

Applied Science

Upper Secondary Syllabus



Papua New Guinea
Department of Education

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Secretary's message

This Applied Science syllabus is to be used by science-trained teachers to teach Upper Secondary students (Grades 11 and 12) throughout Papua New Guinea. This syllabus builds on learning from Lower Secondary Science. It emphasises cultural principles, values and attitudes and the individuality and uniqueness in different ethnic societies.

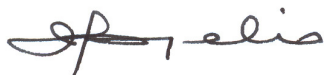
The Upper Secondary Applied Science Syllabus conforms to the National Education Plan's vision, which is that secondary education enables students to achieve their individual potential to lead productive lives as members of the local, national and international community. This syllabus enhances knowledge, skills and attitudes established at the Lower Secondary level, and provides the opportunity for students to gain a deeper understanding of advanced Applied Science knowledge to meet their individual needs as well as local and global demands and challenges. Students are prepared to deal with moral and ethical questions resulting from both local and global issues.

Teachers lead by being innovative, creative and keeping abreast of new information based on scientific research and technological changes.

Through the study of Applied Science, students consider the impacts of human activities on ecosystems and the environment and on individual human beings and human society in Papua New Guinea and globally. Applying their understanding of Applied Science helps students to appreciate factors such as culture, ethics, economics, power relationships and other factors that influence the pursuit of science and have a significant impact on the way people live. The study of Applied Science enables students to make informed decisions about modifying and interacting with nature.

This syllabus incorporates Applied Science units that enable students to become scientifically literate and apply the skills and knowledge of physical, chemical and biological processes for an improved way of life. Besides providing students with the conceptual foundation needed to meet the challenges of fields such as teaching, nursing, mechanics and electronics, the syllabus also equips them to appreciate and apply basic scientific skills and knowledge in their lives and communities.

I commend and approve this syllabus as the official curriculum for Applied Science to be used in all schools with Grades 11 and 12 students throughout Papua New Guinea.



DR JOSEPH PAGELIO

Secretary for Education

Introduction

This syllabus is based on the curriculum principles from the National Curriculum Statement. It has been designed using learning outcomes that identify the knowledge, skills, attitudes and values that all students achieve or demonstrate by the end of Grade 12. It is linked to the national curriculum learning area Science and builds on the knowledge and skills students have learnt in Grades 9 and 10.

This Applied Science syllabus offers content knowledge, skills and values and builds on students' prior learning. It leads towards a number of pathways to post-secondary study and the workforce. It has specialised and general applications in both areas.

Lower Secondary Science Strands	Lower Secondary Science Units	Upper Secondary Units	
		Grade 11	Grade 12
Nature of Science	Indigenous Knowledge and Practices Working Scientifically Working Scientifically through Projects and Investigations	Introduction to Applied Science Traditional Technology	Modern Electronic Communications
Life and Living	Ecology Our Body Microbiology	Environmental Management Health Science	Biotechnology
Matter and Energy	Atoms and the Periodic Table Electricity Chemical Reactions Light Communication	Energy around Us	Food Technology Mineral Products
Earth and Space	Earth and Atmosphere	Hydrology	
Note: Strands 1, 2, 3 and 4 have some relevance to Applied Science			

