

Science

Syllabus

Grades 6, 7 & 8

Standards Based



Papua New Guinea
Department of Education

**'FREE ISSUE
NOT FOR SALE'**

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Issued free to schools by the Department of Education

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Acronyms

AaL	Assessment as Learning
AfL	Assessment <i>for</i> Learning
AoL	Assessment <i>of</i> Learning
BEBoS	Basic Education Board of Studies
CDD	Curriculum Development Division
CP	Curriculum Panel
ESD	Education for Sustainable Development
IHD	Integral Human Development
NDoE	National Department of Education
OBC	Outcomes Based Curriculum
OBE	Outcomes Based Education
SAC	Syllabus Advisory Committee
SBC	Standards Based Curriculum
SBE	Standards Based Education
SCG	Subject Curriculum Group
STEAM	Science, Technology, Engineering, Arts & Mathematics
STEM	Science, Technology, Engineering & Mathematics

Secretary's Message

The development of Grades 6, 7 and 8 Science Syllabus is a direct response to the government's directive through the Outcomes Based Education (OBE) exit report, (Czuba, 2013) to phase out Outcomes Based Curriculum and realign the curriculum using standards based approach.

The realignment of science curriculum from Outcomes Based Curriculum (OBC) to Standards Based curriculum (SBC) is aimed at improving the organisation of content and context of what the students will be studying at that level. It is envisaged that by the end of grade 8, the students will acquire the necessary basic science knowledge, skills and attitude or values to help and prepare them to progress to the next level of learning while at the same time aiming to strive and compete against 21st century competencies and demands.

It is therefore, important for science teachers to be creative, innovative and motivated when teaching science. The realigned Science curriculum is focused on scientific skills and process, utilising the analytical and inquiry based approaches where students will be encouraged to predict, explore, question, test ideas, formulate questions and challenge their own ideas and overtime become scientifically literate. Scientific literacy is critically important for Papua New Guinea to participate productively in an increasingly competitive knowledge and technologically based society.

Teachers are encouraged to use the syllabus in conjunction with the Teacher Guides and other relevant resources to generate creative teaching and learning activities to deliver the Science content.

I commend and approve this Science Syllabus for Grades 6, 7 and 8 to be used in all schools throughout Papua New Guinea.



.....
DR. UKE W. KOMBRA, PhD
Secretary for Education

Introduction

The introduction of Standards Based Education in Papua New Guinea is an important Government directive to raise performance competencies in all aspects of education; curriculum development, teacher training, student and teacher performance, monitoring, school management and leadership. The designing of courses in the curriculum have been done to raise standards in teaching and learning at all levels of schooling through reviewing, aligning, realigning and repositioning of the existing content in order to cater for the shift in the pedagogy.

The purpose of Science Syllabus for Grades 6, 7 and 8 is to provide relevant content and context for teachers to use when planning and teaching Science. The aim at this level is for students to acquire the necessary basic science knowledge, skills, attitudes and values to help and prepare them to progress to the next level of learning while at the same time aiming to strive and compete against 21st century competencies and demands.

The Standards Based Curriculum uses the terms; Content Standards and Performance Standards as yardsticks for teaching and learning. A Content Standard is a statement describing a specific content, skill, competency or behaviour is to be achieved by the students for a given time frame. The standards are student centred and written in terms that enable them to be demonstrated, assessed and measured. These statements are written to show progression from one grade to the next.

The Science course content and context contained in the Outcomes Based Curriculum (OBC) have been realigned and repositioned to improve what students will study at Grade 6, 7 and 8 levels as Standards Based Curriculum (SBC). What is contained in this syllabus is aligned with the Grades 3, 4 and 5 Science syllabus as well as Grade 9 and 10 syllabi.

The content is organised under the three strands; **Life, Physical Science** and **Earth and Space** and is timetabled for 200 minutes per week with a suggested time break up of five lessons for a 40 minutes period. The strands are further broken down into Units, Topics and Sub-Topics in which lessons can be planned and taught. These are further outlined in the Teacher Guides for each of the specific grades.

Time allocation for Science is 200 minutes per week for grades 6, 7, 8. Teachers can use the time allocated to do their timetable or program according to their school program.

Aims and Goals

Ultimate Aim

The ultimate of education in Papua New Guinea is Intergral Human Development (IHD), that is:

- *integral* in the sense that all aspects of a person are important,
- *human* in the sense that social relationships are basic for humanity and should be the building blocks and,
- *development* in the sense that every individual has the potential to grow in the knowledge, wisdom, understanding, skill and goodness.

Goals

- 1) Every person will be dynamically involved in the process of freeing himself or herself from every form of domination and oppression so that each individual will have the opportunity to develop as an integrated person in relationship with others. This means that the National Curriculum must integrate and maximise socialisation, participation, liberation and equality.
- 2) Awareness of human potential and the willingness to develop this potential so that each individual can solve his or her own problems, contribute to the common good of society and maintain, promote and improve learning and living.
- 3) Awareness of the goodness and the dignity of every person. It calls for the promotion of self and mutual respect for self, a sense of self-worth and self-discipline and a sense of responsibility for one self and others.

Overarching Curriculum Principles

Curriculum principles identify, describe and focus attention on the important concerns that must be addressed when developing the curriculum at all levels of schooling. They are based on significant cultural, social and educational values and beliefs.

Relevance

The National Curriculum should be relevant to the social, spiritual and resource development needs of a community. This can be achieved by integrating teaching and learning situations that reflect the knowledge, skills, attitudes and spiritual values needed for integral human development. A relevant national curriculum will prepare students for productive community living; integrate academic and practical education; and will provide ways to paid and unpaid employment.

Most people in Papua New Guinea work in the informal economy. Students who leave at the end of grade 8, 10 and 12 will need to find work in the informal economy. These students, however, will not only need to be skilled to work in the informal economy, but they will also need to be prepared to work in the formal economy and undertake formal education if there are opportunities. All students will need applied and academic skills and knowledge. All students will need to know how to adapt new technologies and knowledge appropriately to their environment.

The National Curriculum will enable teachers to support students learning by encouraging teaching in real-life contexts. This means relating the skills and knowledge of subjects to real life situations. For example, mathematics can be used to study how to run a business, or appropriate technology can be applied to improve water supplies. People from the community could also be brought into the classroom to help teach a topic and support students undertaking useful projects in the community.

Multiculturalism

Papua New Guinea is blessed and fortunate to have so many languages and cultures. The diversity of our cultures is the source of our knowledge, skills, attitudes and values. As a multicultural society, we must protect, promote and respect our many cultures and languages. There are many people from our own ethnic groupings and from other countries with their own cultures, living and working together in Papua New Guinea. This is the most multicultural country in the world. We must ensure that we promote and share our cultures with the rest of the world.

Ethics, Morals and Values

Papua New Guinea is striving to create a society in line with democratic liberal traditions. The citizens of Papua New Guinea should recognise appropriate social relationships based on sound human and religious ethics, morals and values. These are required for interaction with families, villages, and other economic groups and people from other provinces and nations. The process of socialisation requires a belief in the ethics, morals and values of the Melanesian extended family, dialogue with and respect for others and a willingness to conserve and promote those aspects of our traditions, which are consistent with integral human development. Socialisation also requires an awareness of the interdependence of individuals, societies and nations in the modern world. It requires involvement with family, school, church, community and the world beyond.

Integral Human Development

The Philosophy of Education for Papua New Guinea as described in the *Matane Report* acknowledges the National Goals and Directive Principles in the National Constitution and is based on integral human development:

- *integral* in the sense that all aspects of a person are important,
- *human* in the sense that social relationships are basic and,
- *development* in the sense that every individual has the potential to grow in the knowledge, wisdom, understanding, skill and goodness.

Integral human development is the ultimate goal for every person who receives an education and;

- will result in every person being dynamically involved in the process of freeing himself or herself from every form of domination and oppression so that each individual will have the opportunity to develop as an integrated person in relationship with others. This means that the National Curriculum must integrate and maximise socialisation, participation, liberation and equality,
- is based on an awareness of human potential and the willingness to develop this potential so that each individual can solve his or her own problems, contribute to the common good of society and maintain, promote and improve learning and living and,
- can build upon the goodness and dignity of every person. It calls for the promotion of self and mutual respect, a sense of self-worth and self-discipline and a sense of responsibility for one self and others.

Papua New Guinea is a rapidly changing society and faces many challenges. To face this effectively, an individual must strive to become an integrated person and to work with others to create a better community.

