



International Education Agency of PNG

# Science Curriculum

Revised Edition – 2006

## Science: An Overview

Science exists because it serves an innate human desire to make sense of the world. Science is a collection of understandings about the physical and natural world and a system of inquiry involving a variety of investigative skills.

The teaching of science helps children to make sense of and interact with their world. At the same time, science education contributes to the development of society which is better able to consider the vital ethical and social issues to which the advance of science gives rise. Science tries to develop attitude, skills and knowledge that will help students solve problems in this rapid changing world. Science is the vehicle by which our world is changing rapidly, and tomorrow's citizens will need special knowledge and skills if they are to evaluate and deal with this change. It also encourages students to seek scientific explanations of natural phenomena, builds their confidence and ability to effect changes and improvements in their environment and most importantly develops their critical thinking ability.

Students should also be given ample opportunity to develop a range of process skills. These skills can be classified into three interrelated broad groups:

- investigating, which includes the processes of observing, raising questions, hypothesising, planning and carrying out investigations, and fair testing (experimenting);
- appreciating, which involves interpreting, organising and communicating information as a means of developing scientific understandings, and developing positive attitudes towards the role of science and scientists;
- applying, which involves students in using their scientific understandings to explain their world and to solve problems.

The curriculum should also strive to develop in students a number of important attitudes, in particular the following:

- curiosity
- open-mindedness
- perseverance and commitment
- initiative
- scientific and technical reasoning
- interest
- integrity
- cooperation
- safety awareness
- critical thinking
- confidence
- understanding and appreciation

## Science and the IEA Key Outcomes

*IEA schools assist all children to:*

*... Be Self-Directing*

This means that the science curriculum provides a wealth of opportunities for students to direct the path of their learning through the investigative process. They must consider information at hand, determine the questions for further research which this information suggests, and then design, implement and report on their findings.

### *... Communicate Effectively*

The opportunity to investigate scientific phenomena provides countless opportunities to stimulate communication. Students are required to describe their investigations and explain and defend, with evidence, their findings. This can involve both oral and written communication. The reporting of scientific activity requires the development of considerable further vocabulary and skill in using particular language genres.

### *... Behave Ethically*

Few new scientific discoveries do not raise significant value laden questions. The science curriculum involves students in considering many of these issues, and in exploring the impact, both positive and negative, which science has had on society. In this way students develop their own set of values and expectations of ethical behaviour, and test these against those of other groups within society. While doing science they should respect cultural differences.

### *... Work Collaboratively*

Scientific investigations provide wonderful opportunities for students to work in collaborative groups. Through discussing the processes and findings with others, students find that all have something to contribute towards the growth of shared knowledge. Considering the precision with which scientific investigations must be undertaken, students working in groups must have a strong sense of responsibility towards the group to ensure that their involvement and contribution does not jeopardise results.

### *... Analyse and Solve Problems*

Science is the most valuable problem solving tool available to humanity. The scientific process is designed to explore and explain the phenomena which control our problem solving ability. In learning about science, students have a number of opportunities to use their knowledge to solve specific practical problems. At the same time, the science curriculum provides opportunities to learn about the way in which science has been used to solve significant problems in the past, and how it may be expected to do so in the future

## **Science in the PNG Context**

The daily life of Papua New Guineans is continually changing. The rate and extent of changes are such that many of the values, skills and solutions that worked for Papua New Guinea in the past, will not be appropriate for future Papua New Guineans. Papua New Guinea is at a turning point in its relationship with the environment.

In the past, Papua New Guineans have used traditional skills for survival. Children learnt to use stars for directions, the moon as a guide for fishing and gardening, to make special fishing lines from string, about special plants used for contraception. The mixing of traditional colours and dyes, bush medicines, traditional energy use, time telling and navigation are all aspects of science in village life. Water collection methods, sago harvesting, the making of clay pots and tapa cloth typify the wealth of inventions, systems and processes that are available for study in a local context.

Even today many of these things are still in use in most rural areas. Papua New Guineans should value and preserve these traditional skills for future generations and for students from other

cultural backgrounds to learn about and appreciate the wide spectrum of Papua New Guinean culture and the role science plays.

However, Papua New Guineans have to deal with changes effectively and their society requires scientific leaders, workers who are comfortable with technology and confident in their use of it, and citizens able to make informed decisions about scientific issues affecting their environment.

The Papua New Guinean perspectives on science will be apparent when:

Teachers:

- make use of the locally available resources from the community when planning and teaching
- focus on relevant technological practices and systems valued by local communities
- examine the impact of modern lifestyle and consumer goods on different Papua New Guinean communities.

Students:

- recognise and appreciate the traditional survival skills in Papua New Guinean culture
- collect and collate useful information about traditional and modern practices of the technology process
- understand and appreciate the relationship with their environment and have confidence in their ability to effect changes and improvement in the environment
- develop an understanding of significant scientific facts and theories, and the ability to apply them in relevant situations in the community.

## The Curriculum Strands

The Science curriculum is underpinned by a range of inquiry skills which allow students to plan, conduct and evaluate scientific investigations. In the IEA curriculum this is broadly referred to as *working scientifically* and also develops knowledge about the impact of science on our society. The table below illustrates the learning sequence for:

- Observing                      Interpreting
- Communicating              Organising
- Raising questions          Hypothesising
- Testing                         Reporting