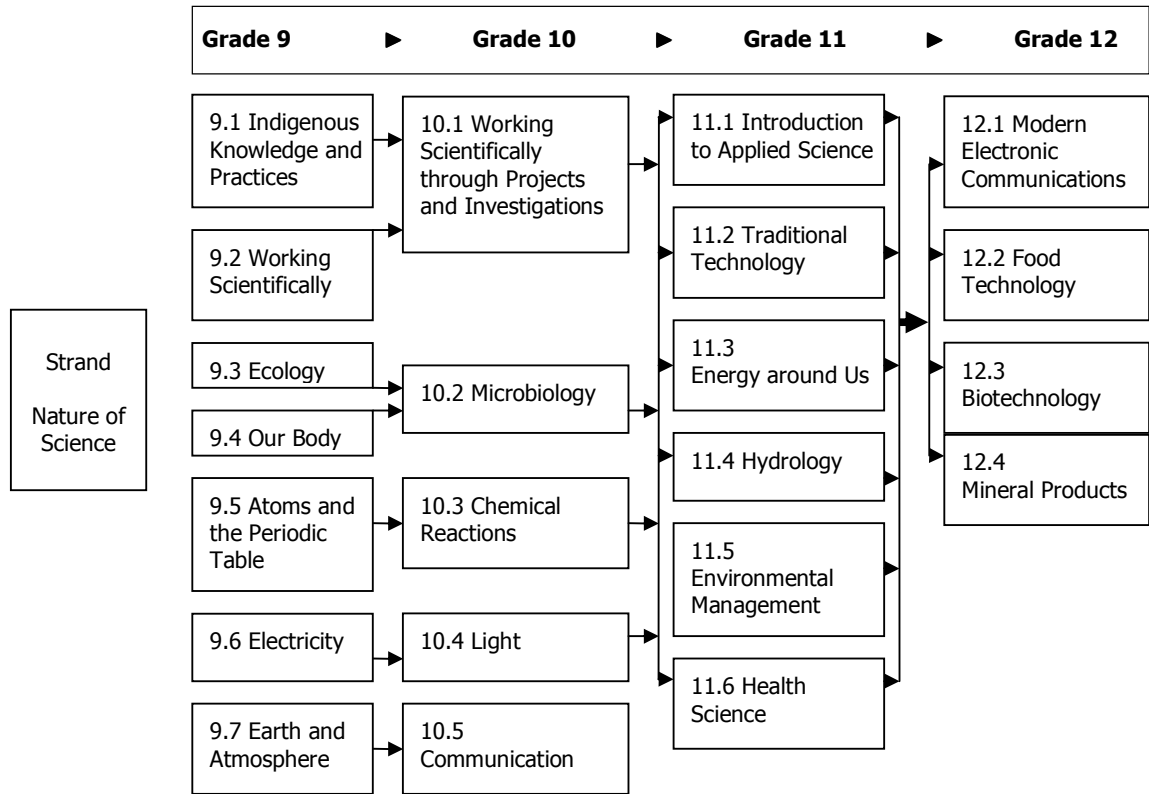
Applied Science is a specialised subject that requires a high level of cognitive competency. Having a high level of numeracy competency and a basic level of language skills would help students to learn and understand scientific processes better.

Assessment is an important component of teaching for learning and is integrated into the learning and teaching activities of Applied Science. Continuous assessment in Applied Science provides feedback to students and the teacher on students' progress towards achievement of the learning outcomes. It helps students improve their standards of achievement by knowing what they need to do well and where they need to improve. In Applied Science, teachers gather evidence from students' work during the course of the term and use those continuous assessments to improve their teaching and students' learning.

The teaching program should also include formal summative assessment of learning to gauge students' level of achievement.

Applied Science is to be timetabled for 240–250 minutes per week in Grades 11 and 12.

Overview of the study of Applied Science from Lower Secondary to Upper Secondary



Rationale

One does not need to look far and wide to see the application of science in our contemporary society. The world we live in is shaped by the application of scientific knowledge. The future depends on using scientific knowledge and skills for sustainable management of our environment and resources.

Scientific knowledge today is the result of human endeavours over many centuries. Over thousands of years, Papua New Guineans have used scientific knowledge in basic traditional practices such as lime making, dye extraction and herbal medicines.

The process of scientific inquiry, which has been developed over time, contributes to the way we live and do things today. It relies on evidence and careful reasoning. With the increasing use of technology in telecommunications, medicine, food and manufacturing industries, the application of scientific knowledge and skills are becoming necessary. It is therefore vital for Papua New Guineans to become scientifically literate to participate effectively in this era of changing technology.

Humans are part of nature and continue to have a greater influence on the environment than any other species. By studying this syllabus, Papua New Guinean students demonstrate understanding of physical, chemical and biological processes of biological life processes, natural systems, interactions and balances, in the context of themselves as human organisms as part of nature and as interacting with nature.

Studying Applied Science enables students to become scientifically literate and apply the skills and knowledge of physical, chemical and biological processes for an improved way of life. Students who pursue careers in teaching and nursing, or as mechanics and electricians, require an understanding of the scientific skills and knowledge taught in Applied Science. The interactive study of environmental management, biotechnology, health and society, energy, simple engineering and food technology can provide the basis for understanding daily science problems and exploring ways to solve them.

Applied Science, being an interdisciplinary science course, enables students to develop critical thinking skills to make informed decisions concerning the manipulation of raw materials and other resources. It enables students to develop inquisitive minds and positive attitudes for better living.

Aims

Applied Science aims to enable students to:

- appreciate and apply the principles of science evident in everyday life and use these to solve problems
- understand the relationships between science, society and the environment and take responsible actions
- evaluate the impact of scientific and technological achievements that affect our lives and take appropriate actions
- examine the effects of human activities on the environment and develop sustainable management practices
- acquire and apply scientific skills to ensure a better and improved standard of living
- recognise and appreciate the importance of traditional techniques in modern scientific applications and develop positive attitudes and values
- recognise and appreciate the positive and negative impacts of modern technology and make informed decisions.