The process of integral human development calls for a National Curriculum, which helps individuals to;

- identify their basic human needs,
- analyse situations in terms of these needs,
- see these needs in the contexts of spiritual and social values of the community and,
- take responsible action in co-operation with others.

The success of a National Curriculum requires the integrated involvement of all the agents of education such as the home, church, school and community. Within the National Curriculum, the teachers must integrate knowledge, skills and attitudes to allow students to achieve the desired outcomes of integral human development.

The Right to Healthy Living

The health status of Papua New Guinea is very low. All citizens have a right to a healthy life such as clean water, a nutritious diet, improved sanitation, appropriate and better local health services. Students need to learn attitudes, skills and knowledge that will help them become productive, healthy and contented citizens of Papua New Guinea. They need to be given a set of skills that will enable them to improve their own and their community's health in order to improve the health status of Papua New Guinea. The National Curriculum will ensure that students have the opportunity to learn about healthy living.

Nation Building and National Unity

Our nation is young and there is still a great deal of nation building to be done. Students need to be given the skills to undertake this task and participate in nationally organised events. The National Curriculum should enable them to understand how Papua New Guinean societies work and how they can be a useful part of these societies. Students should learn that they have a place in Papua New Guinea and that Papua New Guinea has a place in the world as a whole. They will be able to help Papua New Guinea develop a national identity as one nation if they learn to:

- work together with tolerance,
- respect one another, their different traditional ways and resolve problems peacefully,
- respect and act in the spirit of the National Constitution,
- recognise their capabilities and develop their own talents,
- participate in the development of the national community and,
- protect and safeguard the national wealth and resources and consider how they will contribute to national revenues.

Education for Sustainable Development

PNG National curriculum focuses on Education for Sustainable Development (ESD) as an integral part of learning in the 21st century, ensuring learners are equipped to participate in and contribute to their own society and the wider world. Education for Sustainable Development (ESD) is much more than teaching content related knowledge and skills; it is also about teaching new ways of thinking about and perceiving the realities of our world and the possibilities for change. It is an approach to teaching and learning based on the ideals and principles that supports sustainability of - human rights, sustainable livelihoods, peace, environmental protection, health, biological and landscape diversity, climate change, gender equality, and protection of indigenous cultures.

Education for Sustainable Development (ESD) prepares students to be actively involved in creating a sustainable future by engaging them in solutions-based design and action that integrates knowledge across different disciplines and that considers diverse social, economic, and cultural perspectives. These skills and approaches also position students to perform more successfully across the school curriculum and prepare them for higher education and careers in a twenty-first century world.

Gender Equity and Social Inclusion

Gender equity means equally valuing both the differences and the similarities between boys and girls and the varying roles they play. It does not mean that girls become the same as boys. It means that having the ability to access rights or opportunities does not depend on being male or female.

Integrating this critical understanding into our school culture, teaching/learning and assessment strategies and operational planning within the school and the community will help us to understand the differences between boys and girls and to develop different treatments to achieve more equal results regardless of gender.

Social Inclusion means ensuring that people who might be excluded socially because of their gender, age, status, clan, descent, disability, ethnic background, HIV or other health status, migrant status, religion, sexual orientation, social status, where they live or other social identity, have equal conditions for realising their full human rights and potential to contribute to national, political, economic, social and cultural development and to benefit from the results.

The Department of Education Gender Equality in Education Policy NDOE, 2003, recommends that no students in the education system of Papua New Guinea will be disadvantaged on the basis of gender. To implement the policy, teachers have responsibility to use and promote gender equality practices in their classrooms and with the wider community.

In a gender inclusive environment no one student:

- should be involved in all activities through formal and structured learning settings,
- should participate in a curriculum that is inclusive and caters for both gender equality and social issues that enhances learning,
- share and equally participate in activities, involving all students,
- show respect for other students peers and their contributions in the learning environment,
- are exposed to a safe, challenging learning environment which is socially and culturally supportive and,
- pursue program that recognises the contributions to society of both women and men.

The approaches used in Health Physical Education lessons should reflect a balance of gender roles and responsibilities. It is important to provide fair and equal access to resources, participation and teaching time to promote gender equity for girls and boys.

Teachers are responsible for ensuring that what is taught and learned contributes in a positive way to the lives of both girls and boys, and all students should have equal access to the knowledge and skills that schools provide. Teachers are encouraged to have equal expectations of girls and boys and to treat them equally.

Inclusive Curriculum

The Ministry of Education is committed to “support the delivery of inclusive education in all schools by providing support and services to all learners, and by taking appropriate steps to make education available, accessible and adaptable to all learners.” An inclusive curriculum is acknowledged to be the most important factor in achieving inclusive education. In planning and teaching the school curriculum, teachers are therefore required to give due regard to the following principles:

- varied approaches to teaching, learning, and assessment should be planned to allow all students to participate fully and effectively. Justification of what to be delivered to the students should take on the diverse cultures, beliefs, strengths, and interests that exist in any classroom and these influence the way students learn,
- continuous formative evaluation must be used to shape instruction, thus maximising students’ opportunities for achieving success. Assessment strategies must be appropriate to the way the curriculum is designed and delivered and,
- suitable technology should be used in instruction to facilitate learning and enhance success.

The National Content Standards set out what most students should be taught at schools, but teachers should teach the required knowledge and skills in ways that suit student interests and abilities. This means exercising flexibility and drawing from curricular for earlier or later class levels to provide learning opportunities that allow students to make progress and experience success. The degree of differentiation exercised will depend on the levels of student attainment and their innate learning abilities.

Curriculum options in Science should be broad enough for students to have equal opportunities to reach their maximum potential. All learners should have equitable access to and participation in all aspects of the teaching and learning process, regardless of location, gender, ethnicity, ability, disability and socioeconomic circumstances.

To be inclusive teachers will need to ensure that all girls and boys have the opportunity to participate. Teaching practices, including classroom organisation and management, should ensure that girls and boys are able to participate fully in all learning activities. Participation requires that individuals are motivated to achieve the goal of socialisation fully where they are encouraged to develop a sense of obligation for the opportunity to contribute. Through participation, individual creativity can be recognised and encouraged as contributing to social and national development, without losing sight of the principle of communal sharing. Participation is the key to social interaction and can lead to social mobility. It can also help to conserve and generate knowledge and cultural values for future generations.

Student-Centred Learning

Student-centred learning recognises the fact that no two classes are alike and no two children are the same with respect to their needs. A teacher who uses a student-centred approach will endeavour to create a classroom environment that will motivate students to discover new skills and knowledge. In such an environment, the teacher might focus on teaching students how to learn and help them discover relevant information. It is essential to teach students how to learn while at the same time teaching them important content. In a classroom where students - centered learning takes place involves student working together.

The National Curriculum describes the learning outcomes for all subjects. A student-centred approach allows teachers to be more flexible in determining the most effective ways to help all students achieve these learning outcomes.

Lifelong Learning

Formal learning is an important part of a student's education but learning continues throughout life. The initial experience that students have with the school curriculum is critical in encouraging them to continue learning throughout their lives. Going to school should be an enjoyable and satisfying experience for the students and should prepare them for life after school. Students know many things when they come to school. They will learn many things outside of school and continue to learn after they leave school. The National Curriculum should build on what students already know.

Teachers should make use of this knowledge and skills. When students are learning new, unfamiliar things, teachers should relate the new things to what students already understand. These important learning will continue throughout life as students increasingly take responsibility for their own learning. Increasingly, students who leave school will look for opportunities to continue their education and to return to school or some other educational or training institutions in order to improve their qualifications.

Language Development Across the Curriculum

The National Curriculum will provide opportunities for language development across the curriculum. Language development across the curriculum should be encouraged because all subject areas provide meaningful contexts for real purpose learning. Specific subjects have different language requirements such as, the vocabulary and language features of science and the written and oral genres to narrate, explain, persuade, report, and discuss the particular content of various subjects. The conventions and differences must be explicitly taught in relevant contexts across the curriculum.

Standards Based Curriculum Principles

The principles of the Standards Based Curriculum (SBC) include the following:

- setting of high academic standards and a careful and continuous assessment and reporting of students' performance against these standards, will motivate students to perform at a much higher level,
- standards allow every student, every parent, and every teacher to share in common expectations of what students should know, understand, and be able to do,
- students will learn more when more is expected of them in school and at home,
- the setting of clear, measurable, and attainable standards is the key to attaining high academic standards and hence the attainment of the desired quality of education,
- all children are capable of learning and achieving high academic standards, regardless of their backgrounds and,
- students can learn in their own ways and at their own rates.