Process/ Skill	Level 1	Level 2	Level 3	Level 4	Level 5
<p><b>Investigating and Data Gathering:</b></p> <p><i>Formulating or identifying investigable questions and hypotheses, planning investigations and collecting evidence.</i></p>	<ul style="list-style-type: none"> <li>• Responds to instructor’s questions, manipulates materials and undertakes simple observations to answer posed questions.</li> <li>• Asks questions based on observations</li> </ul>	<ul style="list-style-type: none"> <li>• Given a question in a familiar context, identifies a variable. Poses simple scientific questions for testing and devises and records relevant observations</li> <li>• Makes non-standard measurements</li> </ul>	<ul style="list-style-type: none"> <li>• Plans simple investigations and makes predictions which include the identification and control of variables.</li> <li>• Makes simple standard measurements and records data as tables, diagrams or descriptions</li> </ul>	<ul style="list-style-type: none"> <li>• Formulates scientific questions, identifies relevant variables and determines how these can be controlled in Investigations.</li> <li>• Accurately collects and records data.</li> <li>• Demonstrates an understanding of “fair testing”</li> </ul>	<ul style="list-style-type: none"> <li>• Uses scientific knowledge to formulate hypotheses and devises investigations which test these.</li> <li>• Plans experiments using two or more variables.</li> <li>• Can identify variables to be changed and controlled.</li> <li>• Selects and correctly uses appropriate equipment.</li> <li>• Collects and records detailed and descriptive observations.</li> <li>• Persists in trials modifying techniques recognising the limitations on reliability and validity of their data</li> </ul>
<p><b>Interpreting and Communicating Data</b></p> <p><i>Interpreting evidence and drawing conclusions from data and communicating findings.</i></p>	<ul style="list-style-type: none"> <li>• Shares observations.</li> <li>• Can focus on one aspect of the data.</li> <li>• Makes simple reports on their findings through telling, acting out or drawing what happened</li> </ul>	<ul style="list-style-type: none"> <li>• Makes comparisons between objects/events observed.</li> <li>• Understands and can explain simple tables and graphs.</li> <li>• Suggests possible interpretations for their data and begins to use technology in communicating data</li> </ul>	<ul style="list-style-type: none"> <li>• Displays data using a table or graph when provided the variables for each axis.</li> <li>• Can identify and summarize patterns in science data.</li> <li>• Uses a range of techniques in reporting results</li> </ul>	<ul style="list-style-type: none"> <li>• Using technology and a range of media, can present own findings and interpret other’s findings using a variety of graphs, tables.</li> <li>• Using science data, can explain patterns and make suggestions for improving investigations.</li> <li>• Uses some scientific language and equipment</li> </ul>	<ul style="list-style-type: none"> <li>• Uses science concepts to make conclusions from data.</li> <li>• Makes suggestions for extending an investigation</li> <li>• Begins to critique investigations and inconsistencies.</li> <li>• Selects graph style and scale appropriate to the data. Uses scientific language.</li> </ul>

The Science curriculum is organised around five strands. One of these strands, Working Scientifically, is a process strand which outlines the inquiry and investigation skills students will develop through their study of science. The remaining four strands (Matter, Earth and Beyond, Living Things and Energy) are content strands.

The curriculum should be viewed as an integration of process and content strands. Students develop the skills and understandings outlined in the content strands through the process of inquiry. At the same time, the processes cannot develop without practice within the broader contexts of logically developmental content.

The strands are described below.

### ***Working Scientifically***

This strand provides students with the opportunity to develop a range of inquiry skills which allow them to plan, conduct and evaluate scientific investigations. It also develops knowledge about the impact of science on our society. Through achieving the outcomes within this strand, students develop values and have an opportunity to challenge their beliefs.

In particular, the strand is concerned with:

- observing
- communicating
- raising questions
- testing
- interpreting
- organising
- hypothesising
- exploring the social context

### ***Matter***

The Matter strand explores a number of aspects of the wide range of materials and substances which people use. It has a close overlap with the Technology curriculum.

This strand is concerned with the definition, description and analysis of the states of matter and with classifying materials by careful observation and investigation of their properties.

Students consider the use and management of materials and the influence on these uses on the environment. They discover how uses are determined by the properties and structures of materials.

A range of physical and chemical reactions are considered, both man-made and natural. Students explore the nature of these changes including the changing of states.

### ***Earth and Beyond***

This strand considers a diverse range of issues and content from the areas of geology, physical geography and astronomy.

Students explore the structure of the earth and the major processes which bring about change, including plate tectonics, the weathering activities such as rain, snow, hail, fog, wind, cloud formation, etc and related erosion and various cycles such as the seasons.

This strand includes a detailed study of the various elements of the solar system, stars and the constellations. It looks at the nature and effect of rotations and revolutions of planets including the Earth. It also includes consideration of space exploration and some of the related social issues.

### ***Living Things***

The Living Things strand provides for the study of biology of animals and plants and the consideration of the networks which support life. Students explore the skills of classification of different species of living things. It also provides a chance to consider ecosystems and the impact of people on the life of other species.

This strand identifies the features of living and non- living things and explores the internal systems on which living things rely and the ways in which they meet their needs. It considers the functions of various parts of living things and compares parts and their functions between species. It also covers reproduction and growth.

Students consider the way in which living things adapt to environments and change. It examines responses to stimuli and the way in which adaptations can be either natural or imposed. Living Things explores the social and biological issues which surround the survival of species and includes consideration of some endangered and extinct species.

Critical to Living Things is an understanding of the interdependence of living things including consideration of food chains, ecosystems, communities, colonies and biodiversity. This strand also explores the effects of human intervention on these systems.

### ***Energy***

The Energy strand covers the basics of theoretical and applied physics. It examines a number of forms of energy and considers how these are applied and managed to meet various needs.

This strand considers the nature of the following forms of energy: light, sound, heat, electrical, chemical, magnetic, elastic, solar, radiant, kinetic and potential.

Energy overlaps considerably with the Technology curriculum and will provide a number of excellent opportunities for integration. It considers the application of knowledge about forms of energy through the observation and construction of simple machines.

Students consider the social implications of energy use including the effects of use of natural resources, and the Law of conservation of energy and the particle theory including the resources from which it is drawn. It also explores a range of alternative energy sources and the implications of their use.