Strands

The study of Applied Science is described in the strands:

- 'Nature of science'
- 'Life and living'
- 'Matter and energy'
- 'Earth and space'

As a multistrand subject, Applied Science highlights the importance of indigenous and scientific knowledge and skills in improving life. It further investigates human impacts on the environment, biodiversity and the physical and natural world, as well as their applications in society.

Applied Science provides students with an understanding of different types of technology that can contribute to enhancing and improving living standards.

Learning outcomes

The Applied Science learning outcomes identify the knowledge, skills, attitudes and values all students achieve or demonstrate at the end of Grade 12. The learning outcomes for Applied Science are listed below.

Students can:

1. demonstrate an understanding of fundamental principles and models of science
2. apply scientific thinking and skills in technological processes and procedures
3. design and undertake scientific investigations to solve problems
4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways
6. demonstrate an understanding of traditional scientific knowledge and skills and their relevance today.

Note: While all ideas and concepts in Applied Science are linked, the table below indicates the connections that should be highlighted most.

Learning outcomes mapped against units										
Learning outcomes	Units									
	11.1	11.2	11.3	11.4	11.5	11.6	12.1	12.2	12.3	12.4
1. Demonstrate an understanding of fundamental principles and models of science		✓	✓				✓		✓	✓
2. Apply scientific thinking and skills in technological processes and procedures	✓						✓	✓	✓	✓
3. Design and undertake scientific investigations to solve problems	✓			✓	✓				✓	
4. Research and analyse information, procedures and materials	✓		✓	✓	✓	✓	✓	✓		✓
5. Communicate scientific investigations and findings in different ways		✓	✓	✓	✓	✓		✓	✓	
6. Demonstrate an understanding of traditional scientific knowledge and skills and their relevance today		✓				✓		✓		

Unit sequence and content

Grade 11 units	Grade 12 units
<p>11.1 Introduction to Applied Science <i>1–2 weeks</i></p> <ul style="list-style-type: none"> • Overview of Applied Science • Current global issues <p>11.2 Traditional Technology <i>5–6 weeks</i></p> <ul style="list-style-type: none"> • Introduction to traditional technology • Types of traditional technology <p>11.3 Energy around Us <i>8–10 weeks</i></p> <ul style="list-style-type: none"> • Introduction to energy • Fossil fuels • Alternative energy sources • Nuclear energy <p>11.4 Hydrology <i>5–6 weeks</i></p> <ul style="list-style-type: none"> • Water sources • Water testing • Water pollution • Water purification <p>11.5 Environmental Management <i>8–10 weeks</i></p> <ul style="list-style-type: none"> • Forests • Grasslands • Wetlands • Waste management • Pollution <p>11.6 Health Science <i>5–6 weeks</i></p> <ul style="list-style-type: none"> • Health technology • Health chemistry • Monitoring our bodies • Common diseases • HIV and AIDS • Health and safety 	<p>12.1 Modern Electronic Communications <i>5–6 weeks</i></p> <ul style="list-style-type: none"> • Introduction to electronic communications • Components of electronic devices • Application of electronics • Dangers in the use of electronics <p>12.2 Food Technology <i>8–10 weeks</i></p> <ul style="list-style-type: none"> • Food processing • Food preservation • Food analysis • Types of food <p>12.3 Biotechnology <i>8–10 weeks</i></p> <ul style="list-style-type: none"> • Introduction to biotechnology • Extracting natural oils • Natural oil products • Other natural products <p>12.4 Mineral Products <i>8–10 weeks</i></p> <ul style="list-style-type: none"> • Mineral products • Lime making • Brick making

Grade 11 units

11.1 Introduction to Applied Science

1–2 weeks

Context

Why is the world concerned about the 'greenhouse effect'? What are some ways of using water to its maximum benefit? How can wastes be reduced, reused and recycled? What are some ways of harnessing alternative energy sources? What do we mean by common diseases? How can we apply technology to agriculture, food, minerals and other resources?

Knowledge

Knowledge and understanding of science, science literacy and methods are necessary for students to develop skills to resolve day-to-day questions about their natural and built environments. In this unit, students learn about the importance and possibilities of applying science to harness their natural resources and help solve some problems. They are also encouraged to view current global issues with interest to help find solutions. This unit is a prerequisite for the study of Applied Science.

