven true or shown to be false
Inferences	making suggestions to explain evidence collected during investigations. These suggestions may not be correct but are based on the available evidence

Interaction	an action between two or more objects or events.
Investigation	processes of finding out about something. Scientists investigate by conducting experiments
Inclusive	including everything or everyone
Journals	daily records of events
Matter	physical material that has mass and occupies space
Model	a concrete representation of something
Molecule	a chemical combination of two or more atoms to form the smallest part of a compound
Non-biodegradable	matter that cannot be caused to rot or be broken down by living things
Norm-referenced Assessment	assessment that compares students' achievements with achievements of a representative sample of other students. This sample is usually a national sample. The purpose of norm-referenced assessment is usually to sort and rank students
Open Investigation	an investigation where the outcome is not known
Particles	very small parts that together form matter
Progression	moving forward or developing continuously or in stages
Phenomena	changes taking place in nature
Relationship	connection between things
Rote Learning	learning that takes place by repeating steps over and over again rather than learning by doing
Sublimation	direct physical change from solid to gas or gas back to solid
Sustainability	to be able to maintain something in the future without needing additional support or resources
Transmission	a process of passing information from the sender to receiver: consider transmission of energy
Sedimentation	the depositing of suspended particles in layers from large particles to small particles

Appendix

Time allocations for Upper Primary subjects

In Upper Primary the subjects to be taught and their time allocations per week are:

Arts	180 minutes
Language	180 minutes
Making a Living	360 minutes
Personal Development	240 minutes
Social Science	180 minutes
Science	180 minutes
Mathematics	180 minutes

All subjects are core subjects and must be allocated the required number of minutes per week. Each subject is equally important for Integral Human Development. Making a Living and Personal Development have more time allocated because of their practical orientation.

All subjects can be externally assessed (*National Assessment and Reporting Policy*, *2003*).