Rationale, Aim and Goals and Guiding Principles of Science

Papua New Guinea (PNG) like any other countries in the world is also making concerted efforts to boost student achievement in literacy, numeracy and Life skills. Science course is no exception since Science is regarded as a key life skill and efforts are aimed at improving science education to develop deep, lasting changes in how students learn this critical yet vital subject. In fact, Science has always been the main driver for all creativity, innovation, discoveries, inventions or constructions as stressed by International Education Association (IEA, 2003) with the following words;

Science is fundamental in life because it has direct application to nearly all aspects of life and society, from sustaining humankind survival through the maintenance and improvement of lifestyles and health to understanding and solving local, regional, and global issues (IEA, 2003)

Science can be seen as an important hub for linking learning and living and sustaining life overtime. Understanding and knowing about science, having the ability to reason and apply appropriate scientific skills are very important elements to both students' comprehension of life around them and the advancement of humankind.

The realigned Science curriculum is focused on scientific skills and processes, utilising the analytical and inquiry based approaches where students will be encouraged to predict, explore, question, test ideas, formulate questions and challenge their own ideas and overtime become scientifically literate. It is aimed at fuelling the spirit of curiosity and exploration as they progress from one level of learning to another. The knowledge and skill captured at this level should provide a strong foundation to bridge over to next level of learning and discovery.

The end goal is for students to enjoy science and value science as an important tool in helping explore the natural world and human interactions while at the same time nurturing them to grow and become a meaningful member of the society as stipulated under the National Education Act (1983 amended 1995) promoting Integral Human Development.

Aim and Goals

Students to understand and appreciate the interconnectedness between the physical, biological and technological world and have the knowledge, skills and values to make decisions in relation to the sustainable management and the use of the resources for the benefit of all.

Ultimate Aim

The Grades 6,7 & 8 Science subject aims to develop appropriate and positive attitudes and relevant skills to enable students to solve problems and make informed decisions about their future. Their intellectual development is foremost for a fast developing nation.

Goals

Students will be able to:

- develop scientific knowledge and methods to solve problems in daily situations,
- acquire basic scientific concepts to help them understand themselves and the world around them,
- use practical experiences to understanding the importance of sustainable development practices in their own environments,
- learn about and appreciate the interdependence of all living things in the environment,
- develop skills, habits of mind and attitudes necessary for scientific inquiry and,
- use their experiences to build on their interest in and stimulate their curiosity about their environment.

Guiding Principles

Science curriculum principles identify, describe and focus attention on the important concerns that must be addressed when developing and implementing science curriculum. There are the underlying guidelines in which both the teacher and the learner should be aware of and be focused on when teaching or learning Science.

The recipients should be able to develop a certain level of sensitivity to the implications of science for individuals and society and understand that science is a human endeavour with consequent limitations. Students should be guided to create an interest and openness to new ideas, to critically analyse situations, generate new theories and ideas, develop intellectual honesty, integrity and respect for evidence based on data and value the outcome of what is explored and gathered. Science at grades 6, 7 and 8 is founded on the following guiding principles:

- science without laboratory,
- science as inquiry,
- working safely during Science lessons,
- instructional Technology and,
- links to other learning areas (cross-curricular).

Community and Student - Centred Science Learning

Practical Science can be taught without a laboratory. Learning of Science processes and procedures will happen in a regular classroom setting. It is important that teachers establish a Science corner in the classroom where relevant materials and equipment are made accessible to students for planned science activities. These will often be materials collected from home or readily available from local stores such as calibrated jars, tins, newspapers, cardboards, specimens of plants and animals, flower pots, charts, used wires and batteries.

Science as Inquiry

Science as inquiry refers to the many ways in which scientists study the natural world. When engaging in inquiry, students:

- make observations by describing objects and events,
- ask questions,
- plan their activities,
- gather information,
- test ideas and carry out investigations,
- come up with their own conclusions,
- communicate their understanding to others and,
- consider alternative explanations.

Creating and promoting a safe working environment

During science lessons, teachers must be certain that students know how to follow safety guidelines, demonstrate appropriate laboratory safety techniques, and use equipment safely while working individually and in groups. Safety must be given the highest priority in implementing the instructional program for science. Correct and safe techniques, as well as wise selection of experiments, resources, materials, and field experiences appropriate to age levels, must be carefully considered with regard to the safety precautions for every instructional activity. Safe science classrooms require thorough planning, careful management, and constant monitoring of student activities. Class enrolment should not exceed the designed capacity of the room.

Teachers must be knowledgeable of the properties, use, and proper disposal of all chemicals that may be judged as hazardous prior to their use in an instructional activity. The identified precautions involving the use of goggles, gloves, aprons, and fume hoods must be followed as prescribed.

While no comprehensive list exists to cover all situations, the following should be reviewed to avoid potential safety problems. Appropriate safety procedures should be used in the following situations:

- observing wildlife; handling living and preserved organisms; and coming in contact with natural hazards, such as poison ivy, ticks, mushrooms, insects, spiders, and snakes,
- engaging in field activities in, near, or over bodies of water,
- handling glass tubing and other glassware, sharp objects, and lab ware,
- handling natural gas burners, Bunsen burners, and other sources of flame/heat,
- working in or with direct sunlight (sunburn and eye damage),
- using extreme temperatures and cryogenic materials,
- handling hazardous chemicals including toxins, carcinogens, and flammable and explosive materials,
- producing acid and base neutralisation or reactions and dilutions,
- handling power equipment or motors and,
- working with high voltage and exposed wiring.

Enhancing Science Teaching and Learning Using Instructional Technology

The use of current and emerging technologies is essential to the Prep - Grade 12 science instructional program. Technology must, specifically accomplish the following:

- assist in improving every student's functional literacy. This includes improved communication through reading/information retrieval (the use of telecommunications), writing (word processing), organisation and analysis of data (databases, spreadsheets, and graphics programs), presentation of one's ideas (presentation software), and resource management (project management software),
- be readily available and regularly used as an integral and ongoing part of the delivery and assessment of instruction,
- include instrumentation oriented toward the instruction and learning of science concepts, skills, and processes. Technology, however, should not be limited to traditional instruments of science, such as microscopes, lab ware, and data-collecting apparatus, but should also include computers, robotics, interactive-optical laser discs, video-microscopes, graphing calculators, CD-ROMs, probe ware, global positioning systems (GPS), online telecommunication, software and appropriate hardware, as well as other emerging technologies and,
- be reflected in the "instructional strategies" generally developed at the local school division level.

In most cases, the application of technology in science should remain "transparent" unless it is the actual focus of the instruction. One must expect students to "do as a scientist does" and not simply hear about science if they are truly expected to explore, explain, and apply scientific concepts, skills, and processes.

As computing skills are essential components of every student's education, it is important that teaching these skills is a shared responsibility of teachers of all disciplines and grade levels.

Content Overview

The content overview is the description of what students will learn for each grade prescribed in the syllabus content. The Science course is organised into three strands. Each strand identifies a particular aspect of Science that shows progression of learning from one grade to the next. Each strand identifies a particular concept of a subject or particular concepts. Each strand is further organised into units to allow content standards and benchmarks to be written and implemented.

Table of strands and units

The table below outlines the strands and the units for grades 6, 7 and 8 Sciences subject. This helps teachers to understand how to deal with these broader concepts when they are expanded into content standards and benchmarks.

Strands	Units
1. Life	1. Plants 2. Animals 3. Human Body 4. Interaction and Relationship in the Environment
2. Physical Science	1. Energy 2. Force and Motion 3. Matter
3. Earth and Space	1. Our Earth 2. Weather and Climate 3. Space

Science Process Skills Overview

The science process skills are the tools that students use to investigate the world around them and to construct science concepts. It involves skills that require more complex experiences such as the ability to observe that is developed and utilized naturally even in very early ages, in addition to comparison skills, data gathering, data interpretation and ability to hypothesise. It is therefore essential for teachers to have a good understanding of these skills in order to incorporate or focus on certain skills when planning and teaching. The inquiry based approach to teaching and learning promotes the use of science process skills to nurture learners to become interested in science, think scientifically and overtime utilise the skills at different settings.

The table below shows Science Process Skills that should be emphasised in each grade levels when teaching science in the classroom.