Learning outcomes

Students can:

2. apply scientific thinking and skills in technological processes and procedures
3. design and undertake scientific investigations to solve problems
4. research and analyse information, procedures and materials.

To achieve the learning outcomes, students:

- demonstrate an understanding of applied science in everyday life
- review and describe scientific skills and processes
- investigate and present reports on current global issues.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Overview of Applied Science

- overview of Applied Science
- reviewing scientific skills

Current global issues

- importance of the media
- identify and discuss current global issues

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciation of local science knowledge and skills

Process skills

- investigation

Practical activities

Practical activities involve carrying out experiments as follows.

1. Produce a portfolio of newspaper cuttings and/or other types of research material on a current global issue.

11.2 Traditional Technology

5–6 weeks

Context

Did you know that our ancestors have been practising science for centuries? What are some practices that are used traditionally? How did our people come to acquire traditional techniques and skills? What are the scientific principles behind these traditional practices?

Knowledge

Students have learnt about traditional skills and knowledge in the Lower Secondary. They have also used scientific knowledge to explain traditional practices. With the increasing demand for cheap products there is a need to employ simple and/or appropriate technologies to produce them. An exploration of traditional technology provides insights into simple innovations that can be used to process these products. In this unit students explore human dependency on contemporary scientific knowledge and techniques. They can also explain and appreciate the science behind traditional technologies.

Learning outcomes

Students can:

1. demonstrate an understanding of fundamental principles and models of science
5. communicate scientific investigations and findings in different ways
6. demonstrate an understanding of traditional scientific knowledge and skills and their relevance today.

To achieve the outcomes, students:

- investigate the scientific principles behind a traditional technique
- research and investigate a traditional practice and its application in modern science.

Content

Students acquire knowledge and skills through the learning and teaching of this content

Introduction to traditional technology

- definitions
- principles and scientific applications of traditional technology

Types of traditional technology

- artefacts and equipment
 - weapons
 - tools
 - utensils
 - toys
 - musical instruments
- transportation
- traditional food processing and preservation
- traditional textiles

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciation of traditional knowledge

Process skills

- design and construct simple traditional technologies

Practical activities

Practical activities involve carrying out experiments as follows.

1. Investigate traditional extraction processes e.g. food or dye and report the findings.
2. Investigate and explain the scientific principles behind the construction and use of traditional musical instruments.

11.3 Energy around Us

8–10 weeks

Context

What lights up your home? Where do you get your energy from and how safe is it? Which energy source is Papua New Guinea heavily dependent on? Did you know that you can produce cheap energy?

We live in a modern society that is characterised by its reliance upon technology and its consequent high demands for energy. The future of Papua New Guinea depends on making informed choices about energy use, taking account of consequences such as cost and impacts on the environment in particular. This results in the need to consider the efficient use of energy and development of alternative energy resources.

Knowledge

Students already know about basic types of energy from the Upper Primary strand 'Energy at home' and the Lower Secondary strand, 'Matter and energy', that follows. In this unit, students focus on the use of energy in their immediate environment, the source of energy used and the cost and impact of its use. The sources of energy used locally are compared to other sources used nationally and globally. Students become more aware of the finite nature of non-renewable energy resources, and develop an appreciation of the consequences of harnessing, distributing and using energy.

This unit involves students in carrying out practical investigations and studying relevant scientific principles in relation to origin, availability and utilisation as outlined below.

Learning outcomes

Students can:

1. demonstrate an understanding of fundamental principles and models of science
4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways.

To achieve the learning outcomes, students:

- explain the uses of various forms of energy
- describe effects of solar radiation on human life
- investigate and calculate cost of energy consumption in homes and schools
- examine, design and construct energy-producing models
- research and investigate alternative sources of energy production.

Content

Students acquire knowledge and skills through the learning and teaching of this content

Introduction to energy

- principles of energy and energy production
- types of energy
- household energy: calculating costs; small and large appliances

Fossil fuels

- petroleum, coal and natural gas
- composition and origin of fossil fuels
- petroleum products and their uses

Alternative energy sources

- uses of solar energy
- garbage power
- ocean power plant
- wind power
- hydro power
- geothermal energy

Nuclear energy

- radioactivity
- nuclear reactors
- nuclear power plants
- safety and waste disposal

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciation and awareness of cleaner energy

Process skills

- measuring the efficiency of various energy-producing devices

Practical activities

Practical activities involve carrying out experiments as follows.