# 1. MATTER

Level 1		Level 2		Level 3		Level 4		Level 5	
<b>Level Outcomes</b>									
1.01	Apply simple systems of classification to a range of materials	2.01	Explore the nature of a range of materials including their formation	3.01	Begin to use the term 'matter' rather than 'material'. Investigate the structure and properties of a range of matter and consider the impact of various changes on matter	4.01	Explore the nature of a variety of chemical reactions and the properties of various compounds and mixtures	5.01	Investigate and manipulate elements, solutions and compounds and describe chemical reactions in scientific terms
<b>Contributing Outcomes</b>									
▪	Identify properties of materials using only senses	▪	Describe and sort the properties and structure of common materials	▪	Make links between the structure of materials and their physical properties	▪	Explain properties and behaviour of materials using models	▪	Describe a simple atom model
▪	Describe properties of materials	▪	Identify materials with similar physical properties	▪	Investigate how unfamiliar materials can be grouped	▪	Investigate the properties, formation and separation of elements of mixtures and solutions	▪	Compare the properties of pure substances and mixtures, and elements and compounds
▪	Make collections of materials and group them to show variations in property	▪	List how we use common materials	▪	Show how common materials can be combined to be more useful	▪	Explain how the use of materials is determined by their physical and simple chemical properties	▪	Investigate ways of separating various mixtures
▪	Identify some uses of materials	▪	explore the effectiveness of materials in their everyday life	▪	Investigate and describe how properties of materials are linked to their use	▪	Design tests to compare properties of mixtures	▪	Explain how materials can exist in different forms and can be used for particular purposes
▪	Predict and test the effectiveness of materials	▪	Compare different materials that can be used for the same purpose	▪	Describe how natural raw materials are processed	▪	Recognise conditions where processes occur that cause reaction and change	▪	Investigate substances and how they change chemically in everyday situations
▪	Share ideas on suitable choices of materials for familiar activities	▪	Identify whether changes to materials can be reversed and find examples	▪	Investigate the temporary and permanent changes materials go through	▪	Investigate ways to modify change and reaction times	▪	Describe chemical structures of simple and common compounds and explain differences between physical and chemical change
▪	Identify changes in materials using senses	▪	Identify and describe the conditions that affect the rate of change in materials	▪	Identify the consequences of processing materials for humans and the environment	▪	Describe how changes in reaction conditions affect the rate and nature of reaction	▪	Describe common chemical reactions using word and particle equations
▪	Discuss familiar technologies that change materials such as cooking	▪	Use simple technology to show and explain methods which prevent or promote change	▪	Investigate recycling and disposal of materials	▪	Identify reasons why materials are chosen for specific processes	▪	Use chemical processes to make new materials and investigate their properties and uses

## 2. LIVING THINGS

Level 1	Level 2	Level 3	Level 4	Level 5
<b>Level Outcomes</b>				
1.02 Identify some basic features of living things including their fundamental needs	2.02 Identify ways in which living things relate with each other and with their environments and change over time	3.02 Investigate the various features of a range living things and how living and non-living things affect the survival of organisms	4.02 Compare in detail the specific life systems of plants, animals and humans	5.02 Investigate the nature of ecosystems, endangered species and more complex systemic functions
<b>Contributing Outcomes</b>				
<ul style="list-style-type: none"> <li>▪ Identify living and non-living things</li> <li>▪ Investigate the needs of humans, plants and animals</li> <li>▪ Investigate and compare the needs of living things</li> <li>▪ Identify and illustrate some changes that occur over time to humans, animals and plants</li> <li>▪ Illustrate the diversity of animals and plants</li> <li>▪ Investigate ways to care for living things</li> <li>▪ Identify simple systems and cycles in the environment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify observable features of familiar living things and describe their function</li> <li>▪ Describe how certain features help living things to survive</li> <li>▪ Compare the habitats of different living things</li> <li>▪ Investigate changes in features of living things over time</li> <li>▪ Describe how plant and animal structures assist them to survive</li> <li>▪ Discuss the work of people who care for living things</li> <li>▪ Identify life cycles of familiar living things</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate common features of living things</li> <li>▪ Investigate how living things respond to and depend on each other in a habitat</li> <li>▪ Illustrate relationships between living things in a habitat and how they depend on each other</li> <li>▪ Investigate the impact of the aging process on plant and animal structure</li> <li>▪ Compare and contrast similarities and differences in and between groups of familiar living things</li> <li>▪ Describe how humans use the land and sea</li> <li>▪ Identify life cycle stages and systems in animals and plants</li> </ul>	<ul style="list-style-type: none"> <li>▪ Classify living things in a variety of ways</li> <li>▪ Investigate and describe how living things ensure survival to the next generation</li> <li>▪ Identify potential disturbances to an ecosystem's balance</li> <li>▪ Research the effects of lifestyle on human body systems</li> <li>▪ Identify and explain why some living things have become extinct</li> <li>▪ Investigate the effects of human intervention on feeding relationships</li> <li>▪ Describe and compare the functions of animal, human and plant systems and relationships in food chains and webs</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe how living things have changed over time using fossils etc. as evidence</li> <li>▪ Investigate adaptations of plants and animals and how they allow plants and animals to survive in their environment</li> <li>▪ Describe how populations are naturally controlled in an ecosystem</li> <li>▪ Explain how living things help in cycling energy and matter</li> <li>▪ Explore the nature of, and similarities and differences between, cells of plants and animals</li> <li>▪ Investigate the impact of human activity on the environment and explore causes, transmission and control of disease on humans</li> <li>▪ Describe how producers modify natural systems to increase production of materials</li> </ul>