Basic Science Process Skill	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9 & Beyond
Observing	→						→
Classifying	→						→
Measuring	→						→
Inferring				→			→
Predicting	→						→
Communicating	→						→
Integrated Science Process Skill	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9 & Beyond
Formulating hypothesis				→			→
Designing investigation					→		→
Describing relationship between variables					→		→
Defining variables operationally						→	→
Identifying variables				→			→
Experimenting	→						→
Acquiring data			→				→
Organising data in tables and graphs			→				→
Analysing investigations and their data					→		→
Understanding cause and effect relationships		→					→
Formulating models				→			→
Manipulative skill	Grade 3	Grade 4	Grade 5	Grade 6	Grade 7	Grade 8	Grade 9 & Beyond
Using and handling science apparatus	→						→
Maintaining science apparatus correctly and safely	→						→
Cleaning science apparatus correctly	→						→
Handling specimen correctly and carefully				→			→

Content Standards, Benchmarks and Evidence Outcomes

Content Standards, Benchmarks, and Evidence Outcomes are all curriculum standards. However, they have specific curriculum purposes. Despite this, these curriculum standards are interconnected and enable the intended learning outcomes to be attained.

Content Standards

Content Standards are broadly stated expectations of what students should know, understand, and be able to do in particular subject, grade level, or school level. For example, Pupils will be able to interact and convey simple messages using comprehensible language.

Benchmarks

Benchmarks are specifications of content standards or more detailed descriptions of a specific level of performance expected of students at particular ages, grades, or levels of development. For example, grade 6 students will meet the above standard when they ask and answer questions about routine matters using comprehensible language. Benchmarks focus on the essential knowledge, skills, values and attitudes that all students are expected to learn, master and demonstrate competency using various representations in real life situation.

Evidence Outcomes

Evidence outcomes are indicators that indicate students' progress towards meeting an expectation at the mastery level. They measure students' mastery and application of knowledge, skills, values, and attitudes at grade and cluster levels.

Content Standards and Benchmarks Coding

The following is the coding system used to code the content standards and benchmarks. They not only make it easier to interpret and understand the relationship between these two standards but also help with planning lessons and assessing and reporting of students' performance in relation to a content standard.

Grade:	Grade is indicated by the first number (<i>for example, 6</i>)
Strand:	Strand is indicated by the second number (<i>for example, 6.1</i>).
Content Standard:	Content Standard is indicated by the third number (<i>for example 6.1.1</i>)
Benchmark:	Benchmark is indicated by the fourth number (<i>for example, 6.1.1.1</i>)

Thus, the code will read as **Content Standard 6.1.1. and Benchmark as 6.1.1.1**

Grade 6 Strands and Units

Strand 1: Life

Rationale

The Life strand is about living things, their life processes, and their interrelationships and their environment. It deals with the structure and behavior of organisms like plants, animals and human beings. It further explores the characteristics of organisms, life cycles of organisms, and the interactions among all components, living and non-living of the natural environment.

In grade 5, the students have learned about conditions for plant growth, reproduction process in human and animals; and hereditary characteristics in animals, habitat and adaptation, and source of energy for living thing in the environment.

Thus, in grade 6, it is important for students to understand the reproduction process, hereditary characteristics and transportation of water in plants; respiratory and circulatory system of human body and food chain and food web in the ecosystem.

Evidence Outcomes

At the end of grade 6, all students can:

- identify the reproductive parts of a flower and state their functions.
- describe the processes in reproduction process in flowering and non-flowering plants.
- identify the hereditary characteristics in plants.
- describe how water is transported to all parts of the plant through the roots, stem and leaves.
- describe the structure and functions of the respiratory and circulatory system of the human body.
- explain the relationship between the organisms in food chain and food web.

Unit 1: Plants

In this unit, students will learn about the reproductive parts of flowers and the process of reproduction in flowering plants such as pollination and fertilisation; and non-flowering plants and hereditary in plant with regards to characteristics. They will also learn about the pathway of water in plants.

Content Standard	Benchmarks
6.1.1. Students will be able to investigate the reproductive parts, the process of reproduction, and heredity in plants.	<p>6.1.1.1. Identify the reproductive parts of a flower and examine their functions.</p> <p>6.1.1.2. Describe and analyse the sexual reproduction process of flowering plants such as pollination, fertilisation, and seed dispersals.</p> <p>6.1.1.3. Describe and analyse the reproduction process of non-flowering plants using the life cycle of a fern as a case.</p> <p>6.1.1.4. Identify and evaluate the hereditary characteristics of plants.</p>

Content Standard	Benchmarks
6.1.2. Students will be able to investigate the pathways of water in plants.	<p>6.1.2.1. Identify the paths of the water transport system in plants and examine their functions.</p> <p>6.1.2.2. Discuss the transportation of water to all parts of the plant through the roots, stem, and leaves.</p> <p>6.1.2.3. Investigate the process of transpiration in plants.</p>

Unit 3: Human Body

In this unit, students will learn about structures and functions of human respiratory and circulatory systems

Content Standard	Benchmarks
6.1.3. Students will be able to investigate the structure and the functions of the respiratory and circulatory systems of the human body.	<p>6.1.3.1. Describe the structure and the function of the lung.</p> <p>6.1.3.2. Identify the organs of the human respiratory system and examine their functions.</p> <p>6.1.3.3. Investigate the movement of air in and out of the human body through the respiratory system.</p> <p>6.1.3.4. Examine the structure and the function of heart and blood vessels.</p> <p>6.1.3.5. Identify the organs of the human circulatory system and examine their lung functions.</p> <p>6.1.3.6. Explain the relationship between the heart and the lung.</p>

Unit 4: Interaction and Relationship in the Environment

In this unit, students will learn about the paths of energy in the food chain and the food web.

Content Standard	Benchmarks
6.1.4. Students will be able to examine the paths of energy and the relationship of organisms in the food chain and the food web.	<p>6.1.4.1. Use basic research skills to investigate the food chains in different environments such as land and ocean, and draw appropriate conclusions.</p> <p>6.1.4.2. Investigate the relationship between the organisms in the food chain such as prey and predator.</p> <p>6.1.4.3. Analyse food webs in different environments such as land and ocean.</p> <p>6.1.4.4. Examine the relationship between the organisms in the food web such as producers and consumers.</p> <p>6.1.4.5. Assess the impact of population change in a food chain or a food web.</p> <p>6.1.4.6. Probe the roles of decomposers and the recycle of energy in a food chain.</p>

Strand 2: Physical Science

The Physical Science strand is about the study of matter, energy and the changes they undergo. The universe is composed of matter, some branches of physical science are chemistry and physics. Chemistry is the study of the properties of how matter changes. Whilst, physics is the study of matter, energy, motion and forces and how they interact.

In grade 5, the students have learned about properties of heat, electrical circuits, change in motion and regularity of levers, three states of matter and common chemical changes.

Thus, in grade 6, it is important for students to understand the forms of energy, properties of electromagnet, characteristics of weight and mass, types of mixtures and solutions; and methods of separating mixtures.

Evidence Outcomes

At the end of grade 6, all students can:

- identify the different sources, forms of energy and describe how they are changed from one form to another.
- describe the properties of electromagnet.
- measure weights of objects using a spring balance and explain the characteristics of weight and mass.
- describe the properties, types of mixtures and solutions and apply different methods of separating mixtures.

Unit 1: Energy

In this unit, students will learn about the forms and the uses of energy, and the properties of electromagnet.

Content Standard	Benchmarks
6.2.1. Students will be able to investigate the forms and conversion of energy.	<p>6.2.1.1. Recognise that the Sun is the primary source of heat and light energy.</p> <p>6.2.1.2. Examine the different sources of energy.</p> <p>6.2.1.3. Investigate the different forms of energy and their uses.</p> <p>6.2.1.4. Discuss how energy changes from one form to another.</p>
6.2.2. Students will be able to examine the properties of electromagnet	<p>6.2.2.1. Examine the properties of electromagnet.</p> <p>6.2.2.2. Determine that the polarity of the electromagnet changes when direction of the electric current changes.</p> <p>6.2.2.3. Investigate the conditions that strengthen the magnetism of an electromagnet.</p> <p>6.2.2.4. Appraise the uses of electromagnets in daily life.</p>

Unit 2: Force and Motion

In this unit, students will learn about the types of forces and their effects. They will also learn about the mass and weight in relation to gravity.