1. Research and present findings on alternative sources of generating power
2. Investigate and describe the processes of extracting crude oil derivatives
3. Construct models of simple energy producing devices e.g. simple dynamos or steam engines.

11.4 Hydrology

5–6 weeks

Context

Where do you get your water from? Is it safe to drink? Or, did you know that you can make drinking water from sea water? Have you ever wondered why you drink so much water every day? What causes water pollution? Do you know that three-quarters of the world is occupied by water?

Knowledge

Students have acquired an understanding of hydrology in the Lower Secondary strand: 'Earth and space'. They have also attained the scientific knowledge, skills and techniques to conduct suitable activities on hydrology. With mining activities, such as OK Tedi, Panguna, Tolukuma, Ramu and Wau, expanding and compounded by population issues, water use is becoming a concern for all stakeholders. Mine tailings, household wastes and sewerage are deposited into rivers and waterways contributing to water pollution. There is a need to explore ways to minimise this local and current issue. The unit first examines the properties of water and briefly reviews the water cycle. This leads to identifying local water sources and purification processes. Through this work, students develop scientific methods for testing and analysing water in homes, industries and the environment.

Learning outcomes

Students can:

3. design and undertake scientific investigations to solve problems
4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways.

To achieve the learning outcomes, students:

- explore different water sources in the local environment
- analyse the physical and chemical properties of different types of water; that is, tap water, salt water or mud water
- research and describe water purification systems
- investigate and report findings on various water conservation methods.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Water sources

- water table

- fresh water
 - rivers
 - creeks
 - lakes
- sea water

Water testing

- acidity and alkalinity
- properties of water
 - hard and soft water

Water pollution

- types of pollutants
- eutrophication
- water conservation

Water purification

- traditional water purification methods
- types of purification processes
- use of sedimentation in water purification

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciate imperative functions and properties of water

Process skills

- test and analyse water pollutant contents

Practical activities

Practical activities involve carrying out experiments as follows.

1. Conduct water analysis experiments; for example, pH, salinity and solubility tests.
2. Design a water purification model for the local area.
3. Research water conservation methods and make recommendations for the local area.

11.5 Environmental Management

8–10 weeks

Context

Have you ever wondered how much timber is harvested from our forests? Or, what unsustainable logging practices can do to our forests? How can we protect our environment and prevent unsustainable practices? Or, how do we get rid of our wastes?

Knowledge

Students have prior knowledge about forests and forest resources through the Upper Primary strand, 'Managing resources in making a living'. This extends briefly into the Lower Secondary strand 'Life and living', unit 9.3 Ecology, which provides students with an understanding of interdependence in different ecological systems and how human activities can affect these through investigations and models.

This unit begins with investigations into the traditional uses of forest resources and continues to consider the economic values of forests. It further explores the effect of unsustainable and sustainable harvesting practices on the environment. Students also take an investigative approach to studying resource and waste management, and use drawings, illustrations and models to emphasise the topic content.

Learning outcomes

Students can:

3. design and undertake scientific investigations to solve problems
4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways.

To achieve the learning outcomes, students:

- identify and discuss forest, wetlands and grassland resources, and their cultural and economic value
- investigate and report on unsustainable logging and mining practices and their impacts on the environment
- explore and identify waste management strategies and make appropriate recommendations
- investigate and discuss types of pollution and suggest ways to minimise their environmental impact.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Forests

- traditional uses of forest products
- cultural and economic value of Papua New Guinea's forests
 - food, shelter and medicinal values
 - non-timber products
 - carbon trade
 - ecotourism
- effects of forest modification and destruction
 - species loss
- conservation practices
 - ecoforestry
 - reforestation

Grasslands

- types of grasslands
 - lowland (human-made) grasslands
 - high montane grasslands
- uses and benefits of grassland products
 - traditional
 - commercial
- effects of grassland modification and destruction
 - overgrazing
 - commercial farming (monoculture)
 - traditional hunting methods
 - erosion and flooding
- grassland management
 - reforestation
 - sustainable practices

Wetlands

- types of wetland ecosystems
 - freshwater
 - mangroves and estuaries
- marine ecosystems
- developing wetland resources
 - sustainable fishing practices (traditional and modern practices)
 - ecotourism activities
- protection of wetlands

Waste management

- recycling processes and materials
- biodegradable materials
- industrial wastes

Pollution

- types of pollution: land, water, air
- effects of pollution: biomagnification
- management strategies

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciate the importance of Papua New Guinea's natural resources
- recognise the value of natural resources

Process skills

- investigate decomposition rates

Practical activities

Practical activities involve carrying out experiments as follows.