### 3. EARTH AND BEYOND

Level 1	Level 2	Level 3	Level 4	Level 5					
<b>Level Outcomes</b>									
1.03	Develop a basic understanding of how the weather affects life in the local community; and of the nature of major astronomical features identifiable with the naked eye	2.03	Describe changes which affect the Earth through weather and through its daily and seasonal cycle	3.03	Consider the Earth's position within the Solar System and how this impacts on cycles of climate and human impact on the environment	4.03	Explore and identify components and structure of the universe and the Earth, and the role of various forces which act upon them	5.03	Examine the nature of the universe and members of the solar system including exploration of the Earth's geology and related human use of minerals and fossil fuels
<b>Contributing Outcomes</b>									
<ul style="list-style-type: none"> <li>▪ Explore time intervals using celestial bodies</li> <li>▪ Identify features of day &amp; night sky such as sun, moon and stars</li> <li>▪ Describe observable differences between day and night skies</li> <li>▪ Describe how daily life is influenced by weather cycles throughout the year</li> <li>▪ Identify major features of the physical environment</li> <li>▪ Discriminate between natural physical features and man made features</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate the rotation of the Earth around the sun</li> <li>▪ Link features of the sky to patterns of behaviour in everyday life</li> <li>▪ Discuss the characteristics of the solar system</li> <li>▪ Describe features of weather including cloud patterns and ways weather causes changes in environmental features</li> <li>▪ Record how changes to the earth are monitored and how this information is used</li> <li>▪ Research the effects of change on living things, the environment and human activities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify patterns of change seen on earth caused by the relationship between the sun, moon and Earth</li> <li>▪ Find and use information on space exploration to further understandings about the behaviour of Earth</li> <li>▪ Find and describe the features of the universe</li> <li>▪ Explore the effect of weather on human activity</li> <li>▪ Recognise that physical changes to the Earth are a result of physical processes</li> <li>▪ Describe how using the Earth's resources alters the physical environment and find local evidence for this</li> </ul>	<ul style="list-style-type: none"> <li>▪ Explore how different cultures have explained and used knowledge of space</li> <li>▪ Investigate how scientists study the Earth, solar system and the universe</li> <li>▪ Describe the structure of the Earth from core to atmosphere</li> <li>▪ Investigate the effects of weather on living things</li> <li>▪ Describe the characteristics and effect of earthquakes and volcanoes on the Earth</li> <li>▪ Identify characteristics of earth that allow life to exist</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate and report on how space travel and exploration is possible</li> <li>▪ Compare characteristics of Earth with other planets and celestial bodies</li> <li>▪ Investigate and report on the properties of stars</li> <li>▪ Investigate the different features of climatic zones</li> <li>▪ Describe the characteristics and formation of common rocks and soils and interpret gathered information to describe an area's geomorphology</li> <li>▪ Describe the formation, detection and extraction of minerals and fossil fuels</li> </ul>					

## 4. ENERGY

Level 1	Level 2	Level 3	Level 4	Level 5
<b>Level Outcomes</b>				
<p>1.04 Identify the basic properties of simple forms of energy</p>	<p>2.04 Explore factors which effect the transmission of simple forms of energy and begin to develop understandings about magnetism and electrical circuits</p>	<p>3.04 Develop understandings about a range of properties of energy forms and the nature and effect of opposing forces</p>	<p>4.04 Consider the relationships between aspects of movement and develop knowledge and understandings about the operation and real world use of electricity</p>	<p>5.04 Investigate energy conversion and the use of lenses, mirrors and filters and the related properties of light</p>
<b>Contributing Outcomes</b>				
<p>1.04</p> <ul style="list-style-type: none"> <li>▪ Describe properties of simple forms of energy</li> <li>▪ Classify familiar devices according to the source of energy used</li> <li>▪ Illustrate parts of simple devices</li> <li>▪ Identify forms of energy which can impact on everyday life</li> <li>▪ Recognise forms of energy people rely on in every day life</li> <li>▪ Examine how energy is misused at home and school</li> <li>▪ Suggest how misuse of energy can be reduced</li> </ul>	<p>2.04</p> <ul style="list-style-type: none"> <li>▪ Identify energy sources and receivers</li> <li>▪ Explain how people in the community use energy</li> <li>▪ Recognise and describe a simple electrical circuit</li> <li>▪ Describe simply how everyday items work</li> <li>▪ Describe properties of magnets and gravity</li> <li>▪ Investigate the everyday effects of friction and how it can be reduced</li> <li>▪ Explore simple methods of recycling</li> <li>▪ Investigate how people use solar energy</li> </ul>	<p>3.04</p> <ul style="list-style-type: none"> <li>▪ Identify light, sound and motion as forms of energy</li> <li>▪ Research the main forms of energy used in the home and community</li> <li>▪ Design and describe a simple electrical circuit</li> <li>▪ Identify sequences of energy transfers and describe and design ways of facilitating interrupting the transfer of energy</li> <li>▪ Describe the impact of gravity on life</li> <li>▪ Identify patterns of energy use in the home and community</li> <li>▪ Identify alternative forms of energy used in the home and community</li> <li>▪ Recognise the importance of conserving energy</li> </ul>	<p>4.04</p> <ul style="list-style-type: none"> <li>▪ Identify forms of energy such as thermal, kinetic, potential, chemical</li> <li>▪ Compare energy options available for use in the community</li> <li>▪ Design, build and use a variety of electrical circuits</li> <li>▪ Identify &amp; describe process and conditions that affect energy transfer in sequence</li> <li>▪ Compare and contrast the forces of air and gravity</li> <li>▪ Compare energy use today to the past</li> <li>▪ Describe how energy can be stored and how people manage local energy sources</li> <li>▪ Discuss safety issues and practices in using and saving electricity</li> </ul>	<p>5.04</p> <ul style="list-style-type: none"> <li>▪ Explain the properties and use of light as an energy source</li> <li>▪ Explain energy input-output of simple machines</li> <li>▪ Investigate, describe and construct electrical circuits</li> <li>▪ Describe the operation of simple electrical devices</li> <li>▪ Explain why different designs of machines are used</li> <li>▪ Research environmental effects if using different forms of energy</li> <li>▪ Apply knowledge of alternative energy sources to machines</li> <li>▪ Compare costs of different energy forms</li> </ul>