Content Standard	Benchmarks
6.2.3. Students will be able to investigate the types of forces and their effects.	<p>6.2.3.1. Investigate the different types of forces and their effects.</p> <p>6.2.3.2. Distinguish types of forces as contact and non-contact forces.</p> <p>6.2.3.3. Evaluate the effects of forces.</p> <p>6.2.3.4. Categorise force by its magnitude and direction.</p>

Content Standard	Benchmarks
6.2.4. Students will be able to examine the effects of Earth's gravity on weights of objects.	<p>6.2.4.1. Investigate the effects of Earth's gravity on weights and objects.</p> <p>6.2.4.2. Use a spring balance to measure weights of objects.</p> <p>6.2.4.3. Apply Standard International units to measure weight and mass of objects.</p> <p>6.2.4.4. Explain the characteristics of weight and mass.</p> <p>6.2.4.5. Identify and examine examples of gravity in daily life.</p>

Unit 3: Matter

In this unit, students will learn about the properties and types of mixtures and solutions. They will also learn about separating mixtures using filtration and evaporation methods.

Content Standard	Benchmarks
6.2.5. Students will be able to investigate the properties of mixtures and solutions.	<p>6.2.5.1. Describe what solutions are.</p> <p>6.2.5.2. Explain the conditions that affect the solubility of substances such as temperature, amount of water and amount of solute.</p> <p>6.2.5.3. Explain that the weight of water and the solute remains unchanged when the solute is dissolved in water.</p> <p>6.2.5.4. Determine that there is a limit to the amount of solute that can be dissolved in a solvent to form a saturated and an unsaturated solution.</p> <p>6.2.5.5. Examine the components of different types of mixtures.</p> <p>6.2.5.6. Compare and contrast the difference between solutions and suspensions.</p> <p>6.2.5.7. Apply different methods of separating mixtures such as filtering and evaporating.</p>

Strand 3: Earth and Space

Earth and Space strand explores the interconnections between the land, ocean, atmosphere, and life of our planet. These include the cycles of water, rock, and other materials that continuously shape, influence, and sustain Earth and its inhabitants.

Earth and Space is about Earth and its place within the solar system and the universe. It includes the study of the Earth; its land, oceans, atmosphere, and all the life that lives on it from humans to animals to plants. It includes the water cycle, the carbon cycle, the rock cycle, and anything that gradually affects the Earth over time.

The ‘space’ parts talk about the Earth’s position in the solar system, and it also explores the solar system, and universe as a whole.

In grade 5, the students have learned about rocks, minerals and fossils; weather and seasons. There was no content covered for the unit space.

Thus, in grade 6, it is important for students to understand the formation of soil layers, sedimentary rocks, land change, types of moon phases and constellation in the night sky.

Evidence Outcomes

At the end of grade 6, all students can:

- describe the formation of soil layers, sedimentary rocks and the causes of land change.
- identify the causes of the different types of moon phases and explain the effects of the positional relationship between the Moon and the Earth.
- describe the movement of stars in relation to Earth’s rotation and identify the different types of constellation seen in the night sky of Papua New Guinea.

Unit 1: Our Earth

In this unit, students will learn about the formation of soil layers, sedimentary rocks, and causes of land changes.

Content Standard	Benchmarks
<p>6.3.1. Students will be able to investigate the formation of soil layers, sedimentary rocks and the causes of land change.</p>	<p>6.3.1.1. Examine the formation of soil layers.</p> <p>6.3.1.2. Classify and profile the types of sedimentary rocks according to their physical characteristics.</p> <p>6.3.1.3. Investigate the formation of sedimentary rocks.</p> <p>6.3.1.4. Analyse the natural causes of land change such as soil erosion, weathering, volcanoes, and earth quakes.</p>

Unit 3: Space

In this unit, students will learn about the different phases of the moon and its causes, position of the stars in the night sky and the different constellations in Papua New Guinea night sky.

Content Standard	Benchmarks
6.3.2. Students will be able to explain the motion of the moon and the different moon phases.	<p>6.3.2.1. Explain that moon orbits around the Earth.</p> <p>6.3.2.2. Examine the causes of the different types of moon Phases.</p> <p>6.3.2.3. Discuss the positional relationship between Moon, Earth, and the Sun.</p> <p>6.3.2.4. Investigate the effects of the positional relationship between the Moon and the Earth.</p>

Content Standard	Benchmarks
6.3.3. Students will be able to explain the motion and patterns of the stars.	<p>6.3.3.1. Describe the properties of stars.</p> <p>6.3.3.2. Investigate the movement of stars in relation to the Earth's rotation.</p> <p>6.3.3.3. Examine the different types of constellation seen in the night sky of Papua New Guinea.</p> <p>6.3.3.4. Investigate the use of traditional knowledge of the night sky.</p>

Grade 7 Strands and Units

Strand 1: Life

The Life strand is about living things, their life processes, and their interrelationships and their environment. It deals with the structure and behaviour of organisms like plants, animals and human beings.

It further explores the characteristics of organisms, life cycles of organisms, and the interactions among all components, living and non-living of the natural environment.

In grade 6, the students have learned about the reproduction process, hereditary characteristics and transportation of water in plants; respiratory and circulatory system of human body and food chain and food web in the ecosystem.

Thus, in grade 7, it is important for students to understand groups of plants such as flowering and non-flowering plants, groups of animals such as vertebrates and invertebrates, digestive system of human body and ecosystem.

Evidence Outcomes

At the end of grade 7, all students can:

- describe the characteristics and reproduction process in flowering and non-flowering plants.
- classify groups of vertebrates and invertebrates according to their characteristics.
- describe the mechanism of the digestive system and state the functions of nutrients.
- explain the relationships of living and non-living organisms and state the causes and effects of population change of organisms in an ecosystem.

Unit 1: Plants

In this unit, students will learn about the characteristics and reproduction process of flowering and non-flowering plants.

Content Standard	Benchmarks
7.1.1. Students will be able to investigate flowering and non-flowering plants, and their characteristics.	<p>7.1.1.1. Investigate the characteristics of flowering and non-flowering plants.</p> <p>7.1.1.2. Classify and profile different types of flowering and non-flowering plants.</p> <p>7.1.1.3. Examine the reproduction process in flowering and non-flowering plants.</p>

Unit 2 : Animals

In this unit, students will learn about the groups of animals that are vertebrates and invertebrates.

Content Standard	Benchmarks
7.1.2. Students will be able to investigate groups of animals that are vertebrates and invertebrates, and their characteristics.	<p>7.1.2.1. Investigate animals that are vertebrates and invertebrates, and draw appropriate conclusions.</p> <p>7.1.2.2. Evaluate the types of vertebrates and invertebrate.</p> <p>7.1.2.3. Classify and profile groups of vertebrates according to their characteristics.</p>

Unit 3: Human Body

In this unit, students will learn functions of nutrients and digestive system.

Content Standard	Benchmarks
7.1.3. Students will be able to investigate the functions of nutrients and the digestive system.	<p>7.1.3.1. Investigate different types of nutrients and their functions.</p> <p>7.1.3.2. Examine the various organs of digestive system and their functions.</p> <p>7.1.3.3. Investigate the mechanism of the digestive system.</p> <p>7.1.3.4. Explain the roles of enzymes in the digestion of food.</p>

Unit 4: Interaction and Relationship in the Environment

In this unit, students will learn about the components of ecosystem and the roles of organisms in the ecosystem.

Content Standard	Benchmarks
7.1.4. Students will be able to explain the relationship between living things and their environments.	<p>7.1.4.1. Investigate the different components of an ecosystem.</p> <p>7.1.4.2. Examine the relationships of living and non-living organisms in an ecosystem.</p> <p>7.1.4.3. Evaluate the roles of organisms in the ecosystem.</p> <p>7.1.4.4. Analyse possible causes and effects of population change of organisms in an ecosystem such as competing for resources; water, food and space.</p> <p>7.1.4.5. Investigate and profile different types of communities in the environment such as ponds, oceans, and soil.</p>

Strand 2: Physical Science

The Physical Science strand is about the study of matter, energy and the changes they undergo. The universe is composed of matter, some branches of physical science are chemistry and physics. Chemistry is the study of the properties of how matter changes. Whilst, physics is the study of matter, energy, motion and forces and how they interact.

In grade 6, the students have learned about forms of energy, properties of electromagnet, characteristics of weight and mass, types of mixtures and solutions; and methods of separating mixtures.

Thus, in grade 7, it is important for students to understand electricity, properties of light and lens, types of pressures, and properties of density, properties of solutions and atoms, molecules and compounds.

Evidence Outcomes

At the end of grade 7, all students can:

- explain the relationship between electrical currents and voltage and use the instruments and formula to measure and calculate voltage.
- explain the properties of light and function of convex lens.
- describe the pressure applied in solid, liquid and gas and use formula to calculate pressure.
- describe the properties and functions of different types of solutions.
- distinguish between atoms, molecules, elements and compounds.