1. Do water tests to determine pollution rate of local fresh water systems.
2. Investigate decomposition rate of selected biodegradable materials and design ways to recycle them.

11.6 Health Science

5–6 weeks

Context

What are some facts about HIV and AIDS? What are some common diseases? How would you know how to attend to a person who suddenly has a heart attack?

Knowledge

Students have learnt about pathogens and diseases in the Lower Secondary Science strand, 'Life and living'. In this unit, students investigate various types of diseases, their signs and symptoms. They further explore causes and effects of these diseases and identify preventive treatments or cures. Students need to know about the types of testing kits for different diseases and conditions, and to understand the basic chemistry of these testing processes and how they work in monitoring our bodies. Students need to be aware of dangers associated with the testing kits. While some are easily accessible, for others they need to visit a doctor or health professional and be informed of the implications and consequences of testing kits. Students also use current statistics to discuss common diseases in Papua New Guinea and identify health and safety skills for saving lives.

Learning outcomes

Students can:

4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways
6. demonstrate an understanding of traditional scientific knowledge and skills and their relevance today.

To achieve the learning outcomes, students:

- identify and explain basic functions of various common testing processes
- identify and describe symptoms, causes and effects of common diseases prevalent in Papua New Guinea
- investigate and describe the effects of HIV and AIDS on society
- propose and recommend traditional and modern preventive measures and treatment of diseases
- assess situations and apply medical procedures where necessary.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Health technology

- thermometer
- scanner
- blood pressure reading

Health chemistry

- urine testing
- pregnancy testing
- blood sugar testing
- hormones
- drugs in sport

Monitoring our bodies

- seeking help
- helping others; for example, through clinic work experience

Common diseases

- symptoms, causes and effects of diabetes, heart attack, high blood pressure, hepatitis, sexually transmitted infections (STIs)
- preventive measures and treatment
 - traditional practices
 - modern practices

HIV and AIDS

- effects of HIV AND AIDS in society: social, economic, political, spiritual
- counselling
- policies and practices
- follow-up support

Health and safety

- identifying hazardous situations
- crisis management procedures
- applications of health and safety
- counselling

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciating and valuing traditional and modern medicine
- awareness of safety skills and procedures

Process skills

- analysing of statistics of common diseases

General skills

- applying crisis management skills

Practical activities

Practical activities involve carrying out experiments as follows.

1. Research and present findings on various common diseases.
2. Carry out community research on impact of HIV and AIDS on the society.
3. Describe and demonstrate first-aid skills.

Grade 12 units

12.1 Modern Electronic Communications

5–6 weeks

Context

Imagine a society without automobiles, aeroplanes, cellular phones and electricity. How were these technologies discovered? What scientific principles are behind the inventions? Our changing societies depend heavily on the application of electronics.

Knowledge

Students have prior knowledge of electricity, light and magnetism through Lower Secondary Science. The study of modern electronic communications aims to equip students with the knowledge and skills to repair and modify electronic equipment and devices. At the end, students are challenged to improvise new technologies for improving their lifestyles.

Learning outcomes

Students can:

1. demonstrate an understanding of fundamental principles and models of science
2. apply scientific thinking and skills in technological processes and procedures
4. research and analyse information, procedures and materials.

To achieve the learning outcomes, students:

- interpret circuit diagrams in electronic equipment
- research and describe the principles of electromagnetism
- describe the components and functions of electronic devices.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Introduction to electronic communications

- principles of electromagnetism
- history of radio and television
- transmission and reception of electromagnetic signals

Components of electronic devices

- simple digital electronics, such as switches, light emitting diodes (LED)
- functions of:
 - circuit boards
 - capacitors
 - transistors
 - diode (LED)
 - resistors
- future communication in Papua New Guinea

Application of electronics

- auto electronics (can be taught in conjunction with TVET)
- communication electronics and their uses
 - mobile phone
 - internet
 - automatic telling machine (ATM)
 - television
 - digital camera

Dangers in the use of electronics

- effects of electromagnetic radiation on humans
- safety in using electronic devices

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciate the usefulness of electronic devices

Process skills

- interpreting circuit diagrams
- circuit testing

General skills

- data collection and research

Practical activities

Practical activities involve carrying out experiments as follows.

1. Dismantle and identify components of an electronic device.
2. Construct working models of a radio or television; flick books.
3. Build working loudspeaker and microphone.

12.2 Food Technology

8–10 weeks

Context

Did you know that you are what you eat? What is in the food that you eat? What do you do with surplus food? Do you know how beverages are produced?