## 5. WORKING SCIENTIFICALLY

Level 1	Level 2	Level 3	Level 4	Level 5
<b>Level Outcomes</b>				
<p>1.05 Undertake simple observations to answer posed questions and make simple reports on their findings</p>	<p>2.05 Pose questions and devise and record relevant observations and suggest possible interpretations for their data.</p>	<p>3.05 Explore the impact of science on the community and plan simple investigations which include the control of variables and use a range of techniques in recording and reporting results.</p>	<p>4.05 Use scientific language and a range of scientific equipment to plan simple investigations and identify relevant variables to determine how these can be controlled in investigations.</p>	<p>5.05 Formulate testable hypotheses and devise investigations which provide adequate tests of these.</p>
<b>Contributing Outcomes</b>				
<ul style="list-style-type: none"> <li>▪ Describe own knowledge of a topic and engage in class discussion</li> <li>▪ Suggest questions for investigation</li> <li>▪ Follow simple procedures and instructions</li> <li>▪ Communicate observations by talking, drawing or acting out</li> <li>▪ Suggest what their observations mean</li> <li>▪ With assistance, develop generalisations based on their observations</li> <li>▪ Relate observations and interpretations to their own every day life</li> </ul>	<ul style="list-style-type: none"> <li>▪ List with support, own knowledge of a topic</li> <li>▪ Formulate questions to guide investigation and observations</li> <li>▪ Carry out simple tests to answer questions</li> <li>▪ Draw and label simple pictures that represent their observations</li> <li>▪ Draw conclusions by identifying patterns and grouping data</li> <li>▪ Participate in group suggestions for improvements to investigations</li> <li>▪ Describe how the community uses science</li> </ul>	<ul style="list-style-type: none"> <li>▪ Report information and personal experience to support conclusions</li> <li>▪ Design fair tests that control variables</li> <li>▪ Appropriately use suitable equipment for an investigation</li> <li>▪ Record and present information using graphs, table, lists, diagrams etc</li> <li>▪ Identify factors that may have influenced the results of their investigations</li> <li>▪ Identify different ways of finding out about a topic</li> <li>▪ Identify ways that applications of science help people</li> </ul>	<ul style="list-style-type: none"> <li>▪ List important variables in an investigation</li> <li>▪ Explain why a test is 'fair' or not</li> <li>▪ Use equipment accurately</li> <li>▪ Record and collect information to reflect observations correctly</li> <li>▪ Draw conclusions based on information collected and the purpose of the investigation</li> <li>▪ Describe techniques used to enhance observations</li> <li>▪ Locate necessary information to make decisions about applying science</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ask and refine questions to make them suitable for scientific investigation</li> <li>▪ Design fair tests which specify and control variables</li> <li>▪ Use instruments and techniques to make qualitative and quantitative observations with precision</li> <li>▪ Record information in ways to assist in making generalizations</li> <li>▪ Identify and consider factors that influence reliability of data and seek information to support conclusions</li> <li>▪ Decide on appropriate ways of conducting investigations</li> <li>▪ Identify alternative means of solving a problem or reaching an outcome</li> </ul>

## LEVEL 1

Matter	Living Things	Earth and Beyond	Energy	Working Scientifically
<b>Level Outcomes</b>				
1.01 Apply simple systems of classification to a range of materials	1.02 Identify some basic features of living things including their fundamental needs	1.03 Develop a basic understanding of how the weather affects life in the local community and of the nature of major astronomical features identifiable with the naked eye	1.04 Identify the basic properties of simple forms of energy	1.05 Undertake simple observations to answer posed questions and make simple reports on their finding
<b>Contributing Outcomes</b>				
<ul style="list-style-type: none"> <li>▪ Identify properties of materials using only senses</li> <li>▪ Describe properties of materials</li> <li>▪ Make collections of materials and group them to show variations in property</li> <li>▪ Identify some uses of materials</li> <li>▪ predict and test the effectiveness of materials</li> <li>▪ Share ideas on suitable choices of materials for familiar activities</li> <li>▪ Examine how energy is misused at home and school</li> <li>▪ Suggest how misuse of energy can be reduced</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify living and non-living things</li> <li>▪ Investigate the needs of humans, plants and animals</li> <li>▪ Investigate and compare the needs of living things</li> <li>▪ Identify and illustrate some changes that occur over time to humans, animals and plants</li> <li>▪ Illustrate the diversity of animals and plants</li> <li>▪ Investigate ways to care for living things</li> <li>▪ Identify simple systems and cycles in the environment</li> </ul>	<ul style="list-style-type: none"> <li>▪ Explore time intervals using celestial bodies</li> <li>▪ Identify features of day &amp; night sky such as sun, moon and stars</li> <li>▪ Describe observable differences between day and night skies</li> <li>▪ Describe how daily life is influenced by weather cycles throughout the year</li> <li>▪ Identify major features of the physical environment</li> <li>▪ Discriminate between natural physical features and man made features</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe properties of simple forms of energy</li> <li>▪ Classify familiar devices according to the source of energy used</li> <li>▪ Identify common electrical devices</li> <li>▪ Illustrate parts of simple devices</li> <li>▪ Identify forms of energy which can impact on everyday life</li> <li>▪ Recognise forms of energy people rely on in every day life</li> <li>▪ Examine how energy is wasted at home and school</li> <li>▪ Suggest how waste can be reduced</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe own knowledge of a topic and engage in class discussion</li> <li>▪ Suggest questions for investigation</li> <li>▪ follow simple procedures and instructions</li> <li>▪ Communicate observations by talking, drawing or acting out</li> <li>▪ Suggest what their observations mean</li> <li>▪ With assistance, develop generalisations based on their observations</li> <li>▪ Relate observations and interpretations to their own every day life</li> </ul>