Unit 1: Energy

In this unit, students will learn about the electricity, measuring the electric current and voltage and mechanism of static electricity. They will also learn about the properties and application of light and convex lens.

Content Standard	Benchmarks
7.2.1. Students will be able to investigate the function of electricity and the relationship between electrical currents and voltage.	<p>7.2.1.1. Discover the regularity of the electric current flowing through each point of the circuit.</p> <p>7.2.1.2. Use ammeter and voltmeter to measure electric current and voltage in series and parallel circuits.</p> <p>7.2.1.3. Determine that metal wires have resistance to electricity when measuring the electric current and voltage.</p> <p>7.2.1.4. Explain and Compare the relationship between the voltage, electric current, and resistance.</p> <p>7.2.1.5. Use the formula to calculate the voltage. ($Voltage = Current \times Resistance$).</p> <p>7.2.1.6. Investigate the properties and the functions of static electricity.</p>

7.2.2. Students will be able to investigate the relationship between light and convex lens.	7.2.2.1. Investigate the properties of light and the speed of light. 7.2.2.2. Establish that reflection and refraction of light occurs through different interfaces such as water and glass. 7.2.2.3. Examine the properties and functions of convex lens. 7.2.2.4. Explain the mechanism of convex lens such as the eye and camera.
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Unit 2: Force and Motion

In this unit, students will learn about properties of pressure and density.

Content Standard	Benchmarks
7.2.3. Students will be able to investigate the properties of pressure and examine pressure applied in solid, liquid, and gas.	7.2.3.1. Investigate the properties of pressure. 7.2.3.2. Examine the pressure applied in solid, liquid, and gas. 7.2.3.3. Use the formula to calculate pressure. <i>(Pressure = Force/Area).</i> 7.2.3.4. Evaluate the different uses of pressure.
7.2.4. Students will be able to investigate the density of different matter.	7.2.4.1. Investigate and describe the characteristics of density. 7.2.4.2. Compare and contrast the density of different matter. 7.2.4.3. Use the formula to calculate the density. $DENSITY = \frac{Mass}{Volume}$ 7.2.4.4. Appraise the uses of density.

Unit 3: Matter

In this unit, students will learn more about the properties of solutions which they have learned in grade 6. This time they will focus on the different types of solutions and calculation of concentrated solutions. They will also learn new concepts relating to the characteristics of atoms, molecules and compounds.

Content Standard	Benchmarks
7.2.5. Students will be able to investigate the properties and functions of solutions.	7.2.5.1. Examine the terms solute, solvent and solution. 7.2.5.2. Investigate different types of solutions such as solid to liquid; liquid to liquid; and liquid to gas. 7.2.5.3. Explain solute in a solution such as carbon dioxide (CO ₂). 7.2.5.4. Investigate the functions of solution such as hydrochloric acid in terms of changing the property of metal. 7.2.5.5. Distinguish the properties of Acid, Alkaline and Neutral solutions. 7.2.5.6. Compare concentration of solutions and methods of separating them.
7.2.6. Students will be able to explain the composition of matter in terms of atoms, molecules, elements and compounds.	7.2.6.1. Examine the characteristics of atoms and elements. 7.2.6.2. Distinguish between atoms and elements. 7.2.6.3. Classify common elements in the periodic table into metals and non-metals. 7.2.6.4. Examine the characteristics of molecules with symbols. 7.2.6.5. Analyse the characteristics of common compounds and their elements.

Strand 3: Earth and Space

Earth and Space strand explores the interconnections between the land, ocean, atmosphere, and life of our planet. These include the cycles of water, rock, and other materials that continuously shape, influence, and sustain Earth and its inhabitants.

Earth and Space is about Earth and its place within the solar system and the universe. It includes the study of the Earth; its lands, oceans, atmosphere and all the life that lives on it from humans to animals to plants. It includes the water cycle, the carbon cycle, the rock cycle and anything that gradually affects the Earth over time.

The ‘space’ parts talk about the Earth’s position in the solar system, and it also explores the solar system and universe as a whole.

In grade 6, the students have learned about the formation of soil layers, sedimentary rocks, land change, types of moon phases and constellation in the night sky.

Thus, in grade 7, it is important for students to understand the plate movements, natural resources, earth’s atmosphere and types of clouds, weather patterns and seasons.

Evidence Outcomes

At the end of grade 7, all students can:

- describe the composition, structure of the Earth and explain types of geological events caused by plate movements.
- describe natural resources, their uses and ways to conserve them.
- explain the composition of the Earth’s atmosphere, types of clouds and weather patterns In Papua New Guinea.
- describe the causes of day and night and seasons.

Unit 1: Our Earth

In this unit, students will learn about the composition and the structure of the Earth, the relationship between plate movements and earthquake, and the natural resources and the ways to conserve the natural resources.

Content Standard	Benchmarks
7.3.1. Students will be able to explore the composition and the structure of the Earth.	<p>7.3.1.1. Examine the composition and the structure of the Earth.</p> <p>7.3.1.2. Investigate the different movement of tectonic plates divergent, convergent and transformed faults.</p> <p>7.3.1.3. Analyse the types of geological events caused by tectonic plate movements such as earthquakes, volcanoes, and the formation of mountains.</p>
7.3.2. Students will be able to investigate the different natural resources in Papua New Guinea	<p>7.3.2.1. Identify and classify the different types of natural resources into renewable and non-renewable resources.</p> <p>7.3.2.2. Examine the importance and uses of natural resources for humans and other living things.</p> <p>7.3.2.3. Use basic research skills to investigate how natural resources are conserved and suggest ways to make improvements.</p>

Unit 2: Weather and Climate

In this unit, students will learn about the composition of the atmosphere, types of air pressure and the patterns of atmospheric movements. They will also learn about the formation and the types of clouds, characteristics of weather and weather patterns in Papua New Guinea.

Content Standard	Benchmarks
<p>7.3.3. Students will be able to explore the earth's atmosphere, types of clouds and the weather patterns in Papua New Guinea.</p>	<p>7.3.3.1. Investigate the composition of the Earth's atmosphere and the properties of its layers.</p> <p>7.3.3.2. Examine the types of air pressure such as low and high pressure.</p> <p>7.3.3.3. Analyse atmospheric movements and the effects on oceans.</p> <p>7.3.3.4. Investigate the effects of Greenhouse gas in relation to global warming and change in weather patterns.</p> <p>7.3.3.5. Examine the types of clouds and their formation.</p> <p>7.3.3.6. Explain the relationship between weather and clouds.</p> <p>7.3.3.7. Evaluate the characteristics of weather and weather patterns in Papua New Guinea.</p>

Unit 3: Space

In this unit, students will learn about the relationship between the Earth's movement and the Sun in relation to day and night and the seasons.

Content Standard	Benchmarks
<p>7.3.4. Students will be able to investigate the relationship between the Earth's movement and the Sun.</p>	<p>7.3.4.1. Investigate the relationship between orbit and rotation of the earth.</p> <p>7.3.4.2. Relate changes on the Earth such as day and night to the Earth's rotation and its orbit around the sun.</p> <p>7.3.4.3. Investigate the causes of seasons in relation to the tilt of the Earth and the position of the Sun.</p>

Grade 8 Strands and Units

Strand 1: Life

The Life strand is about living things, their life processes, and their interrelationships and their environment. It deals with the structure and behaviour of organisms like plants, animals and human beings.

It further explores the characteristics of organisms, life cycles of organisms and the interactions among all components, living and non-living of the natural environment.

In grade 7, the students have learned about groups of plants such as flowering and non-flowering plants, groups of animals such as vertebrates and invertebrates, digestive system of human body and ecosystem.

Thus, in grade 8, it is important for students to understand the gas exchange system in plants, plant cell and animal cell and changes in the environment and conservation of the environment.

Evidence Outcomes

At the end of grade 8, all students can:

- explain the process of respiration, photosynthesis in plants.
- describe the structure of plant and animal cells and explain the functions of parts of plant cells and animal cells.
- describe natural and human activities that change the environment and identify ways to manage and conserve the environment.

Unit 1: Plants

In this unit, students will learn about the gas exchange system of plants.