Knowledge

In Lower Secondary, students learn knowledge and practices used in indigenous food technology, as well as those used in the production of sago, salt and coconut oil and food preservation.

Students begin this unit by identifying the scientific principles applied in traditional food processes and comparing them with those in modern processes. The procedures in modern food processing will be identified and practised in this course. Students further identify the scientific principles in food preservation techniques, both traditional and modern. The unit ends with determining the presence of certain compounds such as starch, glucose and protein in different food items.

Learning outcomes

Students can:

2. apply scientific thinking and skills in technological processes and procedures
4. research and analyse information, procedures and materials
5. communicate scientific investigations and findings in different ways
6. demonstrate an understanding of traditional scientific knowledge and skills and their relevance today.

To achieve the learning outcomes, students:

- investigate and apply scientific concepts in food production
- perform the procedures in food analysis
- process different food samples.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Food processing

- traditional food processing techniques
- principles of food processing

Procedures

- distillation
- fermentation
- filtration
- separation

Products

- alcohol and beverages
- butchery and meat products

Food preservation

Traditional techniques

- dehydration
- salting
- immersion in water (sago, cassava)

Modern techniques

- chilling
- UV radiation
- antibiotics (tetracyclines)
- antioxidants
- sulphur dioxide
- canning
- pasteurisation

Food analysis

- food composition
 - starch and glucose
 - protein
 - fats and oils
 - vitamins
- water content

Types of food

- organic foods
- inorganic foods
- genetically modified food
 - what is genetically modified food?
 - impact of genetically modified food
 - future of genetically modified food

Attitudes

These are the attitudes gained through this unit.

- appreciate traditional food preservation practices

Practical activities

Practical activities involve carrying out experiments as follows.

1. Conduct fermentation experiments.
2. Analyse composition of different food materials.
3. Investigate and report on local food preservative methods.

12.3 Biotechnology

8–10 weeks

Context

Did you know that the gas used in cooking can come from animal wastes? And, do you know that coconut oil can also be used to drive diesel engines, or used as a local fuel instead of kerosene? Did you know you could produce oil, soap, cosmetics, food preservatives or even fertilisers? Is downstream processing of local crops possible? If other third world countries can use simple technology to help improve their livelihoods, can Papua New Guinea do the same?

Knowledge

Students have learnt the skills and knowledge of decomposition, fermentation and distillation in Lower Secondary. In this unit, students learn more about biotechnology and its applications to humans, in food, agriculture and the environment. As the cost of living increases, so does the need for downstream processing of raw materials. Students acknowledge local practices that have scientific relevance and find ways of improving them to enhance living.

Learning outcomes

Students can:

1. demonstrate an understanding of fundamental principles and models of science
2. apply scientific thinking and skills in technological processes and procedures
3. design and undertake scientific investigations to solve problems
5. communicate scientific investigations and findings in different ways.

To achieve the learning outcomes, students:

- design and construct simple downstream-processing models
- research and report on various methods of extracting biogas
- make soap or cosmetics from local resources.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Introduction to biotechnology

- definition and history

- uses of biotechnology

Extracting natural oils

- virgin oil from plants
- production of biofuel from virgin oil

Natural oil products

- soaps and detergents
- cosmetics

Other natural products

- wax from honey bees
- leather from animal carcasses
- biogas from plant or animal wastes

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- appreciate traditional techniques
- appreciate the value of animal wastes

Process skills

- extraction techniques
- producing soaps from caustic soda and oil or pig fat

Practical activities

Practical activities involve carrying out experiments as follows.

1. Produce virgin oil from coconut, peanut, pandanus nut, sunflower and so on.
2. Make soap from oil and caustic soda.
3. Make candles from plant or animal wax.

12.4 Mineral Products

8–10 weeks

Context

Nature has nested in its crust abundant substances useful to humankind. From our highlands to the coast, lie these raw treasures of nature. How many products obtained from the crust can you see? All you need is some creativity and inventions to convert these raw materials into useful products.

Knowledge

Students have prior chemistry knowledge from Lower Secondary Science. In this unit, they apply scientific skills and methodologies to extract useful substances from the crust, using some of them as reagents to manufacture other useful products. The unit first examines chemical reactions and reagents and then investigates both traditional and modern techniques of separation. Finally students manufacture useful products from the minerals.

Learning outcomes

Students can:

1. demonstrate an understanding of fundamental principles and models of science
2. apply scientific thinking and skills in technological processes and procedures
4. research and analyse information, procedures and materials.