## LEVEL 2

	Matter	Living Things	Earth and Beyond	Energy	Working Scientifically
<b>Level Outcomes</b>					
2.01	Explore the nature of a range of materials including their formation	2.02 Identify ways in which living things relate with each other and with their environments and change over time	2.03 Describe changes which affect the Earth through weather and through its daily and seasonal cycle	2.04 Explore factors which effect the transmission of simple forms of energy and begin to develop understandings about magnetism and electrical circuits	5.05 Formulate testable hypotheses and devise investigations which provide adequate tests of these.
<b>Contributing Outcomes</b>					
	<ul style="list-style-type: none"> <li>▪ Describe and sort the properties and structure of common materials</li> <li>▪ Identify materials with similar properties</li> <li>▪ List how we use common materials</li> <li>▪ Explore the effectiveness of materials in their everyday life</li> <li>▪ Compare different materials that can be used for the same purpose</li> <li>▪ Identify whether changes to materials can be reversed and find examples</li> <li>▪ Identify and describe the conditions that affect the rate of change in materials</li> <li>▪ Use simple technology to show and explain methods which prevent or promote change</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify observable features of living things and describe their function</li> <li>▪ Investigate how living things respond to and depend on each other in a habitat</li> <li>▪ Compare the habitats of different living things</li> <li>▪ Investigate the changes in features of living things over time</li> <li>▪ Describe how plant and animal structures assist them to survive</li> <li>▪ Discuss the work of people who care for living things</li> <li>▪ Identify life cycles of familiar living things</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate the rotation of the Earth around the sun</li> <li>▪ Link features of the sky to patterns of behaviour in everyday life</li> <li>▪ Discuss the characteristics of the solar system</li> <li>▪ Describe features of weather including cloud patterns and ways weather causes changes in environmental features</li> <li>▪ Record how changes to the earth are monitored and how this information is used</li> <li>▪ Research the effects of change on living things, the environment and human activities</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify energy sources and receivers</li> <li>▪ Explain how people in the community use energy</li> <li>▪ Recognise and describe a simple electrical circuit</li> <li>▪ Describe simply how everyday items work</li> <li>▪ Describe properties of magnets and gravity</li> <li>▪ Investigate the everyday effects of friction and how it can be reduced</li> <li>▪ Explore simple methods of recycling</li> <li>▪ Investigate how people use solar energy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ask and refine questions to make them suitable for scientific investigation</li> <li>▪ Design fair tests which specify and control variables</li> <li>▪ Use instruments and techniques to make qualitative and quantitative observations with precision</li> <li>▪ Record information in ways to assist in making generalizations</li> <li>▪ Identify and consider factors that influence reliability of data and seek information to support conclusions</li> <li>▪ Decide on appropriate ways of conducting investigations</li> <li>▪ Identify alternative means of solving a problem or reaching an outcome</li> </ul>

### LEVEL 3

Matter	Living Things	Earth and Beyond	Energy	Working Scientifically
<b>Level Outcomes</b>				
3.01 Begin to use the term 'matter' rather than 'material'. Investigate the structure and properties of a range of matter and consider the impact of various changes on matter	3.02 Investigate the various features of a range living things and how living and non-living things affect the survival of organisms	3.03 Consider the Earth's position within the Solar System and how this impacts on cycles of climate and human impact on the environment	3.04 Develop understandings about a range of properties of energy forms and the nature and effect of opposing forces	3.05 Explore the impact of science on the community and plan simple investigations which include the control of variables and use a range of techniques in recording and reporting results.
<b>Contributing Outcomes</b>				
<ul style="list-style-type: none"> <li>▪ Make links between the structure of materials and their physical properties</li> <li>▪ Investigate how unfamiliar materials can be grouped</li> <li>▪ Show how common materials can be combined to be more useful</li> <li>▪ Investigate and describe how properties of materials are linked to their use</li> <li>▪ Describe how natural raw materials are processed</li> <li>▪ Investigate the temporary and permanent changes materials go through</li> <li>▪ Identify the consequences of processing materials for humans and the environment</li> <li>▪ Investigate recycling and disposal of materials</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate common features of living things</li> <li>▪ Describe how certain features help living things to survive</li> <li>▪ Illustrate relationships between living things in a habitat and how they depend on each other</li> <li>▪ Investigate the impact of the aging process on plant and animal structure</li> <li>▪ Compare and contrast similarities and differences in and between groups of familiar living things</li> <li>▪ Describe how humans use the land and sea</li> <li>▪ Identify life cycle stages and systems in animals and plants</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify patterns of change seen on earth caused by the relationship between the sun, moon and Earth</li> <li>▪ Find and use information on space exploration to further understandings about the behaviour of Earth</li> <li>▪ Find and describe the features of the universe</li> <li>▪ Explore the effect of weather on human activity</li> <li>▪ Recognise that physical changes to the Earth are a result of physical processes</li> <li>▪ Describe how using the Earth's resources alters the physical environment and find local evidence for this</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify light, sound and motion as forms of energy</li> <li>▪ Research the main forms of energy used in the home and community</li> <li>▪ Design and describe a simple electrical circuit</li> <li>▪ Identify sequences of energy transfers and describe and design ways of facilitating interrupting the transfer of energy</li> <li>▪ Describe the impact of gravity on life</li> <li>▪ identify patterns of energy use in the home and community</li> <li>▪ Identify alternative forms of energy used in the home and community</li> <li>▪ Recognise the importance of conserving energy</li> </ul>	<ul style="list-style-type: none"> <li>▪ Report information and personal experience to support conclusions</li> <li>▪ Design fair tests that control variables for an investigation</li> <li>▪ Appropriately use suitable equipment for an investigation</li> <li>▪ Record and present information using graphs, table, lists, diagrams etc</li> <li>▪ Identify factors that may have influenced the results of their investigations</li> <li>▪ Identify different ways of finding out about a topic</li> <li>▪ Identify ways that applications of science help people</li> </ul>