Content Standard	Benchmarks
8.1.1. Students will be able to investigate the respiration and photosynthesis, and gas exchange systems of plants.	<p>8.1.1.1. Investigate the process of respiration in plants.</p> <p>8.1.1.2. Explain the process of respiration using the equation. (glucose + oxygen ⇒ carbon dioxide + water)</p> <p>8.1.1.3. Examine the process of photosynthesis in plants.</p> <p>8.1.1.4. Investigate the process of photosynthesis using the equation. (carbon dioxide + water ⇔ glucose+oxygen)</p> <p>8.1.1.5. Explain the system of gas exchange in plants.</p>

Units 1 & 2: Plants and Animals

In this units, students will investigate the structure of plant and animal cells.

Content Standard	Benchmarks
8.1.2. Students will be able to investigate the structure of plant and animal cells.	<p>8.1.2.1. Investigate the structure of plant and animal cells, and draw appropriate conclusions.</p> <p>8.1.2.2. Examine the functions of parts of plant cells and animal cells.</p> <p>8.1.2.3. Compare and contrast the similarities and the differences between plant cells and animal cells.</p>

Unit 4: Interaction and Relationship in the Environment

In this unit, students will learn about environmental changes caused by human activities, natural events and pollution and the importance of conserving the environment.

Content Standard	Benchmarks
8.1.3. Students will be able to Investigate environmental changes, evaluate their effects, and analyse strategies for conserving the environment.	<p>8.1.3.1. Use basic research skills to investigate the environmental changes caused by human activity and natural events, and draw appropriate conclusions</p> <p>8.1.3.2. Examine the effects of environmental changes on living things (for example, species extinction).</p> <p>8.1.3.3. Probe the different types of pollution and evaluate their effects on the ecosystem.</p> <p>8.1.3.4. Analyse ways of managing and conserving the natural environment, and propose strategies for improvement.</p>

Strand 2: Physical Science

The Physical Science strand is about the study of matter, energy and the changes they undergo. The universe is composed of matter, some branches of physical science are chemistry and physics. Chemistry is the study of the properties of how matter changes. Whilst, physics is the study of matter, energy, motion and forces and how they interact.

In grade 7, the students have learned about electricity, properties of light and lens, types of pressures and properties of density, properties of solutions and atoms, molecules and compounds.

Thus, in grade 8, it is important for students to understand the electric current and magnetic field; force and work, chemical reactions and state changes in relation to heat.

Evidence Outcomes

At the end of grade 8, all students can:

- explain the relationship between the direction of force, direction of magnetic field and the direction of electric current.
- use appropriate instrument and the formula to measure and calculate force.
- explain the relationship between chemical change and heat and use word equations, models and symbols to represent different chemical changes.
- describe the effect of heat on volume and the motion and arrangement of the particles in solid, liquid and gas using particles model.

Unit 1: Energy

In this unit, students will investigate the electric currents and magnetic fields such as the relationship between magnetic forces and lines of magnetic forces, and the relationship between the strength of electric current and the strength of magnetic fields. They will also learn about electromagnetic induction and application of electromagnets.

Content Standard	Benchmarks
8.2.1. Students will be able to investigate the relationship between the electric currents and the magnetic fields.	<p>8.2.1.1. Examine the characteristics of magnetic field.</p> <p>8.2.1.2. Investigate the relationship between magnet force and lines of magnetic force.</p> <p>8.2.1.3. Examine the direction of magnetic field around the electric current.</p> <p>8.2.1.4. Discover that an electric current can be obtained by moving coils and magnets.</p> <p>8.2.1.5. Compare and contrast the difference between direct currents and alternating currents.</p> <p>8.2.1.6. Identify and evaluate the applications of electromagnet in daily life.</p>

Unit 2: Force and Motion

In this unit, students will learn about measuring force and work using spring balance and applying Hooke's law.

Content Standard	Benchmarks
8.2.2. Students will be able to investigate the relationship between force and work.	<p>8.2.2.1. Examine the relationship between Force, Work, and Distance.</p> <p>8.2.2.2. Use this formula to calculate work. ($Work = force \times distance$)</p> <p>8.2.2.3. Use appropriate instrument to measure force.</p> <p>8.2.2.4. Apply Hooke's law to demonstrate that the extension of the spring is proportional to the load applied.</p>

Unit 3: Matter

In this unit, students will learn about chemical reactions, representing chemical reactions with models and symbols, and conserving the mass of a substance during the chemical change. They will also learn about the effects of heat on the volume of different matter and the arrangement of particles in solids, liquids, and gas.

Content Standard	Benchmarks
8.2.3. Students will be able to investigate the different types of chemical changes and their properties.	<p>8.2.3.1. Investigate different types of chemical changes and their properties.</p> <p>8.2.3.2. Explain the relationship between chemical change and heat.</p> <p>8.2.3.3. Describe conservation and regularity of mass in chemical changes.</p> <p>8.2.3.4. Use word equations to represent chemical change.</p>
8.2.4. Students will be able to investigate the arrangement of particles when heat is applied in matter.	<p>8.2.4.1. Examine the properties of solid, liquid, and gas in relation to volume.</p> <p>8.2.4.2. Analyse the effect of heat on volume and the motion of particles in solid, liquid, and gas.</p> <p>8.2.4.3. Investigate the diffusion process in liquids and gases.</p> <p>8.2.4.4. Observe the melting and boiling point of matter and draw appropriate conclusions.</p> <p>8.2.4.5. Examine the difference in the arrangement of the particles (atoms and molecules) using particles model.</p> <p>8.2.4.6. Explain the physical change that occurs to substances during the process of change of state in matter.</p>

Strand 3: Earth and Space

Earth and Space strand explores the interconnections between the land, ocean, atmosphere and life of our planet. These include the cycles of water, rock and other materials that continuously shape, influence and sustain Earth and its inhabitants.

Earth and Space is about Earth and its place within the solar system and the universe. It includes the study of the Earth; including its lands, oceans, atmosphere and all the life that lives on it from humans to animals to plants. It includes the water cycle, the carbon cycle, the rock cycle and anything that gradually affects the Earth over time.

The ‘space’ part talks about the Earth’s position in the solar system, and it also explores the solar system, and universe as a whole.

In grade 7, the students have learned about plate movements, natural resources, earth’s atmosphere, and types of clouds, weather patterns and seasons.

Thus, for grade 8, it is important for students to understand about types of volcanoes and igneous rocks, rock cycle, climate change, solar system and galaxy.

Evidence Outcomes

At the end of grade 8, all students can:

- describe the formation of volcano and igneous rock.
- explain the formation of sedimentary, igneous and metamorphic rocks.
- distinguish between weather, climate and effects of climate change on Earth.
- describe solar system and its components and motion of objects in the solar system.

Unit 1: Our Earth

In this unit, students will learn about the mechanism and types of volcano, types and characteristics of igneous rocks and rock cycle.

Content Standard	Benchmarks
8.3.1. Students will be able to investigate the mechanism of volcano and formation of igneous rocks	<p>8.3.1.1 Investigate the formation of volcano.</p> <p>8.3.1.2 Identify different types of volcanoes.</p> <p>8.3.1.3 Explain the formation of igneous rock.</p> <p>8.3.1.4 Identify the types of igneous rocks.</p> <p>8.3.1.5 Distinguish volcanic and plutonic rocks based on their characteristics.</p>

Content Standard	Benchmarks
8.3.2. Students will be able to investigate the formation of rocks.	<p>8.3.2.1. Identify the three types of rocks.</p> <p>8.3.2.2. Examine the characteristics of the three types of rocks.</p> <p>8.3.2.3. Investigate the formation of sedimentary, igneous and metamorphic rocks, and draw appropriate conclusions.</p> <p>8.3.2.4. Investigate the process of rock cycle.</p> <p>8.3.2.5 Identify and evaluate the factors that cause rocks to change.</p>

Unit 2: Weather and Climate

In this unit, students will learn about the mechanism and the types of volcanoes, types and characteristics of igneous rocks and rock cycle.

Content Standard	Benchmarks
<p>8.3.3. Students will be able to investigate weather, climate, and the effects of climate change.</p>	<p>8.3.3.1. Investigate the factors that determine climate and draw appropriate conclusions.</p> <p>8.3.3.2. Compare and contrast the differences and the similarities between weather and climate.</p> <p>8.3.3.3. Examine the characteristics of climate in Papua New Guinea.</p> <p>8.3.3.4. Analyse the causes and the effects of the different types of climate change.</p> <p>8.3.3.5. Evaluate the strategies for mitigating climate change and propose ways of improving them.</p>

Unit 3: Space

In this unit, students will learn about space, the structure and the components of the solar system and the galaxy.