To achieve the learning outcomes, students:

- relate relevant traditional knowledge, beliefs and skills in lime making
- describe the scientific processes involved in producing mineral products
- apply scientific techniques in brick and lime making
- research, analyse and interpret data on mineral production.

Content

Students acquire knowledge and skills through the learning and teaching of this content.

Mineral products

- definition
- types of mineral products
 - lime
 - cement

- glass
- brick

Lime making

- ingredients or raw materials
- chemical processes
- uses of lime

Brick making

- ingredients or raw materials
- chemical processes
- uses of brick

Attitudes, values and skills

These are the specific skills practised and attitudes gained through this unit.

Attitudes and values

- being responsible and self-reliant

Process skills

- estimating ratios of chemical constituents

General skills

- decision making
critical thinking

Practical activities

Practical activities involve carrying out experiments as follows.

1. Research and report on cement and glass making procedures.
2. Produce lime and brick using available resources and examine quality and strength.

Assessment components, weightings and tasks

The internal assessment mark for Applied Science is to be based on the Grade 11–12 syllabus only. Final assessment should be based on a range and balance of assessment instruments. One task may be used to assess several components. The components, weightings and tasks for Grade 11 and 12 units are detailed below.

Components, weighting and tasks for Grade 11

Component	Weighting	Tasks
Written tests	150	These may include multiple-choice items, short answers and extended responses, statistical interpretation, graphical skills, calculations. These can utilise contemporary or hypothetical situations
Practical tests on basic skills	100	Testing the ability of students to do simple scientific techniques, such as investigating a scientific problem
Practical assignments and projects	50	Practical work competency and some ratings given on presentation and communication
Marks	300	

Components, weighting and tasks for Grade 12

Component	Weighting	Tasks
Written tests	150	These may include multiple-choice items, short answers and extended responses, statistical interpretation, graphical skills, calculations. These can utilise contemporary or hypothetical situations
Practical tests on basic skills	100	Testing the ability of students to do simple scientific techniques, such as constructing a model
Practical assignments and projects	50	Practical work competency and some ratings given on presentation and communication
Marks	300	

Assessment, examinations and certification

The assessment and reporting practices described here are detailed further in the *National Assessment and Reporting Policy for Papua New Guinea* (2003) and in other support materials produced by the Department of Education.

Assessment

The main purpose of assessment is to improve student learning.

Assessment needs to be *for* learning as well as *of* learning. It is used to evaluate and improve learning and teaching, report achievement and provide feedback to students on their progress.

Assessment measures students' achievement of learning outcomes as described in the syllabus. It is the ongoing process of identifying, gathering and interpreting information about students' achievement of the learning outcomes.

Learning and teaching using an outcomes approach requires teachers to plan their teaching and assess learner performance in relation to outcomes using criteria derived from those outcomes. Assessment involves focusing less on whether a learner has 'passed' or 'failed' and more on what outcomes a learner has achieved and in which areas further support is required.

Assessment in Applied Science

A student's achievement in Applied Science at the end of Grade 12 will be assessed against the learning outcomes. Assessment of student progress towards achieving these learning outcomes is cumulative throughout Grades 11 and 12.

It is important that teachers plan the learning and teaching sequence so that there is a balanced spread of assessment during the year. Some tasks, such as investigations or case studies, can be designed so that they are completed over a period of time rather than at the end of the unit. Other tasks can be done immediately the relevant section of the unit or topic has been covered.

Assessment for certification

A student's overall achievement in Applied Science will be both internally and externally assessed. The final mark awarded to each student will be a combination of the internal assessment mark provided by the school and the examination mark.

Internal assessment

Internal assessment provides a measure of a student's achievement based on a wider range of syllabus content and outcomes than may be covered by the external examination alone. For Applied Science, the internal

assessment marks will provide a summation of each student's achievements in Grades 11 and 12. The assessment tasks used to determine the internal assessment mark must comply with the components, weightings and types of tasks specified in the table on page 31. A variety of tasks gives students the opportunity to demonstrate all the learning outcomes in different ways to improve the validity and reliability of the assessment.

All schools must meet the requirements for internal assessment as specified in the *Grade 12 Assessment, Examination and Certification Handbook*.

Recording

All schools must meet the requirements for maintaining and submitting student records as specified in the *Grade 12 Assessment, Examination and Certification Handbook*.

Certification

Candidates will be awarded the national certificate only if they meet all requirements for internal and external assessment. Eligibility rules for the award of certificates are specified in the *Grade 12 Assessment, Examination and Certification Handbook*.