## LEVEL 4

Matter	Living Things	Earth and Beyond	Energy	Working Scientifically
<b>Level Outcomes</b>				
4.01 Explore the nature of a variety of chemical reactions and the properties of various compounds and mixtures	4.02 Compare in detail the specific life systems of plants, animals and humans	4.03 Explore and identify components and structure of the universe and the Earth, and the role of various forces which act upon them	4.04 Consider the relationships between aspects of movement and develop knowledge and understandings about the operation and real world use of electricity	4.05 Use scientific language and a range of scientific equipment to plan simple investigations and identify relevant variables to determine how these can be controlled in investigations.
<b>Contributing Outcomes</b>				
<ul style="list-style-type: none"> <li>▪ Explain properties and behaviour of materials using models</li> <li>▪ Investigate the properties, formation and separation of elements of mixtures and solutions</li> <li>▪ Explain how the use of materials is determined by their physical and simple chemical properties</li> <li>▪ Design tests to compare properties of mixtures</li> <li>▪ Recognise conditions where processes occur that cause reaction and change</li> <li>▪ Investigate ways to modify change and reaction times</li> <li>▪ Describe how changes in reaction conditions affect the rate and nature of reaction</li> <li>▪ Identify reasons why materials are chosen for specific processes</li> </ul>	<ul style="list-style-type: none"> <li>▪ Classify living things in a variety of ways</li> <li>▪ Investigate and describe how living things ensure survival to the next generation</li> <li>▪ Identify potential disturbances to an ecosystem's balance</li> <li>▪ Research the effects of lifestyle on human body systems</li> <li>▪ Identify and explain why some living things have become extinct</li> <li>▪ Investigate the effects of human intervention on feeding relationships</li> <li>▪ Describe and compare the functions of animal, human and plant systems and relationships in food chains and webs</li> </ul>	<ul style="list-style-type: none"> <li>▪ Explore how different cultures have explained and used knowledge of space</li> <li>▪ Investigate how scientists study the Earth, solar system and the universe</li> <li>▪ Describe the structure of the Earth from core to atmosphere</li> <li>▪ Investigate the effects of weather on living things</li> <li>▪ Describe the characteristics and effect of earthquakes and volcanoes on the Earth</li> <li>▪ Identify characteristics of earth that allow life to exist</li> </ul>	<ul style="list-style-type: none"> <li>▪ Identify forms of energy such as thermal, kinetic, potential, chemical</li> <li>▪ Compare energy options available for use in the community</li> <li>▪ Design, build and use a variety of electrical circuits</li> <li>▪ Identify &amp; describe process and conditions that affect energy transfer in sequence</li> <li>▪ Compare and contrast the forces of air and gravity</li> <li>▪ Compare energy use today to the past</li> <li>▪ Describe how energy can be stored and how people manage local energy sources</li> <li>▪ Discuss safety issues and practices in using and saving electricity</li> </ul>	<ul style="list-style-type: none"> <li>▪ List important variables in an investigation</li> <li>▪ Explain why a test is 'fair' or not</li> <li>▪ Use equipment accurately</li> <li>▪ Record and collect information to reflect observations correctly</li> <li>▪ Draw conclusions based on information collected and the purpose of the investigation</li> <li>▪ Describe techniques used to enhance observations</li> <li>▪ Locate necessary information to make decisions about applying science</li> </ul>

## LEVEL 5

	Matter	Living Things	Earth and Beyond	Energy	Working Scientifically
<b>Level Outcomes</b>					
5.01	Investigate and manipulate elements, solutions and compounds and describe chemical reactions in scientific terms	5.02 Investigate the nature of ecosystems, endangered species and more complex systemic functions	5.03 Examine the nature of the universe and members of the solar system including exploration of the Earth's geology and related human use of minerals and fossil fuels	5.04 Investigate energy conversion and the use of lenses, mirrors and filters and the related properties of light	5.05 Formulate testable hypotheses and devise investigations which provide adequate tests of these.
<b>Contributing Outcomes</b>					
	<ul style="list-style-type: none"> <li>▪ Describe a simple atom model</li> <li>▪ Compare the properties of pure substances and mixtures, and elements and compounds</li> <li>▪ Investigate ways of separating various mixtures</li> <li>▪ Explain how materials can exist in different forms and can be used for particular purposes</li> <li>▪ Investigate substances and how they change chemically in everyday situations</li> <li>▪ Describe chemical structures of simple and common compounds and explain differences between physical and chemical change</li> <li>▪ Describe common chemical reactions using word and particle equations</li> <li>▪ Use chemical processes to make new materials and investigate their properties and uses</li> </ul>	<ul style="list-style-type: none"> <li>▪ Describe how living things have changed over time using fossils etc. as evidence</li> <li>▪ Investigate adaptations of plants and animals and how they allow plants and animals to survive in their environment</li> <li>▪ Describe how populations are naturally controlled in an ecosystem</li> <li>▪ Explain how living things help in cycling energy and matter</li> <li>▪ Explore the nature of, and similarities and differences between, cells of plants and animals</li> <li>▪ Investigate the impact of human activity on the environment and explore causes, transmission and control of disease on humans</li> <li>▪ Describe how producers modify natural systems to increase production of materials</li> </ul>	<ul style="list-style-type: none"> <li>▪ Investigate and report on how space travel and exploration is possible</li> <li>▪ Compare characteristics of Earth with other planets and celestial bodies</li> <li>▪ Investigate and report on the properties of stars</li> <li>▪ Investigate the different features of climatic zones</li> <li>▪ Describe the characteristics and formation of common rocks and soils and interpret gathered information to describe an area's geomorphology</li> <li>▪ Describe the formation, detection and extraction of minerals and fossil fuels</li> </ul>	<ul style="list-style-type: none"> <li>▪ Explain the properties and use of light as an energy source</li> <li>▪ Explain energy input-output of simple machines</li> <li>▪ Investigate, describe and construct electrical circuits</li> <li>▪ Describe the operation of simple electrical devices</li> <li>▪ Explain why different designs of machines are used</li> <li>▪ Research environmental effects if using different forms of energy</li> <li>▪ Apply knowledge of alternative energy sources to machines</li> <li>▪ Compare costs of different energy forms</li> </ul>	<ul style="list-style-type: none"> <li>▪ Ask and refine questions to make them suitable for scientific investigation</li> <li>▪ Design fair tests which specify and control variables</li> <li>▪ Use instruments and techniques to make qualitative and quantitative observations with precision</li> <li>▪ Record information in ways to assist in making generalizations</li> <li>▪ Identify and consider factors that influence reliability of data and seek information to support conclusions</li> <li>▪ Decide on appropriate ways of conducting investigations</li> <li>▪ Identify alternative means of solving a problem or reaching an outcome</li> </ul>

## Teaching and Learning in Science

Every child needs a body of scientific knowledge, understanding and skills to enable them to investigate and interact effectively with their environment. The teaching of science in schools should engage students in learning experiences that provide these necessities.