Content Standard	Benchmarks
<p>8.3.4. Students will be able to explore space, the solar system, and the galaxy.</p>	<p>8.3.4.1. Examine the universe.</p> <p>8.3.4.2. Investigate different ways of observing the universe and evaluate their effectiveness.</p> <p>8.3.4.3. Use basic research skills to investigate and report on the history of space exploration.</p> <p>8.3.4.4. Explain the solar system and analyse its components.</p> <p>8.3.4.5. Probe the motion of objects in the solar system.</p> <p>8.3.4.6. Examine the galaxy.</p>

Assessment, Monitoring and Reporting

The relationship between the assessment standards, the content standards, and the teaching standards assessment is an integral part of good instruction. The most effective teaching aligns the content standards with teaching and learning instruction and assessment.

What is assessment?

The term “assessment” is generally used to refer to all activities teachers use to help students learn and to monitor and measure students’ progress. Assessment is an on-going process of identifying, gathering and interpreting information about student’s progress towards achievement of the content standards described in the subject syllabuses.

What is Standards Based Assessment?

In a standards based curriculum, assessment is viewed not only as a final product (summative), but more importantly as a continual process (formative) that provides pupil performance data to teachers and students regarding their progress towards achieving the intended standards. A timely and ongoing assessment of a student’s understanding is the key to the learning process. Throughout the year, teachers will be assessing students on each content standard and identifying areas where a student or a group of students need more attention.

Assessment refers to all activities undertaken by teachers and by students in assessing themselves, which provide information to be used as feedback to modify the teaching and learning activities in which they are engage.

Purposes of Assessment

The primary purpose of assessment is to improve students’ learning and teachers’ teaching as both respond to fulfil the following information:

- Inform and improve students’ progress and achievements in learning.
- Provide valuable information that enable teachers, schools and NDOE to make decisions about how to improve the quality of teaching and learning in the education system.
- Inform teachers of the progress of students learning in order to adjust teaching planning to improve student learning.
- Inform parents and guardians, about their children’s progress and achievements.
- Provide information for schools and systems, about teaching strategies, resource allocations and curriculum; and other educational institutions, employers and the community, about the achievements of students in general or of particular students.

Whatever its purpose, assessment is seen as an integral part of the learning and teaching program rather than a separate process.

Types of Assessment

Papua New Guinea National Curriculum has adopted the following types of assessment to monitor and assess the achievement of content standards.

- Assessment *for* learning
- Assessment *of* learning
- Assessment *as* learning

Assessment *as* and Assessment *for* are also known as *formative assessments* and Assessment *of* is also known as *summative assessment*.

Assessment *for* Learning

Assessment *for* learning, also known as *classroom assessment*, is different. It is an ongoing process that arises out of the interaction between teaching and learning. It is not used to evaluate learning but to help learners learn better. It does so by helping both students and teachers to see;

- the learning goals and criteria,
- where each learner is in relation to the goals,
- where they need to go next and,
- ways to get there.

Assessment *of* Learning

Assessment *of* learning is the use of a task or an activity to measure, record and report on a student's level of achievement in regards to specific learning expectations such as unit tests and end of term or year exams. It is normally referred to as summative assessment.

Assessment *as* Learning

Assessment *as* learning is the use of an assessment task or an activity by the teacher in his/her everyday teaching. This strategy provides students with opportunities to understand what they have learnt or is having difficulties with. Self and peer assessments allow students to reflect on their own learning and identify areas of strength and weakness. These tasks offer students the chance to set their own personal goals to improve their own learning.

Diagnostic Assessment

Apart from these three main types of assessment teachers are expected to do the diagnostic test/assessment to identify strengths and weaknesses in students. This can be done before any teaching and learning of a new content and for new entry levels for students.

Diagnostic assessment is a form of pre-assessment that allows a teacher to determine students' individual strengths, weaknesses, knowledge, and skills prior to instruction. It is primarily used to diagnose student difficulties and to guide lesson and curriculum planning.

Assessment Methods

These are some methods that teachers can use to assess students' performance in Science lessons.

- Observing students during the lesson
- Conferencing with students
- Profiles
- Tests
- Assignments (projects/reports/quizzes/presentations/practical work samples).

Recording and Reporting

Recording

Teachers must keep accurate records of students' achievement of their learning. They must report these achievements in fair and accurate ways to parents, guardians, teachers and students. Examples of recording methods include:

- Anecdotal notes in a journal or diary
- Checklists
- Portfolios of students' work
- Progressive records
- Work samples with comments written by the teacher.

Reporting

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

Students' reports should be based on assessment information collected from ongoing assessments. Schools will decide on how reports will be presented to best suit the needs of their communities. Methods will include interviews and written reports.

Written reports should include;

- a written record of content standards achieved by students since the previous report,
- a written record of the content standards the student is now working towards and,
- information about students' attitudes, values and other additional information that is specific to individual students.

Monitoring and Evaluation

All stakeholders have a role to play in using assessment information to make judgment about students' achievements. Analysis of assessment data must be used to inform decisions makers about;

- the effectiveness of teaching, learning and assessment programs,
- suitability of available resources,
- the degree of community participation in schools,
- trend in students' achievement at local and national levels and,
- the contribution of the education systems to the future development of the nation.

Evaluation is part of the process of continuously raising standards of student achievement in PNG. Assessment information used for evaluation purposes should be used in ethical and constructive ways.

Monitoring

The teachers are encouraged to practice general supervision over the teaching and learning content of Science instructions in primary classes within the school. Teachers also advise school officials, school boards, and other teachers in the development and improvement of Science programs, and identify strategies to improve Science education.

The assessment coordinators in the schools should develop and use the monitoring tools to check on the progress of teaching and learning of Science content.

Evaluation

Teachers will use assessment information to evaluate the effectiveness of their teaching, learning to make improvements to their teaching practice in order to improve student learning. Evaluation tools such as written records, questionnaires, logs and diaries, submissions or records of meetings and discussion with general staff members, teaching staff, parents and other community members.

Glossary

Word	Definition
Assessment	Activities teachers use to help students learn and to monitor their progress.
Assessment Strategies	Different styles and ways of assessing students work.
Assessment For Learning	A common form of assessment. It is an ongoing process that arises out of the interaction between teaching and learning. Also referred to as formative assessment.
Assessment As Learning	It is a design to inform students what they will do well and what they need to improve on daily/weekly basis as an integral part of everyday teaching and learning such as exercise, activities or experiments students do or practice in each lesson.
Assessment Of Learning	Provides a summary of students learning over a set period of time and is generally carried out at the end of a course or project. Sometimes it is referred to as summative assessment and is evaluative.
Assessment Tasks	On-going test of knowledge, skills and attitudes/values gained throughout the particular unit or topic.
Benchmark	Benchmarks are specifications of content standards or more detailed descriptions of a specific level of performance expected of students at particular ages, grades, or levels of development. Benchmarks focus on the essential knowledge, skills, values and attitudes that all students are expected to learn, master and demonstrate competency using various representations in real life situation.
Content Standards	Broadly stated expectation of what students need to know, understand, and be able to do as intended by the syllabus. They define the breadth and depth of knowledge, skills and processes and attitudes and values that are to be taught in the strand, unit or topic.
Evidence Outcomes	Evidence outcomes are indicators that indicate students' progress towards meeting an expectation at the mastery level. They measure students' mastery and application of knowledge, skills, values, and attitudes at grade and cluster levels. Senior primary school students must demonstrate proficiency in the following knowledge, skills, values, and attitudes to prepare them for junior high school.
National Education Assessment	Is a learning system and is a systematic and ongoing process of collecting and interpreting information about students' achievements.
Science process skills	Skills that scientists use to study and investigate the world. They are the vehicle for generating content and a means by which concepts are formed.
Standard	A standard is a level of quality or achievement, especially a level that is thought to be acceptable. It is something used to measure or estimate the quality or degree of something, for example, how good a piece of work is.
Standards Based Education (SBE)	Is an academic program in which clearly defined academic content, performance standards are aligned. It spells out what schools and communities need to do to ensure achievement of expectations. It is a philosophical concept that is centred on the process of planning, developing, delivering, monitoring and improving education programs.
Standards Based Curriculum (SBC)	It is a cumulative body of knowledge and set of competencies that form the basis for a quality education.
National Education Assessment	Is a learning system and is a systematic and ongoing process of collecting and interpreting information about students achievements.
Standard	A standard is a level of quality or achievement, especially a level that is thought to be acceptable. It is something used to measure or estimate the quality or degree of something.

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