Children come into the classroom excited and curious about their environment. They have already formed some concepts of their own, by their early explorations and by comparing, quantifying and seeing relationships in their observations, or by using the observations made by other people. Information received by children will be accumulated, categorised, rearranged and modified by them to form concepts and to predict outcomes, and they will exercise some control over the effect of the environment on them.

Children often develop thinking skills and behaviour to explain problems and may design ways to check their tentative hypotheses about their world. This process of searching generates further curiosity.

At any one time amongst the children in a class, the concepts held are incomplete or even inaccurate, and the skills to process information are at different stages of refinement. It is the teacher's role to help the children discover their stage of concept development in any one area, and to help each child build on those ideas.

The function of practical work in science is to enable the student to perceive the phenomena that theory attempts to explain. It poses new problems to the student which can lead to explanations which can in turn be tested. This process allows students to challenge their own understanding of underlying theories.

Implementation of the science program must incorporate a balance between scientific process and content. While a wide range of teaching strategies are acceptable, the curriculum should reflect a commitment to four fundamental understandings about learning in science:

- children learn through active involvement and a range of first hand practical experiences,
- students need to be presented with opportunities to explore, challenge and find answers to their own questions about science,
- students need learning opportunities which extend beyond the classroom and into the community so that science is experienced in the context in which it is used,
- science learning is enhanced through its integration with other curriculum areas.

Successful science education includes the following experiences:

- problem identification
- collecting information and hypothesising
- experimenting
- decision making
- communicating and recording
- applying findings and presentation of results

A program should include the following skills:

- **Process skills:** interpreting maps, utilizing experimental controls, differentiating between observations and inferences, testing ideas and hypotheses, and formulating scientific laws.
- **Motor skills:** copying diagrams, making models, using measuring instruments, connecting circuits, using heating apparatus, using microscopes and lenses, preparing microscope slides, performing dissections, using magnets and compasses and preparing displays.
- **Interactive skills:** communicating ideas, and findings, participating in group work, acquiring scientific attitude, acquiring an appreciation of, and respect for the environment and acquiring an appreciation of traditional scientific knowledge.

## Safety

A teacher must consider organisation of space, children and equipment for successful and safe science activities.

The following precautions are worthy of particular note:

**Safety Glasses** Should be provided whenever sharp or other dangerous objects are being used.

**Razor Blades** Use single sided (eg: GEM) blades.

**Scissors** Use only for cutting, not for poking and puncturing. Keep flat on the table when not in use.

**Hammers** Break objects such as rocks inside a strong cloth bag

**Saws, Chisels, Knives** Use only with close supervision.

**Gas Burners** Follow the manufacturer's instructions very carefully for valves, lighting, storing and using. Do not allow children at lower grades to light up Bunsen burners. Close supervision when dealing with gas burners.

**Spirit Burners** Only ever refill or store away when cold. Don't light one burner by holding close to another.

**Candles** Stand in sand in an aluminium can.

**Matches** Strike away from body to light.

**Naked Flames** Must be used with extra care. Keep good spacing between work areas. Ensure appropriate ventilation, stable equipment, suitable clothing and absence of any flammable liquids. Know the fire drill.

**Test Tubes** Keep the mouths of test tubes pointed away from faces.

**Fire Safety Equipment** Might include a bucket of sand, a bucket of water, a metal dustbin lid to smother flames, a fire blanket, masonite or hardiplank desk protection under hot objects, and a serviceable fire extinguisher.

**Clothing** For both children and teachers, keep long hair tied back, allow no loose, frilly, billowing, streamer-like clothing, and try to ensure shoes are worn.

**Glassware** Find suitable instructions before cutting or bending glass. Put broken glass in a suitable labeled container and not in a wastepaper basket. Wet stoppers and tubing and protect hands before inserting tubes into stoppers. Avoid asking children to transport glass objects around the school. Children should not be asked to carry a glass aquarium.

**Thermometers** Long thermometers should not be left standing in a jar or beaker, or used for stirring liquids. They should not be put in children's mouths. Separated liquid in thermometers can be restored by leaving in the freezer (there is a risk of bursting if heated.) Students should not use mercury thermometers.

**Chemicals** Should be stored correctly away from child access. Should never be ingested. Splashes on skin or in the eye should be thoroughly irrigated with water (all eye injuries require medical advice). Be aware of first aid procedures for swallowed chemicals.

**Electrical Equipment** Normal safety household rules apply. There is no risk of electric shock from dry cells, but avoid short circuiting because of the heat generated.

**Sun** Children must *never* look directly at the sun or even reflected ray of the sun. Use only indirect light near a window for lighting microscopes.

**Live Specimens** Need to be housed and cared for adequately so that their worthwhile study can be carried out in the classroom. Take precautions about the transfer of parasites and disease, and always wash hands after handling animals. Become aware of poisonous plants and animals in your area. Ensure children report any bites or scratches from animals. Collect animals by sweeping into a container with a sturdy stick or paint brush, not fingers, and wear shoes when collecting. Avoid culturing bacteria.

**Mercury** Mercury is a toxic metal. If a mercury thermometer is broken and the mercury is not cleared away properly, it will penetrate the pores of wooden tables and concrete floors and will persistently emit poisonous vapour. Student should not use mercury thermometers. Cover larger drops of mercury with sulphur which may then be swept up with a brush and plastic pan and stored temporarily in a sealable jar. A cloth or paper towel should not be used. Smaller deposits can be collected in a medicine dropper.